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Trade Liberalization and Consumer Prices of Tradable Goods: Evidence from the FTA and Consumer Price Index

by

Chendong Li

A THESIS

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Abstract

This thesis examines how the Canada - U.S. Free Trade Agreement (FTA) affects prices. I study two potential effects of the FTA: 1) the impact of the FTA on the border cost between Canada and the U.S. and 2) the impact of the FTA on the domestic consumer price of tradable goods in Canada. I make use of disaggregate CPI data for Canada and U.S. to examine the deviations from the law of one price after the FTA and exploit variations in tariff preference across time, characteristics of goods and exposure to trade with the U.S. to analyze the effect of FTA on consumer prices. In my thesis, with respect to the border cost between Canada and the U.S I find that my result shows that border cost still exists following the introduction of the FTA. In terms of the domestic consumer price, my results show that one percentage point increase in the FTA tariff concession decreases the consumer price of tradable goods in the provinces with average exposure to trade with the U.S. by at least 7.19% to at most 11.60%.

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This thesis is dedicated to my parents for their endless love, support and encouragement.

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Chapter One: Introduction

Canadian consumers have often wondered why there are significant price differences in similar goods between Canada and the United States. The higher price Canadians pay for lower American priced goods also captures the attention of the Canadian media (The Globe and Mail, 20/08/2012). There is anecdotal evidence confirming the existence of price gaps (Porter, 2009; The Canada-USA Price Gap, 2013). In economic theory, the law of one price predicts that such price differences can exist if there are costs or barriers of moving goods between countries. Goldberg and Knetter (1997) suggest that trade costs and barriers may be a crucial determinant of persistent deviation of absolute law of one price. In my study, I examine the impact of the elimination of trade barrier through the Canada-United States Free Trade Agreement (FTA) on prices.

From two approaches, I study the impact of the FTA on prices. Using the method of Engel and Rogers (1996), I make use of six CPI good categories for U.S. metropolis and Canadian provinces to examine whether the border cost between Canada and the U.S still exists after the FTA went into effect. Then, I use Difference-in-Difference-in-Difference method and exploit variations in tariff preference across time, characteristics of goods and exposure to trade with the U.S. to analyze the impact of the FTA on domestic consumer prices in Canada.

Canada and the United States have the largest trade relationship in the world and each country is the largest trade partner of the other.[1] In 2011, the import value of goods and services from the United States to Canada accounted for 60.8% of Canada's total imports, and the exports to the U.S. accounted for approximately 70% of Canada's total exports (Canada's State of Trade: Trade and Investment Update, 2012). The essential goal of the FTA was to eliminate barriers to trade in goods and services between Canada and the United States, by eliminating customs duties and by cancelling restrictions on the exports and imports of most commodities. There are many research studies devoted to uncovering the impact of FTA on labor employment (Beaulieu, 2000), trade flow, and welfare in Canada (Trefler 2004), trade creation and diversion (Clausing, 2001) in Canada. However, ordinary households or consumers may also be concerned about the effect of the FTA on consumer prices. This leads to the research question: does free trade and an open border between the U.S. and Canada affect domestic consumer prices? Does the price gap between Canada and U.S. converge after the FTA? Also, what is the impact of the FTA on the consumer price of tradable goods? However, there appears to be very little research examining this question, especially the latter[2].

The Canada-US Free Trade Agreement (FTA) was signed by the leaders of both countries on January 2, 1988 and was implemented on January 1, 1989. FTA either

[1] From Wikipedia "Canada-United States trade relations": http://en.wikipedia.org/wiki/Canada%E2%80%93United_States_trade_relations#cite_note-3

[2] Romalis (2007) and Trefler (2004) are the only two researches by far I noticed that studies the impact of CUFTA on import prices not consumer prices. Others did some work to examine the impact of the tariff reduction and trade liberalization on consumer prices in India Marchand (2012) and Mexico Nicita (2008). Detail discussion of their work is presented in Section 2.2.

eliminated a wide range of trade restrictions or set a timeline to reduce the bilateral tariff between the U.S. and Canada over ten-year period. As many papers suggest (Nicita, 2009; Porto, 2006), there are two channels through which trade policies affect domestic consumer prices. First, trade policies directly affect the price of imported good by imposing a tariff. Second, domestic producers compete with imports. Trade policies indirectly affect consumer prices through increasing competing substitute goods as well as changing the local producer's markup. Detail discussion is presented in the Section 3.1. For the case of U.S. and Canada, there is an additional potential channel, cross border shopping, which is widely reported by the press (Strauss, 2012). Due to a long and open border across Canada, frequent cross-border shopping will pressure producers and retailers in Canada to adjust their prices to compete with U.S. retailers[3].

Despite the FTA's important impact on prices, empirical studies often have difficulty identifying the influence of the FTA on price difference between Canada and the U.S, especially the impact of the FTA on domestic consumer prices.

It's complicated to directly examine why the price is different between Canada and the U.S. Engel and Rogers (1996) use the size of border coefficient to examine how border affects the price difference between Canada and the U.S. They assume that the volatility of the prices of similar goods in different cities should be positively related to the

[3] The report of the Canada-USA Price Gap provides four recommendations and one observation to the Minister of Finance. In the observation, the report explicitly mentions that "As more Canadian consumers become aware of smartphone applications and Internet sites for price shopping and comparison, and become price-savvy consumers, competitive pressures in Canada will increase and the price for products in Canada will converge to U.S. prices."

distance between those cities; but holding distance constant, volatility should be higher between two cities separated by the national border. Through this method, they partially answer why the law of one price generally failed in reality. They find that “while distance is an economically significant determinant of price dispersion, the effect of the border relative to distance is extremely large”. In this study, I update their data and explore after largely eliminating tariff barriers by the FTA, whether the border cost between Canada and the U.S. decrease or not.

Border cost is a measure of tariff barriers and non-tariff barriers, both of which affect the price dispersion across location. After the FTA went into effect in 1989, tariff barriers were widely removed. Then border cost mainly measures effect of non-tariff barriers. However, less is known about the impact of tariff reduction, elimination of tariff barriers, on consumer prices in Canada. The effect of the FTA on consumer prices is hard to determine because unobserved factors affect consumer prices such as price inflation, demand and supply and macroeconomics. Isolating unobserved factors is essential to identifying the FTA’s effect on consumer prices. Another problem is that it is difficult to find an ideal control group. Ideally, Canadian goods are randomly divided into two groups. The treatment group is affected or liberalized by the FTA and control group is completely not affected or protected by the FTA. Then, the effect of the FTA on domestic consumer prices is obtained by simply comparing the price of treatment goods and control goods. However, Trefler (1993) and Goldberg and Maggi (1999) suggest that trade policy is always endogenously determined; therefore this kind of randomization is impossible. Moreover, the control group that is completely not affected by the FTA is very difficult to find.

Since randomized groups are not a viable way to analyze the FTA's effect, I combine several different control groups to examine this issue in this study. I exploit continuous difference-in-difference-difference (DIDID) method to identify the causal effect of the FTA on consumer price of tradable goods. I use Consumer Price Index (CPI) data in Canada. The treatment group in my DID framework is tradable goods which are highly affected or liberalized by the FTA in the province intensely exposed in the trade with the U.S. For the control group, I combine three groups of good categories. I start with non-tradable goods (basically services) as the control group. Studies (Schwanen, 1993; Morici, 1989) suggest that the FTA removed few restrictions on services especially non-business services. For example, the FTA has a limited effect on the tariff for travel, freight and shipping, and various institutional or individual transactions, which consists of 63 percent of Canada's total trade in services[4]. The FTA took some modest but pioneering steps toward the liberalization of trade in business services.[5] In addition, the FTA addresses trade in services with the exception of medical and legal services, childcare, basic telecommunications, transportation, and government services. (Morici, 1989) In this sense, prices of non-tradable goods such as medical care services could be independent of the FTA. However, this is not generally true because non-tradable goods

[4] The rest of 37 percent of trade in services are basically business services including banking, engineering, consulting or broadcasting.

[5] Compared with FTA, in the North American Free Trade Agreement, the commitments to liberalize trade in service are more "encompassing" and applying to any sector.

consist with tradable components and non-tradable components. The FTA may indirectly affect the price of services by changing the price of its tradable components. Instead of using dichotomous variables, I employ a continuous measure of treatment and control groups by measuring the tradability of all the tradable goods and service. Using the continuous measure of tradability, I do not need to distinguish between tradable and non-tradable goods and could save my methodology from suspicion which is arbitrarily determining tradable and non-tradable goods by common sense.

Another control group comes from the variation in protection. For example, the exports and imports of auto and automotive equipment were already liberalized between Canada and the United States in the agreement of Auto Pact in the 1960s. Hence, the prices of automotive products should not be sensitive to the introduction of the FTA. In addition to auto, there are some goods that are protected from the U.S. market competition in the FTA such as medical equipment and dairy products (Schwanen, 1997). Thus, theoretically the FTA should not affect the price of these products. These tradable goods (purchase of vehicle, medical care products and dairy products) are named as FTA non-sensitive goods and are viewed as another control group in my study.

In the DID framework, one is always concerned about whether there is a common trend between the treatment and control group. To address the problem of common trend over tradable and non-tradable goods, and over FTA-sensitivity products and FTA-non-sensitivity products, I exploit another variation, the exposure to trade with the

U.S. by provinces in Canada. This setting is equal to the Triple Difference (DIDID).

In my thesis, I make use of six CPI good categories for Canadian provinces and U.S metropolis to examine the border cost between Canada and the U.S after the FTA went to into effect in 1989. I find that no obvious trend shows that border cost disappears following the introduction of the FTA. Then I make use of provincial CPI data for tradable and non-tradable goods and exploit provincial CPI data for FTA-sensitive and non-sensitive products to examine the impact of FTA on domestic consumer prices of tradable goods. In conclusion, I find that the FTA has significant effects on the price of tradable goods faced by the local consumers. My results show that one percentage point increase in the FTA tariff concession decreases the consumer price of tradable goods in the provinces with average exposure to trade with the U.S. by at least 7.19% to at most 11.60%. The FTA Canadian (U.S.) tariff concession is defined by the difference between the average Canadian (U.S.) tariff against the rest of the world and the average Canadian (U.S.) tariff against U.S. (Canada). My results indicate that one percentage point increase in the Canada preferential to the U.S. combining with one percentage point increase in the U.S. preferential to the Canada together decreases the consumer price of tradable goods in the provinces with average exposure to trade with the U.S. by at least 7.19% to at most 11.60%[6].

My paper ties several strands of literature. Since the seminal paper of Deaton (1989), there has been great interest on the welfare effects induced by trade policy changes.

[6] More explanation for this result is presented in Section 4.2.

Based on Deaton's framework, there is a large body of literature in the field of trade and development that studies the impact of trade liberalization on domestic consumer prices (Huber, 1971; Robertson, 2000; Goldberg and Pavcnik 2004; Porto, 2006; Nictia, 2009). These studies basically examine how much tariff reduction pass through to the domestic price. Even though Canada is already an open country in terms of trade, the FTA still plays a significant role in Canada's imports and exports due to a very close and important trade relationship with the U.S. (Trefler, 2004; John Romalis, 2006; Clausing, 2001). However, the impact of the FTA on the household is still not clear, especially on consumer prices of tradable goods. My study fills in this vacancy and provides evidence on how the FTA impacts on consumer prices of tradable goods. In addition, this paper also contributes to the literature of border costs and market segmentation (McCallum, 1995; Engel and Rogers, 1996; Parsley and Wei, 2001). The magnitude of price changes following the introduction of the FTA is partly because of the different trade costs and market integration between the two countries (Nictia, 2009). Trade costs vary across local markets. By affecting the cost of imported goods, they affect the substitute of local product for imported goods. Consumer prices at the local level are, therefore, determined not only by imported price and tariff but also by the local producer prices and trade costs. Thus the level of integration of local markets into global economy ultimately determines the magnitude of price changes induced by the trade policy.

The thesis is organized as follows. In Chapter Two, I briefly introduce the FTA and review the important literature related to the impact of trade liberalization on prices.

Chapter Three develops the empirical techniques (DIDID) to estimate the impact of the FTA on consumer prices. Chapter Four shows the data I used in the study and present the result of how the FTA affects consumer prices. Chapter Five concludes.

Chapter Two: How Does the FTA Affects the Price Dispersion between Canada and the U.S.

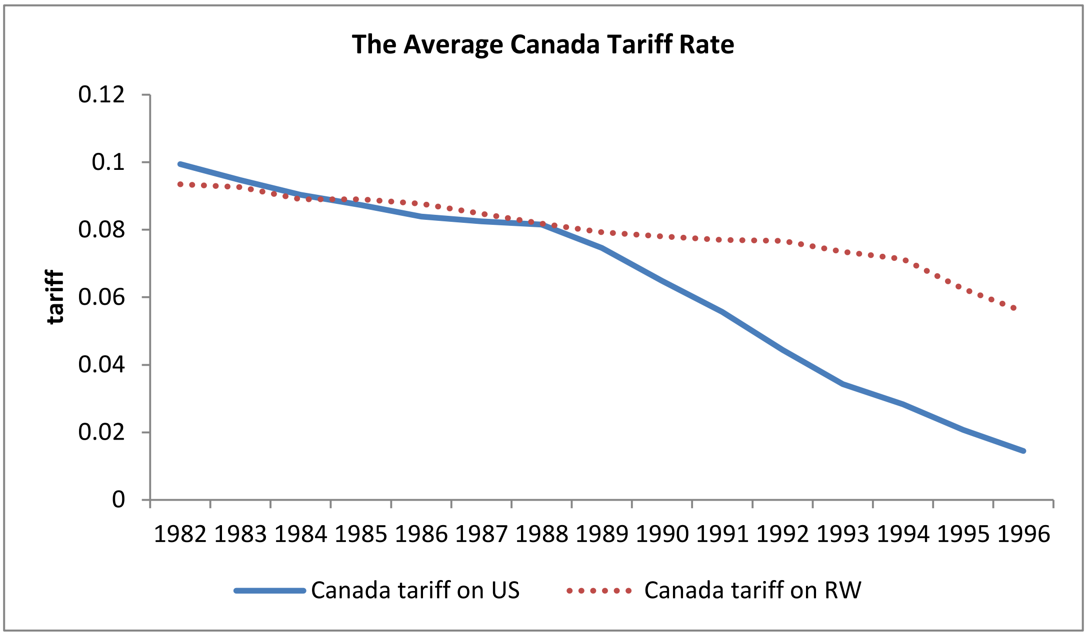
2.1 Brief Overview of Canada-the United States Free Trade Agreement

Canada and the U.S. started to be interested in the free trade by the early of 1980s. In 1986 Canada proposed a Free Trade Agreement to the U.S. and bilateral negotiation towards the free trade started from this year. On October 4th, 1987, the agreement was reached on the Canada-U.S. Free Trade Agreement (FTA) by the two countries. The FTA was signed by the leader of two countries on January, 1988. In the U.S, Free Trade Agreement did not generate much opposition. The polls even showed that 40% percent of American were not aware the agreement was agreed[7]. Nonetheless, the debate in Canada over whether to implement the agreement was very contentious. For instance, the leader of Liberal Party of Canada, John Turner, actively fought against the FTA (Christopher Waddell, 2007). The debate came to a close only after Brian Mulroney, the leader of Progress Conservative Party, who support the free trade, won the governing majority and was elected to be the Prime Minister on November 1988. Eventually, during the office of Mulroney, Canada-U.S. Free Trade Agreement came into implementation on January 1st, 1989.

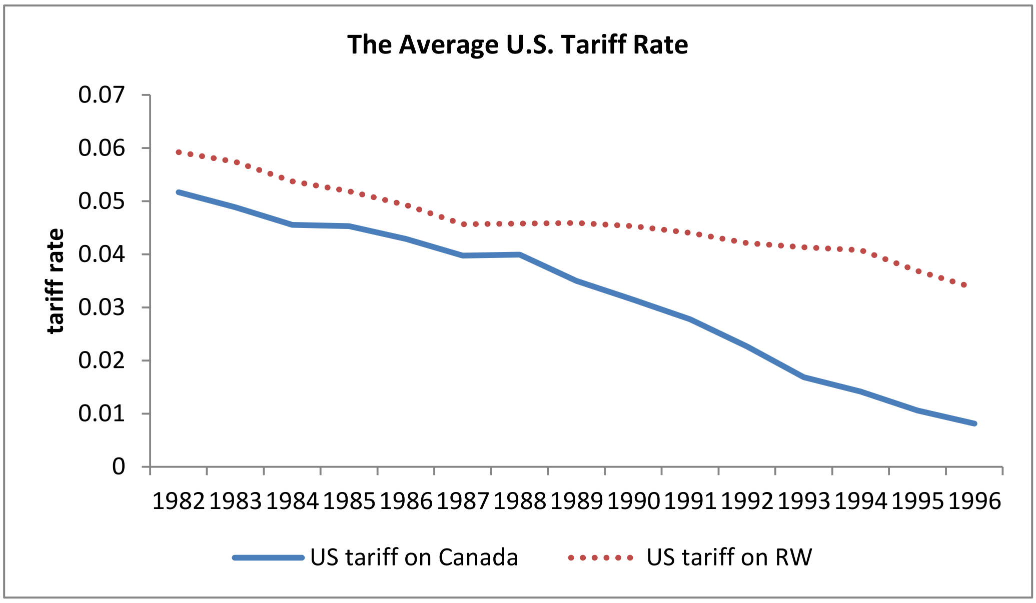
[7] From E-Notes Encyclopedia of Business, "U.S.-Canada Free Trade Agreement of 1989.

The key feature of FTA is that it is a preferential trade agreement which removes restriction of trade between Canada and the U.S. without changing barriers to other countries in the world. The Panel A of Figure 1 displays Canada's average manufacturing tariff against the United States and Canada's average manufacturing

Figure 1: Tariff data in Canada and U.S.



Panel A



Panel B

(Source: Data from Trefler (2004))

tariff against the rest of the world. Likewise, the Panel B plots the U.S. tariffs against Canada and the rest of the world. The source of tariff data is from Trefler (2004). He calculates the average tariff data of the 4-digit SIC level industries for Canada and the U.S. from 1982 to 1996. Before the FTA from 1982 to 1988, the average Canada tariff rate against the U.S. was 9.2 percent while the corresponding average U.S. tariff rate against Canada was 5 percent.

After the enforcement of the FTA from 1989 to 1996, the tariff between the two countries decline dramatically. The average Canada tariff rate against the U.S. was 4.2 percent while the corresponding average U.S. tariff rate against Canada was 2.1 percent. Conversely, as demonstrated in Figure 1, the tariff rate for both Canada and the U.S. against the rest of world does not change much.

In the next section, I present the impact of the FTA on the border cost between Canada and the U.S. and examine whether the border cost exists or not after the FTA went into effect.

2.2 How wide is the border between Canada and the U.S. after the FTA went into effect?

As mentioned in the introduction, there are significant price differences relative to similar goods between Canada and the United States, which are reported widely in the press (Porter, 2009; The Canada-USA Price Gap, 2013; The Globe and Mail, 20/08/2012). Despite the fact that the Canadian dollars had skyrocketed in the last several years, approaching the $1.10 against the U.S. dollars at the highest point, the rapid climbing exchange rate, however, seems to have had a fairly slight change to the price disparity between United States and Canada. Table 2-1 demonstrates the price that the U.S. and Canadian retailers pay to their suppliers for the same product. As Table 2-1 shows, for all of the goods shown Canadian retailers pay more than U.S. retailers. For instance, Canadian retailers pay 11% more for an electric toothbrush to 114% for a pack of low dose Aspirin.

Which factors lead to the price differences across the border? There are several reasonable explanations. One point is that due to the fierce competition and the scale effect in the U.S. markets, American could enjoy the lower price than the rest of the world. Conversely since the cost of production and labor is typically higher in Canada, the retailers fail to cut their prices as low as that in the U.S. However, this explanation is untenable if we take this fact into consideration that the same good from the same company, such as the textbooks or automobiles, are sold much higher in Canada than that in United States. In addition, Russell Hillberry and David Hummels (2008) examine the manufacturers' shipments within the United States on a very fine grid. They propose that shipments play a significant role on trade.

Table 2-1: Price paid by Canadian and U.S. retailers for 15 identical consumer products

Item Description	**Price paid by U.S. Retailors** (Can $)	**Price paid by Canadian Retailers** (Can $)	**Difference**
Soap-16 pk	6.99	8.98	28%
Shampoo-1.5L	9.33	12.46	34%
Conditioner-1.18L	6.23	10.00	61%
Automobile Tires	128.21	169.69	32%
46in LED TV	888.75	1,001.00	13%
Printer	116.65	171.99	47%
Water Filters-6 pk	22.77	26.76	18%
Coffee Maker	127.76	167.19	31%
Electric Toothbrush	91.29	100.99	11%
Iburophen 200mn-250ct	10.76	18.29	70%
Aspirin 81mg low dose-350ct	10.16	21.78	114%
Ketchup-2.5L	3.92	6.90	76%
Freezer bags-150pk	6.10	9.24	51%
Laundry Dtergent-5L	11.27	13.94	24%
Orange Juice -7.56L	10.01	12.66	26%

(Note: Table 2-1 is provided by the Retail Council of Canada on April 24, 2012, from Senate Report: The Canada-USA Price Gap)

Nevertheless, this point fails to explain the reason why there are patent disparities on prices of certain goods between cities within one country and across the border even through the distances between these cities are almost the same. Considering the border effect, John McCallum (1994) makes use of the data of imports and exports from each location-pair of Canadian provinces and American states to examine the border effect through the gravity model. He points out that “Canada-US border has a decisive effect on trade patterns”. If border affects the trade a lot, how does it affect the price distribution? Motivated by John McCallum, Engel and Rogers (1996) examine the importance of distance and border in determining the volatility of the price. Exploiting Consumer Price Index to measure the variance of the relative price of city-pair between

Canada and United States, they find that relative to distance, the effect of border plays a significant role on the price dispersion.

This section mainly follows Engel's idea and tries to examine the price disparity between US and Canada from the perspective of border effect. My study contributes to the literatures on border effect in two ways. Firstly, since 1988, Canada-US Free Trade Agreement had been into effect for more than ten years. Is there any change for the border effect on price disparity? Does the border disappear due to this event? Engel's data period ended at the year of 1994. In order to better answer the questions above, I extend his data from January 1979 to May 2011. Exploiting this data's long period, I separately examine the volatility of price before and after the Free Trade Agreement was signed and find that the volatility of price across the border after 1989 is a little higher than that found before 1988. This empirical evidence, at the very least, demonstrates that there is not any obvious trend showing that the border is disappearing. The second contribution is that the results of my study confirm Engel's finding - relative to distance, border plays a significant role on determining the price differences.

The remainder of the Chapter Two proceeds as follows. Section 2.2.1 presents the source and analysis of data. Section 2.2.2 addresses my regression methods and results. Although Canada-US Free Trade Agreement was signed in 1988, the effect of the border is still extremely large. Chapter 2.2.3 summarizes the conclusion.

Table 2-2:The goods selected in the Consumer Price Index and Urban areas or Province Used

Good	United States	Canada
1	Food at home	Food purchased from stores
2	Food away from home	Food purchased from restaurants
3	Alcoholic beverages	Alcoholic beverages
4	Fuel and other utilities	Water, fuel and electricity
5	Private transportation	Private transportation
6	Medical care	Health care

Notes: The regions and provinces included are: New York-Northern New Jersey-Long Island, Los Angeles-Riverside-Orange County, Chicago-Gary-Kenosha; Ontario, Alberta, British Columbia, Manitoba, Saskatchewan. Data is from CANSIM Table 326-0020.

2.2.1 Data

The data for the United States and Canada was obtained from the Bureau of Labor Statistics and Statistic Canada. I choose 6 goods from the given basket of Consumer Price Index shown in Table 2-2. All of the price indices are seasonally unadjusted. I select the 6 goods because these goods almost exactly match between the components of price index in Canada and in US respectively.

The monthly Consumer Price Index from January, 1979 to May, 2011 was used for 6 main provinces in Canada: Ontario, Alberta, British Columbia, Manitoba, Quebec, Saskathewan and 3 core metropolis or urban areas in United States: New York-Northern New Jersey-Long Island, Los Angeles-Riverside-Orange County, Chicago-Gary-Kenosha. Since Statistics Canada changed their data basket, I can not get the complete monthly urban basket of Consumer Price Index. Therefore, the only available data in Statistics Canada is monthly price index with complete details by province.

Since I choose provincial monthly price index, it is difficult to calculate the distance due to the unclear central point of each province. Inspired by McCallum (1995), I solve this problem through the following method. The goods consisting in the provincial Consumer Price Index are organized according to the weight of its core city. For example, for Alberta, the provincial CPI involves two cities: Calgary and Edmonton. So the central point of each province is defined as an average of the longitudes and latitudes of these core cities weighted by population of each city. Then we calculate the distance of the region or province pairs through their longitudes and latitudes.

2.2.2 Regression and Results

The method and regression mainly follow Engel's paper (1995). Due to the different base years of Consumer Price Index as well as the volatility of exchange rate between Canada and United States, it is impossible to compare the price index directly. However, by converting the Canadian Consumer Price Index into U.S dollars and calculating the log of variance of relative price index, I can avoid the impact from the different base years.

My regression model is shown as following. Define $P_{j,k}^{i}$ as the log of the price of good *i* in location *j* relative to the price of good i in location k. Then convert all price indices into US dollar through the monthly average exchange rate[8]. I take the difference in the log of relative price between time *t* and *t-1* as $\Delta P^{i}_{j,k}$ and then measure the standard deviation of $\Delta P^{i}_{j,k}$ in each month as the volatility of $\Delta P^{i}_{j,k}$ which is the dependent variable in the following regression-$V(\Delta P^{i}_{j,k})$. Since I select 3 regions in United States and 6 provinces in Canada, for each good *i*, there are 36 region pairs as the observations in my regression.

In Table 2-3, for each of the 6 goods, I report the average of the standard deviation for region pairs that are (1) within United States (2) within Canada (3) across the border. I also measure the average distance of each column as a reference.

Similar to Engel's conclusion, Table 2-3 reveals that the volatility of prices for cross-border region pairs is generally higher than that within one country. However, the difference between my study and Engel's is that from my results, volatility of prices between Canadian region pairs is generally higher than that between U.S. region pairs. I think there are mainly two reasons for this outcome. One is that I only select three regions in U.S in my data set. The small sample may not offer a convincing result. The other reason is that New York, Los Angeles and Chicago are the core metropolis in US. It is highly possible that they share some common features in the markets and prices so that their volatility of price in these three regions is not as obvious as I expect. Another

[8] I use the United States noon spot rate as the monthly average exchange rate. The data is obtained from Bank of Canada.

point worth mentioning is that since these three regions in U.S. are further apart from each other, their average distance is larger than that of cross the border. However, their volatility of price is much smaller than those of cross the border. This may provide another evidence that relative to distance, border also play a significant role determining the volatility of price.

Table 2-3: Average Relative Price Volatility

Good	US-US	Canada-Canada	US-Canada
1	0.01006	0.01144	0.01937
2	0.00614	0.00578	0.01664
3	0.01245	0.00985	0.01945
4	0.04133	0.04949	0.04828
5	0.01116	0.01275	0.02000
6	0.01106	0.01229	0.01936
Average	0.01537	0.01693	0.02385
Distance (km)	0.01006	0.01144	0.01937

Notes: Each entries gives for each good, the average value of volatility of relative price between region pairs within the United States, within Canada, and across the border, respectively. The volatility is the standard deviation of log of the relative price. The final row gives the average distance between each region.

My regression model is as following:

(3.1) $V(\Delta P_{j,k}^{i}) = \beta_1^i r_{j,k} + \beta_2^i B_{j,k} + \sum_{m=1}^{n} \gamma_m^i D_m + \mu_{j,k}$

$r_{j,k}$ is the log of the distance between the region pairs. $B_{j,k}$ is a dummy variable about whether locations j and k are cross the borders. In other word, if the region pairs are cross-border, $B_{j,k}$= 1. $\mu_{j,k}$is the regression error. Followed by Engel's model, for each region in my sample, I include a dummy variable in equation (1). That is for region pair (j,k), the dummy variables for region j and k take on the values of 1.

I report my regression in Table 2-4 with the CPI data from January 1979 to May 2011. In Table 2-4, the coefficient on the log of distance is positive and statistically significantly at the 10-percent level in all the six goods. This result shows that distance plays a significant role on determining the price difference. The positive coefficients of distance are interpreted as the more distance between locations, the more price disparity will be. The coefficients on the dummy variable of the border are positive and highly significant at the 10-percent level in 5 good categories. According to Engel's explanation, "interpretation of the coefficient on the border dummy in the regression is the difference between the average standard deviation of prices for region pairs that lie across the border less the average for pairs that lie within one of the two countries, taking into account the effect of distance." In other words, the coefficient of the border dummy variable illustrates that considering distance, whether two locations across the border also matter so much on the volatility of price. After extending Engel and Roger's data from 1994 to 2011, the coefficient of border dummy for 5 good categories are still statistically significant at 10-percent level. Thus, these results show that after the FTA, the border cost between Canada and the U.S still exists.

To show the impact of Free Trade Agreement on the border effect, I choose the CPI data from January 1979 to December 1988 before the FTA went into effect and CPI data from January 1989 to May 2011 after the FTA. Table 2-5 reports the result of Equation (3.1) following the introduction of the FTA. The coefficients on the log of distance are positive and statistically significantly. This shows that the volatility of the price is positively related to the distance. Except from the good 4 and 5, the coefficients on the dummy variable of the border are statically significant at 5-level percent. The positive coefficient of border dummy are interpreted as holding distance constant, the volatility of the price is higher between those regions across the border, which confirms the existence of the border cost after the FTA. To check the border cost before the FTA, Table 2-6 reports the regression result of Equation (3.1) using CPI data from January 1979 to December 1988. Similar to the Table 2-5, the coefficients on the log of distance are positive and statistically significantly. For good categories 2, 3, 4, the coefficients on the dummy variable of the border are statically significant at 10-level percent. The result in Table 2-6 shows that before the FTA, the border cost between Canada and the U.S exists at least for the good categories 2, 3, 4.

Table 2-4: Regression of volatility of relative price in respect to distance and the Border from January 1979 to May.2011

Goods	Log distance	Border	Adjusted R^2
1	17.019^{a}	76.124^{b}	0.97
	(0.149)	(1.695)	
2	7.993^{c}	114.417^{c}	0.96
	(0.982)	(11.188)	
3	15.68^{b}	80.326^{b}	0.99
	(0.566)	(6.45)	
4	12.3981^{a}	-370.391	0.99
	(17.324)	(197.461)	
5	18.125^{a}	85.985^{b}	0.98
	(0.422)	(4.807)	
6	12.753^{b}	94.284^{b}	0.97
	(0.835)	(9.515)	

Notes: All regression also include dummy variables for each location pair in the sample. Standard errors are reported in the parenthesis. Coefficients and standard errors on log distance and border dummies are multiplied by 10^4. The dependent variable is the standard deviation of log of the relative price. Significance: a: 1 percent; b: 5 percent; c: 10 percent. The sample period is from January 1979 to May.2011. In each regression, there are 36 observations.

Table 2-5: Regression of volatility of relative price in respect to distance and the Border from January 1989 to May 2011

Goods	Log distance	Border	Adjusted R^2
1	16.661^b	91.211^b	0.99
	(1.154)	(13.151)	
2	7.122^c	133.219^b	0.98
	(1.184)	(13.49)	
3	12.994^b	99.946^a	0.98
	(0.642)	(7.319)	
4	147.426^c	-450.55	0.87
	(0.09)	(240.441)	
5	15.076^c	99.347	0.98
	(1.861)	(21.209)	
6	9.89^a	122.609^a	0.99
	(0.07)	(0.832)	

Notes: All regression also include dummy variables for each region pair in the sample. Standard errors are reported in the parenthesis. Coefficients and standard errors on log distance and border are multiplied by 10^4. The dependent variable is the standard deviation of log of the relative price. Significance: a: 1 percent; b: 5 percent; c: 10 percent. The sample period is from January 1989 to May 2011. In each regression, there are 36 observations

Table 2-6: Regression of volatility of relative price in respect to distance and the Border from January 1979 to December 1988

Goods	Log distance	Border	Adjusted R^2
1	17.651^c	40.365	0.98
	(1.964)	(22.383)	
2	9.698^b	69.597^c	0.96
	(0.693)	(7.899)	
3	20.576^a	42.074^c	0.99
	(0.489)	(5.57)	
4	34.752^a	15.259^c	0.99
	(0.144)	(1.646)	
5	23.109^c	68.26	0.95
	(3.996)	(45.542)	
6	17.608^c	39.618	0.97
	(1.875)	(21.376)	

Notes: All regression also include dummy variables for each location pair in the sample. Standard errors are reported in the parenthesis. Coefficients and standard errors on log distance and border are multiplied by 10^4. The dependent variable is the standard deviation of log of the relative price. Significance: a: 1 percent; b: 5 percent; c: 10 percent. The sample period is from January 1979 to December 1988. In each regression, there are 36 observations.

Table 2-7: Average Relative Price Volatility from Jan.1979 to Dec.1988

Goods	US-US	Canada-Canada	US-Canada
1	0.00854	0.01220	0.01634
2	0.02661	0.00829	0.01463
3	0.01292	0.01261	0.01864
4	0.05144	0.02217	0.04098
5	0.00729	0.01645	0.02003
6	0.00889	0.02158	0.02044
Average	0.01928	0.01555	0.02184

Notes: Table 2-6 reports the average relative price volatility from January 1979 to December 1988 through the similar method employed in Table 2-1.

Table 2-8: Average Relative Price Volatility from Jan.1989 to May.2011

Good	US-US	Canada-Canada	US-Canada
1	0.01066	0.01476	0.02061
2	0.00440	0.00870	0.02049
3	0.01227	0.01046	0.01978
4	0.00911	0.05872	0.05099
5	0.00859	0.01060	0.02000
6	0.00999	0.01100	0.01859
Average	0.00917	0.01904	0.02507

Notes: Table 2-7 reports the average relative price volatility from January 1989 to May 2011 through the similar method employed in Table 2-1.

Similar to Table 2-3, for each of the 6 goods I separately report the average standard deviation within the country and across the border in Table 2-7 before the FTA and in Table 2-8 after the FTA. Table 2-7 and Table 2-8 demonstrate that for some goods ((i.e good 1: food at home)), the standard deviation of price volatility within the U.S. and Canadian border increases after the FTA and for some other good (i.e. good 3: Alcoholic beverages), the mean standard deviation decrease after the FTA. However, for almost all six goods the average standard deviation of price volatility for location pairs across the border increase after the FTA with the only exception of good 6, medical care. The higher price volatilities after the FTA for location pairs across the border shows that price volatility for the six goods between Canada and the U.S. still exists after the FTA.

2.2.3 Conclusion

In this chapter, I make use of the Consumer Price Index to examine importance of distance and border on the price disparity. My empirical results suggest that relative to the distance, the border plays a significant role on determining the price difference. In addition, although the Canada-US Free Trade Agreement has been into effect for more than ten years, my results imply that the border cost between Canada and U.S still exist. But this result comes with limitation. Because I only use six good categories, small data sets may bias the result. In Chapter 4, I cover 36 good categories and further explore the issue by looking at the impact of the Free Trade Agreement on Canadian prices.

Chapter Three: Empirical strategy: Difference-in-Difference Methodology

3.1 Background: How Does Trade Liberalization Affects Consumer Prices

There is a large literature evaluating the welfare effects of preferential trade agreement (PTA), but only a few of them focus on the effect of the PTA on prices. Trefler (2004) examines the long run and short run impact of the FTA on employment, labor productivity, import price and trade creation/diversion in Canada through comparing these variables in the pre-FTA period with them in the post-FTA period. In the paper, he uses fixed effects to control business cycle, industry-level heterogeneity, industry-specific shock, all of which may contaminate the effect of the FTA. He finds that employment losses 5 percent which corresponds to 100,000 lost jobs in the short run. Conversely, the FTA raises labor productivity in all manufacturing by 7.4 percent and slightly raises real annual earnings by 3 percent. In particular, he also investigates the impact of FTA on import prices, which is neglected by most other papers. Despite lack of real prices data of import goods, he uses import unit value at the 10-digit Harmonized System (HS 10) as producer prices. Because Canadian trade data before 1988 is not available, he can not compare the change of import prices from U.S before and after the FTA as he did for employment, labor productivity *et al*. Instead, by choosing OECD countries including United Kingdom, Germany, France, and Japan as the benchmark, he implements the following regression to estimate the effect of tariff cut on imported prices:

$$(3.1.1) \quad \Delta \ln p_{i1us} - \Delta lnp_{i1OECD} = \alpha + \beta^{CA}(\Delta\gamma_{i1US} - \Delta\gamma_{i1OECD}) + \varepsilon_i$$

where $\Delta \ln p_{i1us}$ is the change of log Canada's import price of HS10 product *i* during the FTA period. (1 and 0 represents data is from 1988 to 1996 and 1980 to 1986) $\Delta\gamma_{i1US}$ is the change of Canada's tariff against US for HS10 product *i* during the FTA period. Δlnp_{i1OECD} denotes the simple mean of the log import price change for the United Kingdom, Germany, France and Japan. Likewise for $\Delta\gamma_{i1OECD}$.

Using the method above, Trefler finds that import prices slightly decrease by 0.4% ($\hat{\beta}^{CA}$ is -0.004) after the FTA. Considering endogeneity of tariff, he uses an instrument set that consists of log values in 1980 for (1) Canadian hourly wage (2) the level of employment (3) Canadian imports from the U.S. (4) U.S. imports from Canada. The IV estimate finds the FTA reduces import prices by 7 percent ($\hat{\beta}^{CA}$ is -0.073).

Although Trefler exploits very decent method to estimate the impact of FTA on prices, there are two drawbacks: 1) unit value may not fully reflect the import price; and 2) it is still not clear whether lower import prices after the FTA drive down the consumer prices. In my paper, I make of use Consumer Price Data and exploit difference-in-difference-in-difference (DIDID) method to capture the two problems.

Another paper that focuses on NAFTA and CUFTA's impact on price is Romalis (2007).

Without simplifying "small country" assumption, which most papers make when analyzing effect of trade policy, he developed a novel approach to estimate the impact of NAFTA on the trade volume and welfare. Romalis identifies key demand and supply parameters using detail trade data in a general equilibrium model and then apply these available parameters to the calculations of NAFTA's price and welfare effects. Romalis identifies demand elasticities through studying where NAFTA members and European Union source their imports. Because NAFTA reduces tariffs among three NAFTA members without reducing tariffs against the rest of the world, the tariff gap between NAFTA partners and the rest of world will cause North American consumers to substitute toward low tariff goods and away from other sources of import. Constant inverse supply elasticity is identified by introducing tariff and the demand of import as an instrumental variable for the industry production. Any change in tariffs imposed by the NAFTA will shift demand for products from all sources. These movements in the demand curve identify the supply curve. He founds the estimates of mean demand (substitution) elasticity applying US tariffs ranges from 6.2 to 10.9. That is, with a substitution elasticity of 6, the median U.S. tariff of 5.5% will reduce consumption of imported varieties relative to domestic varieties by 27%. He estimates the supply elasticity to be 0.45, which suggests that a shock to demand that causes a 1% increase in worldwide consumption will cause the supply price to increase by 0.45%.

With demand and supply elasticity available, Romalis estimates the effect of NAFTA on prices and welfare. In equilibrium, the change in demand due to NAFTA will be equal to the change in supply. According to the equilibrium condition, he combines demand and supply equations together after totally differentiating. Applying iterated computation, he gets a function of tariff reductions, the estimated price and quantity responses. In conclusion, Romalis finds there is much trade diversion. Every 1% reduction in intra-North American tariffs causes a 2.8% to 3.9% decline in exports from rest of the world (non-EU) to North American relative to the European Union. In contrast with the substantial impact on trade volume, NAFTA has a modest effect on the supply price. Even in the highly liberalized industry, larger tariff preference only leads to decline of supply price by less than 5%. Conversely, my study shows that one percentage point increase in the FTA tariff concession lowers the consumer price of tradable goods in the provinces with average openness to the U.S. markets by at least 6.21%. There may be two reasons causing the differences.

(1) In Romalis (2007), he analyzes production prices instead of consumer retail prices. It is possible that facing more competitive substitutes induced by importing, retailers shrink their mark-ups leading to a lower consume prices.

(2) Due to the tariff data constraint, I do not have the tariff data by products. Only using overall average tariff may lead to the larger estimates.

Nicita (2009) analyzes the effects of the trade liberalization that took place in Mexico from 1990 to 2000 on the price of goods, wages and distributive effects of tariff liberalization across all households. Specifically, to examine the effect of tariff cuts of household prices, he estimates a regression of household prices on tariff, producer price, world price, trade cost and interaction term between tariff and distance separately for goods of agriculture and manufacturing.

(3.1.2) $lnP_{gtr} = \beta_0 + \beta_1 lnPP_{gtr} + \beta_3 lnPX_{gt} + \gamma \ln(1 + \tau_{tg}) + \gamma_1 \ln(1 + \tau_{tg}) TC_r + \gamma_2 (\ln(1 + \tau_{tg}) TC_r)^2 + \varepsilon_{gtr}$

where P_{gtr} denotes the market price faced by a household for a good g at time *t* in region *r*; PP_{gtr} is the producer price; PX_{gt} denotes the international price in local currency; $\tau_{tg}$is the *ad valorem* tariff; trade cost (TC_r) is the shortest driving distance from each of the states' capitals to the nearsest point of entry at the United States border.

The coefficient of interest is γ which implies the percentage increase in the local prices for one percent increase in the tariff. γ_1 and γ_2 captures the distributive effect of tariff liberalization, that is, the effect of trade cost on the tariff pass-through. Considering the potential endogeneity of the producer price, Nicita uses its two-year lagged value as an instrument and finds that the magnitude of pass-through of tariff cuts to the household price is 33% for agriculture products and 27% for manufacturing.

Following Nicita (2009), Marchand (2012) estimates the impact of Indian trade reforms on prices of tradable goods and nominal wages. Similar to Nicita (2008), Marchand uses the following equation to estimate the extent to which changes in tariff rates and the elasticity of its pass-through to domestic prices:

(3.1.3) $lnp_{ist} = \beta_0 + \beta_1 lnp^*_{it} + \beta_2 ln(1+\gamma_{it}) + \beta_3 lne_t + X'\beta_4 + \varepsilon_{ist}$

where p_{ist} is the domestic price of traded good i in state s at time t, p^*_{it} is the world price of good i at time t, γ_{it} is the ad-valorem tariff rate. e_t is the exchange rate in domestic currency. $X'$is the control variable including the year fixed effect, state fixed effect. β_2 is the variable of interest that captures the elasticity of tariff pass-through to the domestic price of traded goods. Since there is significant difference between rural and urban area in India, Marchand estimates the regression above for rural and urban area separately. She finds the elasticity of tariff pass-through to the consumer price is 33% to 49% in rural areas and 64% to 68% in urban areas.

This magnitude of price decline in both Nicita (2009) and Marchand (2012) is significantly higher than the estimates in my study. In summary, there are three reasons in the following.

(1) The price data in the two papers is annually real consumer price collected from domestic household survey. But the data I employ in my study is monthly price index which is measured by weighted price of basket goods. Different price measurement and frequency may lead to the distinguished result.

(2) Mexico and India are widely viewed as small closed countries before the trade liberalization. Substantial tariff reduction should have a much more significant effect on consumer prices than Canada which is already recognized as a small open country before the FTA.

(3) Nicita (2009) and Marchand (2012) implicitly assume tariff liberalization is

exogenous and is not correlated with error term. However, Trefler (2004) and (Grossman and Helpman, 1994, 1995) suggest that tariff liberalization may be endogenous and correlated with industry characteristics. Trefler (2004), therefore, employ a set of instrument variable to control the endogeneity of tariff. Nicita (2009) and Marchand (2013) may be undermined by a modest endogeneity problem in their main specification. In my study, I exploit a third difference, the exposure to trade with the U.S, to control the different industry characteristics.

3.2 Trade Liberalization and the Retail Price Faced by Consumers

The relationship between tariff changes and domestic consumer price is often complex and the mechanism of transmission is still ambiguous (Nicita (2009), Marchand (2012)). While border prices of tradable goods are quite sensitive to the tariff changes (Trefler (2004))[9], consumer prices faced by households are affected by various factors including imported prices, local producer prices, trade cost and retailer pricing strategy *et al*. Explicitly illustrating the mechanism of transmission is beyond the topic of my paper. But theoretical intuition is presented in this section.

The following procedure is based on Nicita (2009). I regard Canada as a small open economy. The imported prices of tradable goods are a function of world prices,

[9] From the definition in OECD Statistics, the border price is the import of export price of a commodity used for calculating the market price supporting price gap, usually measured as unit value of imports and exports.

exchange rates, tariffs and trade costs:

(3.2.1) $P_B = eP^*(1+\gamma)TC$

where P_B is the border price of tradable goods, P^* denotes the world price and e denotes exchange rate, γ is the *ad valorem* tariff rates and TC is the transportation costs. Equation 3.2.1 clearly shows that border prices are directly affected by tariff shocks. However, the consumer price of tradable goods P_T is complicated by the competitiveness and substitution of local products. The price of tradable goods is a weighted average of the price of the domestically produced good (PP_T) and the price of imported goods (P_B) as presented in 3.3.2.

(3.2.2) $P_T = PP_T^{\alpha}{P_B}^{1-\alpha} = PP_T^{\alpha}(eP^*(1+\gamma)TC)^{1-\alpha}$

where PP_T is the price of local products. α is the elasticity of substitution between local products and imported goods. Followed by Nicita (2009), $1-\alpha$ are also interpreted as the elasticity of pass-through or the extent to which world prices, tariff shocks and trade costs affect domestic consumer prices.

From Equation (3.2.2), there are three channels that trade policy affects domestic consumer prices. (1) Trade policies can directly affect the price of imported goods by imposing a tariff. (2) Imported goods introduce a substitute of local product. Trade policies can indirectly influence the competitiveness of imported goods relative to the local product by adjusting the tariff. The pressure from the substitute of imported goods may lower the price of the local producer by shrinking their markup. (3) Trade costs play a role on the price of consumer goods through affecting the cost of imported goods. Trade costs vary across geography of markets. Therefore, similar to the function of tariff, trade costs also affect the competitiveness of imported goods as a substitute of local product. For the cases of U.S. and Canada, there is an additional potential channel widely reported by the Canadian press that trade policies affect consumer prices through affecting the cost of arbitrage. (The Globe and Mail, 22/11/2012; Senate Report, 2013). 80% of the Canadian population lives within 200 miles of the US border. Due to the long-distances and relative open border between Canada and the United States, frequent cross-border arbitrages and greater use of price shopping and comparison tools will increase competition and force great pressure on producers and retailers in Canada. Hence, producers and retailers had to adjust their price to compete with U.S. retailers[10].

3.3 Estimation Strategy

My interest is to specify a regression model that explains the impact of FTA-mandated tariff concessions on the prices of consumer goods. Satisfying this object, the basic model is:

(3.3.1) $lnP_{itc} = \sigma_t + \beta_1(\gamma_t^{Can-World} - \gamma_t^{Can-US}) + \beta_2\left(\gamma_t^{US-World} - \gamma_t^{US-Can}\right) + \varepsilon_{itc}$

where $P_{itc}$is the consumer price index for good *i* at time *t* and province *c*. σ_t is the time

[10] The report of the Canada-USA Price Gap provides four recommendations and one observation to the Minister of Finance. In the observation, the report explicitly mentions that “As more Canadian consumers become aware of smartphone applications and Internet sites for price shopping and comparison, and become price-savvy consumers, competitive pressures in Canada will increase and the price for products in Canada will converge to U.S. prices.”

fixed effect that controls for the time-varying factors that are common to all goods and locations. γ_t^{Can-US} is Canada's average tariff against the United States and $\gamma_t^{Can-World}$ is Canada average tariff against the rest of the world. Followed the definition of Trefler (2004), $\gamma_t^{Can-World} - \gamma_t^{Can-US}$ is the FTA-mandated Canadian tariff concessions granted to the United States and is named as γ_t^{Can} in the rest of the paper. Likewise, γ_t^{US-Can} is the United States' average tariff against Canada and $\gamma_t^{US-World}$ is the United States' average tariff against the rest of the world. $\gamma_t^{US-World} - \gamma_t^{US-Can}$ is the FTA mandated U.S. tariff concession granted to Canada and is named as γ_t^{US} in the following. Obviously, there are some problems using estimating equation (3.3.1).

First, since P_{itc} is consumer price index not a real price, I try to convert the index to the real price. The way to construct CPI is to divide real price of one good in a certain year by the counterpart in a base year. The base year in my database is the year of 2002. This base year is the same no matter what the good is and where the geography is. Thus estimation (3.3.1) can be written as

(3.3.2) $$ln(\frac{p_{itc}}{p_{i0c}} \times 100) = \sigma_t + \beta_1\gamma_t^{CA} + \beta_2\gamma_t^{US} + \varepsilon_{itc}$$

where γ_t^{CA} is the FTA-mandated Canadian tariff concessions granted to the United States, γ_t^{US} is the FTA mandated U.S. tariff concession granted to Canada, small p_{itc} denotes the real price and p_{i0c} is the real price of good *i* at location c in the base year of 2002. Rearranging the regression (3.3.2), we will get:

(3.3.3) $$ln\, p_{itc} = \sigma_t + \beta_1\gamma_t^{CA} + \beta_2\gamma_t^{US} + ln\frac{100}{p_{i0c}} + \varepsilon_{itc}$$

where $ln\frac{100}{p_{ioc}}$ is a fixed value for specific goods and locations. We do not know the value of $ln\frac{100}{p_{ioc}}$, but we can substitute a good×location fixed effect variable ϑ_{ic} for it:

(3.3.4) $ln\,P_{itc} = \sigma_t + \beta_1\gamma_t^{CA} + \beta_2\gamma_t^{US} + \vartheta_{ic} + \varepsilon_{itc}$

Another adjustment required for the estimation Equation (3.3.1) and (3.3.4) is to add the good×year and province×year fixed effect. Good×year effect may capture temporal variation in the specific goods. Province×year fixed effect may capture the province specific shocks such as changes in macroeconomic environment. Hence, I introduce the good×year fixed effect δ_{it} and province×year fixed effect μ_{ct} into Equation (3.3.4):

(3.3.5) $\ln P_{itc} = \sigma_t + \beta_1\gamma_t^{CA} + \beta_2\gamma_t^{US} + \vartheta_{ic} + \delta_{it} + \mu_{ct} + \varepsilon_{itc}$

The last important issue for the specification is how to isolate some unobservable macro factor such as price inflation. As Figure 2 in later Section 3.4 shows, due to inflation generally prices always increase so that β_1 and β_2 can not pick up the real impact of FTA on the consumer price. To isolate price inflation effect, I make use of difference-in-difference (DID) approach. Detail explanation of DID is presented in the next section.

3.4 The General Difference-in-Difference Methodology

The basic intuition of the difference-in-difference approach is to compare the performance of the treatment group pre- and post- treatment relative to the performance of control group pre- and post-treatment. Ideally, the control group shows what would have happened to the treatment group in the absence of the treatment. Applied to my study of trade liberalization on consumer price of tradable goods, one compares consumer prices of tradable goods pre- and post- free trade with the prices of control group pre- and post- free trade. The effect of free trade on consumer price is identified as the estimated difference-in-difference of consumer price pre- and post-FTA between the two groups.

In the next part, to develop my empirical strategy I will introduce a typical difference-in-difference (DID) method following the structure of Slaughter (2001) and the detail discussion of Meyer (1994). Then I address how I apply DID in the case of Canada-U.S. Free Trade Agreement and particularly concentrate on how I define my control group.

Without control group, the basic form of single difference is like Equation (3.4.1) when the outcomes variables can be observed both before and after the treatment application.

(3.4.1) $y_{it} = \alpha + \beta d_t + e_{it}$

where y_{it} is the outcome variable i (*i=1,…,N*) at time t (*t=0* or *1*), d_t is a dichotomous variable and is equal to one if *t=1* and zero if *t=0,* and e_{it} is an error term. Equation (3.3.5) is categorized in the form of single difference. The dichotomous variable d_t is replaced by the variable of FTA-mandated tariff concession in Equation (3.3.5). For Equation (3.4.1), β identifies the causal effect of treatment under the identifying assumption, that is, in the absence of the treatment, β would be 0. Obviously there exists some other unobserved time-varying factors that affects prices i.e. price inflation. Thus, in most circumstances, Equation (3.3.5) is not satisfied with the identifying assumption. Due to unobserved factors including price inflation, even in the absence of FTA, prices of the same good would be different before and after the year of 1989.

The Difference-in-Difference approach accounts for these unobservable macro factors that are common to the treatment and control group by incorporating a control group that does not receive the treatment but undertakes the similar forces and factors as the treatment group. The specification of the Difference-in-Difference is

(3.4.2) $\mathrm{Y_{jt}} = \alpha + \gamma \mathrm{d_j} + \lambda d_t + \delta(\mathrm{d_j} * d_t) + \varepsilon_{jt}$

where *j* indexes the two groups with *j* =1 for the treatment group and *j* =0 for the control group; d_t is a dichotomous variable equal to one if *t*=1 and zero if *t* = 0. $\mathrm{d_j} * d_t$ is the interaction term equal to one if both $\mathrm{d_j} = 1\ and\ d_t = 1$ and zero otherwise. δ is the key coefficient which captures the causal effect of the treatment following to the policy changes. δ is calculated by the change in mean outcomes for the treatment group minus the change in mean outcomes for the control group. The coefficient λ identifies how the control group is affected over time by non-treatment forces while coefficient γ captures the any time-invariant difference in outcomes of the treatment group. Similar to the single difference, the key identifying assumption of Difference-in-Difference is that $\mathrm{E}\left[\varepsilon_{ist} \middle| \mathrm{d_j} * d_t\right] = 0$, which identify that in the absence of treatment δ is zero in both group. This identifying assumption will be valid when the untreated control group is very similar to the treatment group (Meyer (1994)).

So far, the treatment group has been defined by the interaction of two dummy variables, usually a dummy variable for being in the treatment group and one for being after the time of treatment. But sometimes we need that treatment is defined by the interaction of more than two dummy variables. The interaction of more than two dummy variables is suitable if the treatment group differ from the comparison group along several dimensions. Double Difference is usually appropriate when treatment group and control group show similar trend before the treatment and show separate trend after the treatment. However, when treatment and control group demonstrates distinguished trends before the policy change a third variation or dimension is necessary. As Mayer (1994) mentioned, high order of interaction of treatment may have the advantage of removing any trend along these other dimensions of the data.

Based on the Equation 3.4.2, the regression equation for the treatment of three-order interaction is

$$Y_{jtk} = \alpha + \gamma d_j + \lambda d_t + \theta d_k + \gamma_1(d_j * d_t) + \lambda_1(d_j * d_k) + \theta_1(d_t * d_k) + \delta(d_j * d_t * d_k) + \varepsilon_{jtk}$$

where y is the outcome variable; d_j indexes the two groups with *j* =1 for the treatment group and *j* =0 for the control group; d_t is a dichotomous variable equal to one if *t*=1 and zero if *t* = 0. d_k = 1 if *k* =1 and 0 otherwise; $d_j * d_t$, $d_j * d_k$, and $d_t * d_k$ is the three possible interactions of two factors (the first order interactions); $d_j * d_t * d_k = 1$ if the *j*=1, *t*=1 ,and *k*=1 and 0 otherwise is the interaction of all three factors (the second order interactions). δ is the key coefficient which captures the treatment on the outcomes. This design is called difference-in-difference-in-difference (DIDID) approach.

Example of the DIDID is Gruber (1994) who examined the incidence of mandated maternity benefits. In Gruber (1994), the treated groups are those women of certain ages (*j=1*) in the affected states (*k=1*) after the mandate (*t=1*). The coefficient of the second order of interaction term is the key parameter of interests. All three first order interaction terms are also included in the estimation equations.

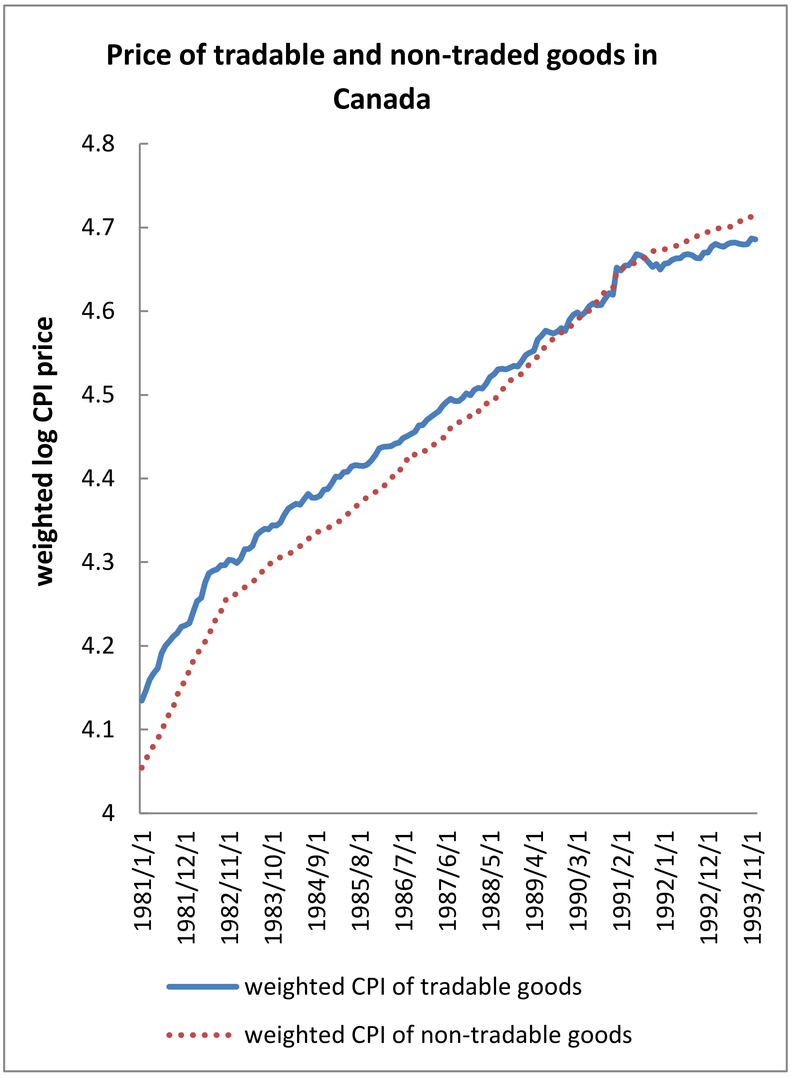
In the next section, I will present control groups in the DIDID approach and how DIDID methodology applies to estimating the effect of the FTA.

3.5 The Difference-in-Difference Methodology Applied to Canada U.S. Free Trade Agreement

In this chapter, I combine several groups of goods as my control group. First, I use the price of non-tradable goods (services) as control group. Studies (Schwanen, (1993); Peter Morici, (1989)) suggest that the FTA removed few existing restrictions on trade in services especially non-business service. For example, the FTA did not modify the rule or traffic for freight and shipping, and various institutional or individual transactions which consist of 63 percent of Canada's total trade in services (Schwanen, 1993). The rest of 37 percent of trade in services are basically business services including banking, engineering, consulting or broadcasting. The FTA took some modest but pioneering steps toward the liberalization of trade in business services.[11] In this sense, the prices of non-tradable goods seem to be independent of the FTA. However, this is not generally true because non-tradable goods consist with tradable components and non-tradable components. The FTA may indirectly affect the price of service by changing the price of its tradable components. Using the continuous measure of tradability, I do not need to distinguish between tradable and non-tradable goods and save my methodology from suspicion which is arbitrarily determining tradable and non-tradable goods by common sense. Detail discussion is presented in the following.

[11] In the North American Free Trade Agreement, the commitments to liberalize trade in service are more "encompassing" and applying to any sector (Schwanen, (1993),T.A. MacDonald, 1998).

Figure 2: The price trend of tradable and non-tradable goods



Note: Figure 2 shows the price trend of tradable and non-tradable goods. The aggregate price is constructed through weighted average five CPI categories including all items, all goods less food, food, services less rent, and rent. Detail method is presented in the Appendix. CPI is from January 1981 to December 1993. Dataset is downloaded from Charles Engel's personal website and its original source is OECD Statistics

Figure 2 demonstrates the price trend of tradable and non-tradable goods in Canada from 1981 to 1993. The data is from Charles Engel's personal website and its original source is from OECD Statistics. Engel (1999) constructs the aggregate price index of tradable and non-tradable goods through weighted average the price index of five good categories including all items (AI), all goods less food (AGLF), food (F), services less rent (SLR), and rent (R). The detail method is presented in the Appendix. From Figure 2, tradable and non-tradable goods share very similar trend before the free trade agreement in Canada. Due to price inflation, the general trend for both prices is always rising. In the early 1980s, the price of non-tradable goods was higher than the price of tradable goods. But around 1990 after the FTA came in to effect on January 1, 1989, the rising speed for the price of non-tradable goods is more than the price of tradable goods. Tradable goods obviously lowered its speed of price rising in 1991 and then the price trend of both goods started to be separate. This trend suggests that there exists a time delay for the producers or retailors to adjust the prices. The CPI difference in December 1993 for tradable and non-tradable goods is ($e^{4.71} - e^{4.68}$) 3.28. Relative to the price of tradable goods, the percentage difference is 3.0 percent. The difference is a little small because of the highly aggregated price of tradable and non-tradable goods. In the following, the representative price trend of disaggregate good categories is presented.

Figure 2 exhibits the similar trend of aggregate tradable and non-tradable goods pre the FTA and distinguished trend post the FTA. However, it is possible that for different disaggregate goods they would exhibit distinguished trends. Figure 3 demonstrates the

CPI trend for shelter, food and private transportation. According to the Equation (3.5.4) in the Section 3.4, I measure the tradability of nine good categories shown in Table 4-2. Among them, shelter is the least tradable goods while food and private are the top 2 most tradable goods. Shelter is, therefore, viewed as the representative non-tradable goods while food and private transportation represents the tradable goods. Similar to the Figure 2, Figure 3 shows the generally rising price trend for the three goods categories. But the rising speed for food and private transportation obviously slows down around 1991 after the FTA. Comparing with Figure 2, Figure 3 demonstrates distinguished price trends of representative tradable and non-tradable goods. For example, there has been a steady increase for the non-tradable goods, shelter, from 1982 to 1993 while tradable goods, private transportation and food, show a fluctuated increase during this period. Figure 3 shows that the treatment group for tradable goods and control group for non-tradable goods may demonstrate distinguished price trends before the FTA. In this case, the condition for the Difference in Difference will not be satisfied that treatment group and control group should demonstrate a similar price trend before the policy change and then a separate price trend after the policy change. Due to distinguished trends, the outcome of Difference in Difference would be contaminated by both the impact of FTA and the difference in trends.

In order to control the potentially distinguished price trend for disaggregated goods, I use a third variation, the exposure to trade with the U.S. by province. This set-up is equal to the Triple Difference (DIDID). The simple method to measure the exposure to trade is to aggregate the value of import and export with the U.S. and then divide it by the Gross Domestic Product (GDP) of the province.

(3.5.1) $$Exposure\ to\ Trade_c = \frac{IMPORT_c + EXPORT_c}{GDP_c}$$

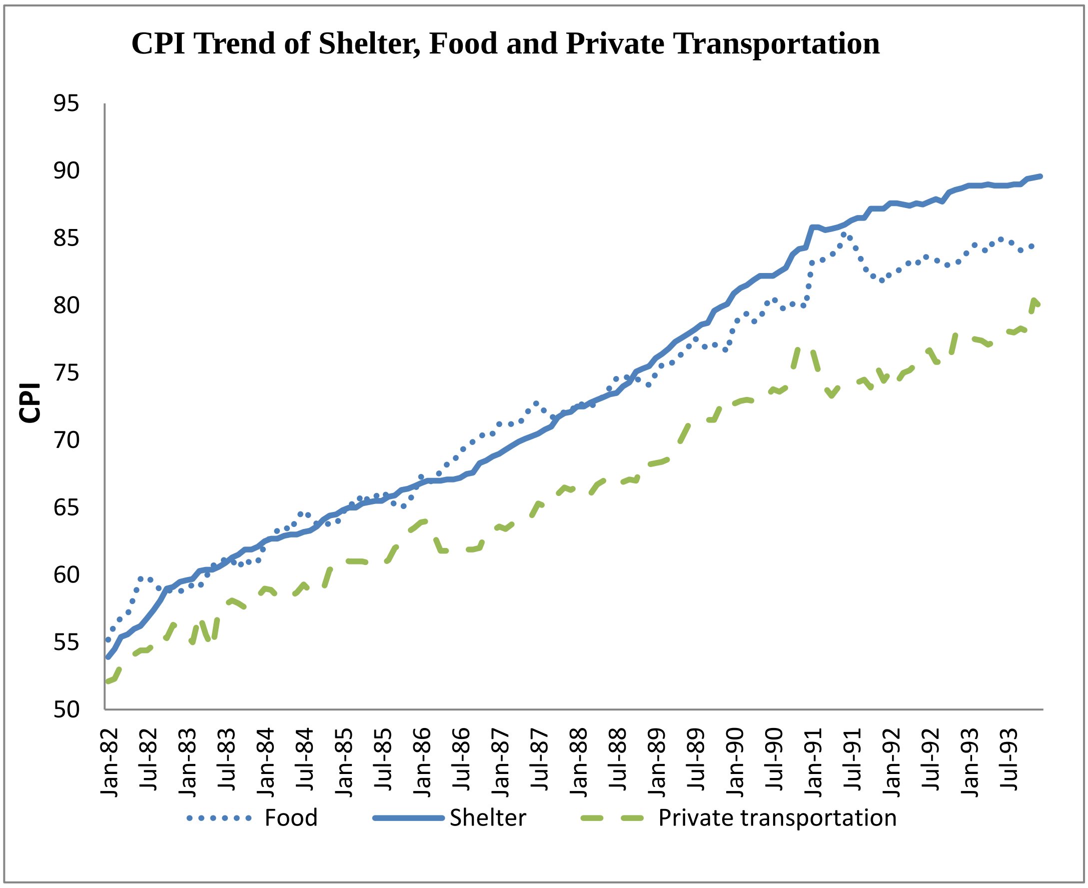
where $IMPORT_c$ denotes the value of import for the province c from the U.S. and $EXPORT_c$ denotes the value of export for province c to the U.S. I normalize the provincial trade flow by GDP_c, the GDP of the province c. The values of exposure to trade with the U.S. for 12 provinces and territories, and the overall Canada in 1988, 1991 and 1993 are listed in the Table 3-1. The exposure to trade I employed in the regression is in the year of 1998 prior the FTA. This ensures that the measured difference in exposure is not the result of an endogenous response to the FTA.

The choice of non-tradable goods as the control group does not come without some concessions. The non-tradable goods would be a perfect control group if prices of non-trade goods are not affected by the free trade agreement. However, this is not generally true. As the trade literature suggests (Dixit and Norman (1980), Wooland (1982), Porto (2006), Marchand (2012)), for a small open economy i.e. Canada, the domestic price p_T is given by:

(3.5.2) $$p_T = ep_T^*(1 + \gamma_T)\tau$$

where e is the exchange rate, p_T^* is the world price, γ_T is the tariff rate, τ is the trade cost. In principle, free trade agreement will substantially reduce the tariff rate so

Figure 3: CPI trend of Shelter, Food and Private Transportation



Note: Figure 3 shows the distinguished price trends for shelter, food and private transportation prior and post the FTA. According to my measure of tradability for nine disaggregated goods categories shown in Table 4-2, Shelter is the representative non-tradable goods. Food and private transportation is viewed as representative tradable goods. Data used in Figure 3 is national CPI from January 1982 to December 1993. Data is from CANSIM Table 326-0020.

that drives down the price of traded goods. Given the price of tradable goods, the equilibrium prices of the non-traded goods p_{NT} are endogenously determined by

(3.5.3) $p_{NT} = p_{NT}(p_T, p_{TI}) = p_{NT}(ep_T^*(1+\gamma_T)\tau, ep_{TI}^*(1+\gamma_{TI})\tau)$

where p_{TI} is the price of intermediate price, p_{TI}^* is the world price of intermediate price. After the introduction of free trade, the prices of non-trade goods, therefore, vary with the change of price of tradable goods. Using the continuous measure of tradability, theoretically, more ingredients of tradable goods could lead to a high value of tradability. Value of tradability is the partially from the magnitude of the mixture of tradable and non-tradable goods. Thus, I could save my methodology from suspicion which is arbitrarily determining tradable and non-tradable goods by common sense. I use the following formula to calculate its tradability.

(3.5.4) $(IMPORT_i + EXPORT_i + \text{import}_i + \text{export}_i) / \text{HE}_i$

where the capital letter $IMPORT_i, EXPORT_i$ is the value of Canada's international import and export with the world for good i and small letter $\text{import}_i, \text{export}_i$ is the value of interprovincial import and export for good i; HE_i denotes the household expenditure for good i. All the data are in 1988 before the enforcement of the FTA. Column 3 of Table 4-2 in Section 4.1 reports the value of tradability for nine goods categories. Using Equation (3.5.4), I could save my methodology from suspicion which is arbitrarily determining tradable and non-tradable goods by common sense.

Another control group comes from the variation in protection of trade. For example, the exports and imports of auto and automotive equipment were already liberalized between Canada and the United States in the agreement of Auto Pact in 1960s. Hence, the prices of automotive products should be not sensitive to the introduction of FTA. In addition to the auto, there are still some goods protected from the U.S. market competition in the FTA. For instance, medical equipment and dairy products are protected and not liberalized by the FTA (Schwanen, 1997, T.A. MacDonald, 1998).

Table 3-1: Exposure to Trade with the U.S. by Provinces

	Province	**Exposure to Trade (1988)**	**1991**	**1993**
1	Newfoundland and Labrador	0.36	0.28	0.30
2	Prince Edward Island	0.09	0.10	0.11
3	Nova Scotia	0.35	0.33	0.33
4	New Brunswick	0.44	0.47	0.53
5	Quebec	0.38	0.37	0.45
6	Ontario	0.67	0.61	0.80
7	Manitoba	0.28	0.32	0.37
8	Saskatchewan	0.40	0.37	0.44
9	Alberta	0.28	0.31	0.37
10	British Columbia	0.50	0.42	0.47
11	Yukon	0.17	0.19	0.04
12	Northwest Territories including Nunavut	0.05	0.06	0.07
13	Overall Canada	0.49	0.46	0.58

Notes: Exposure to trade with the U.S. are measure in Equation (3.5.1) using the value of Canada's international import and export with the U.S. and GDP for 12 provinces and overall Canada in 1988 (before the FTA), 1991 and 1993 after the FTA. Data are from CANSIM Table 228-0060.

Thus, theoretically the FTA should not affect the price of these products. These tradable goods (purchase of vehicle, medical care products and dairy products) are named as FTA non-sensitive goods and are another control groups. Conversely, other tradable goods such as meat, clothing, fruit, vegetable *et al* are named as FTA sensitive goods and are my treatment group. However, this classification also comes with some concessions. First, treatment group has to be a dummy variable that is equal to 0 when goods are FTA non-sensitive and 1 otherwise. I can not employ a continuous measure of treatment. Moreover, I do not have the access of tariff data for these products. Just using average tariff data over all products may restrict the accuracy of this method. The limitation also happens in the control group of non-tradable goods. Similar to the first control group, I also exploit the exposure to trade with the U.S. by province as the third variation to control for the different trends for treatment and control group.

3.6 Estimation Specification

My specification is based on Equation (3.3.5) and (3.4.2).

(3.6.1) $lnP_{itc} = \beta_1 \text{Treatment}_i \times \text{Openess}_c \times \gamma_t^{CA} + \beta_2 \text{Treatment}_i \times \text{Openess}_c \times \gamma_t^{US} + \vartheta_{ic} + \sigma_t + \delta_{it} + \mu_{ct} + \varepsilon_{itc}$

where 1) P_{itc} is the CPI of good *i* at time *t* in the province *c*. 2) For the control group of non-traded goods (services), $\text{Treatment}_i = Tradability_i$, the tradability of good *i* listed in Table 4-2. When control group is FTA non-sensitive goods, $\text{Treatment}_i = 1$ if the goods are FTA sensitive, $\text{Treatment}_i = 0$ if the goods are FTA non-sensitive (purchase of vehicle, medical cares, dairy products). 3) γ_t^{CA} is the FTA-mandated Canadian tariff concessions granted to the United States, γ_t^{US} is the FTA mandated U.S. tariff concession granted to Canada. 4) ϑ_{ic} is a good×province effects. I use ϑ_{ic} to get rid of the base year problem of consumer price index and captures idiosyncratic measure error 5) σ_t is time fixed effects that capture the aggregate shocks such as exchange rate fluctuation that may affects prices. 6) δ_{it} is a good×year fixed effect captures temporal variation in good characteristics that affect prices. (7) μ_{ct} is a province×year fixed effect that captures the province specific shocks such as changes in the macroeconomic environment.

The coefficients of interest is β_1 and β_2. The estimated coefficient $\hat{\beta}_1$ measures the percentage change in price of tradable (FTA sensitive) goods that experience the competition from the United States markets following the introduction of the FTA in the trade exposed area relative to the change in prices for non-tradable (FTA non-sensitive) goods in the same location. Similarly, $\hat{\beta}_2$ measures the percentage change in price of tradable (FTA sensitive) goods that experience an increased access to the United States markets following the introduction of the FTA in the trade exposed area relative to the change in prices for non-tradable (FTA non-sensitive) goods in the same location.

Chapter Four: Results

4.1 Data

For the control group of non-tradable goods, in order to measure the tradability of CPI good category, I have to select some good categories to match the trade flow data due to the data constraint. In addition, in terms of the control group of FTA-non-sensitive, all the goods I exploit in this method are tradable goods while I use both tradable goods and non-tradable goods for control group of non-tradable goods. I exploit three CPI data sets to examine the effect of FTA on the consumer prices of tradable goods. Data and results are discussed below.

1. *Provincial CPI data **36** disaggregated good categories.* I use two provincial CPI data sets in my paper. One provincial data set covers **36** disaggregated good categories. But due to the data constraint, I can not match all these goods categories to the trade flow data. Hence, for this data set I use dichotomous variable to denote tradable and non-tradable goods instead of continuous variable. Goods categories are listed in Table 4-1.

2. *Provincial CPI data **9** disaggregated good categories.* Another provincial data set covers 9 goods categories. I match the nine good categories with input-output trade flow data so as to make the treatment variable continuous. Column 3 in the Table 3-1 reports

the value of tradability for nine goods categories. Again using the continuous variable of tradable and non-tradable goods, I could save my methodology from the suspicion which is arbitrarily determining tradable and non-tradable goods by common sense. To give some statistical intuition, I use national CPI data for the nine good categories to analyze their statistics[12]. Column 4 and 5 list the mean CPI of the nine good categories prior to the FTA (from January 1982 to December 1988) and post the FTA (from January 1989 to December 1993). Due to price inflation, mean CPI of all goods increases after the introduction of FTA. But the speed of price rising varies a lot across goods. Column 5 lists the speed of price rising relative to the mean CPI prior to the FTA[13]. Column 5 suggests that for good categories with lower tradability (i.e. shelter, alcoholic beverages and tobacco products and recreation, education and reading), the rising speed is significantly higher than the good categories with higher tradability (i.e. food, private transparent, household operations, furnishings and equipment, clothing and footwear). Though prices of both tradable and non-tradable goods increase during the period partly due to the price inflation, the speed of price rising for the non-tradable goods (lower value of tradability) is significantly higher than the tradable goods (higher value of tradability) after the introduction of the FTA.

To illustrate this relationship, I draw the correlation scatter plot in Figure 4 using the value of tradability and speed of price rising. Panel A in Figure 4 shows that there exists a negative correlation between the tradability and speed of price rising among the nine

[12] Here I do not use provincial data because it is too long-winded to show statistics of nine goods for all the 12 provinces and territories.

[13] The speed of price rising is defined by the $\frac{mean\ CPI\ post\ the\ FTA - meanCPI\ prior\ the\ FTA}{mean\ CPI\ prior\ the\ FTA}$.

good categories. Excluding the private transportation and alcohol & tobacco, two outliers, I plot the rest of seven good categories in Panel B in Figure 5. Again, it also shows a negative correlation. The higher the value of tradability, the slower the speed of price rising is. Such statistics and figure indicate that it is reasonable to infer that FTA has distinguished influences on the tradable and non-tradable goods, that is, relative to the non-tradable goods, FTA significantly lower the price of tradable goods.

Both two provincial CPI data covers **12** provinces and territories in Canada. The monthly CPI is from Jan.1982 to Dec.1993. Because the tariff data is only available from Jan.1982, I start my sample period from Jan.1982. Since North American Free Trade Agreement came into effect on January 1st, 1994, I end my data period in December 1993 so as to exclude the impact of Mexico on Canadian markets. Table 4-2 lists the good categories, corresponding tradability and locations in the provincial CPI data set.

3. For the control group of FTA non-sensitive goods, I exploit provincial CPI data for 25 disaggregate **tradable** goods in 12 province and territories. The monthly CPI is from Jan.1982 to Dec.1993. FTA-non-sensitive goods are marked with NS in the parenthesis. The goods categories are listed in Table 4-3.

4. Trade Flow Data: I use trade flow data and Canadian household expenditure data to calculate tradability of goods according to the Equation (3.5.4). Both data sets are in

1988 before the enforcement of the FTA. The data are from CAMSIM Table 386-0003.

5. Provincial Import and Export: According to the Equation (3.5.1), I use the value of import and export for province and GDP data to calculate the exposure to trade for provinces. Both data sets are from 1988 before the enforcement of the FTA. The data are from CANSIM Table 228-0060.

Table 4-1: Categories of Disaggregate Goods in Provincial Consumer Price index

	Good
1	Meat
2	Fish, seafood and other marine products
3	Dairy products
4	Bakery products
5	Cereal products (excluding infant food)
6	Fruit, fruit preparations and nuts
7	Vegetables and vegetable preparations
8	Other food products and non-alcoholic beverages
9	Homeowners' maintenance and repairs
10	**Electricity (N)**
11	**Water (N)**
12	**Fuel oil and other fuels (N)**
13	**Telephone services (N)**
14	**Child care and housekeeping services (N)**
15	Household cleaning products
16	Paper, plastic and foil supplies
17	Furniture
18	Household textiles
19	Household equipment
20	Clothing
21	Footwear
22	Clothing accessories, watches and jewellery
23	**Clothing material, notions and services (N)**
24	Purchase of passenger vehicles
25	Gasoline
26	**Taxi and other local and commuter transportation (N)**
27	Health care goods
28	**Health care services (N)**
29	Personal care supplies and equipment
30	**Personal care services (N)**
31	**Travel services (N)**
32	**Cablevision and satellite services (including pay per view television) (N)**
33	Tuition fees
34	Reading material and other printed matter (excluding textbooks)
35	Alcoholic beverages
36	Tobacco products and smokers' supplies

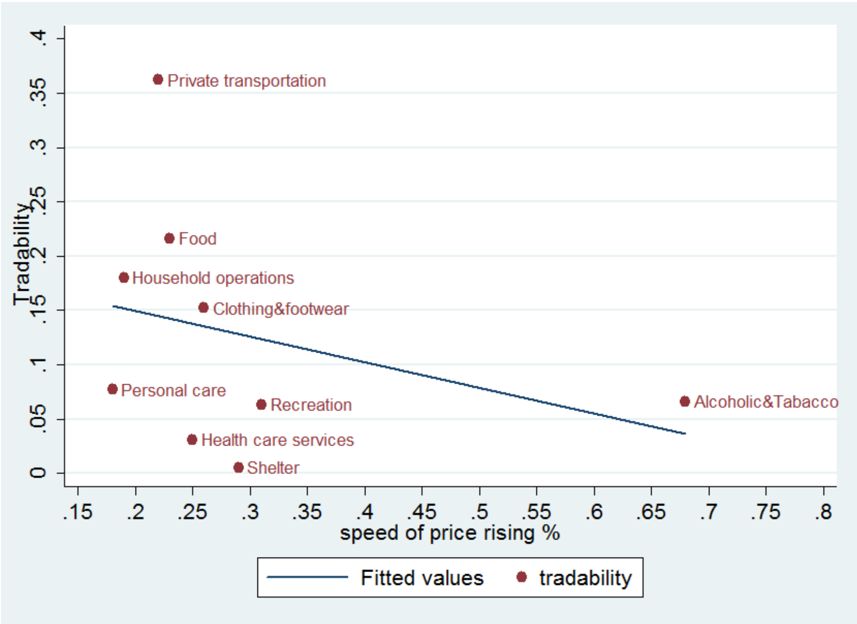
Note: the sample period is from January 1980 to December 1993. The goods in bold letter with N in the parenthesis are regarded as non-tradable goods in this dataset. The provinces are listed in Table 4-2. Source: CANSIM Table 326-0020.

Table 4-2: Categories of Goods in Provincial Consumer Price index, the Corresponding Tradability and their Statistical characteristics

	Goods	Tradability	Mean CPI From 1982 to 1988	Mean CPI From 1989 to 1993	Speed of CPI rising
1	Food	**0.216**	**66.01**	**81.41**	**23.34%**
2	Shelter	**0.005**	**65.49**	**84.76**	**29.44%**
3	Household operations, furnishings and equipment	**0.18**	**72.39**	**86.13**	**18.98%**
4	Clothing and footwear	**0.152**	**72.09**	**91.05**	**26.30%**
5	Health care services	**0.031**	**57.15**	**71.43**	**24.99%**
6	Private transportation	**0.362**	**60.90**	**74.60**	**22.49%**
7	Alcoholic beverages and tobacco products	**0.066**	**43.41**	**72.93**	**67.98%**
8	Personal care supplies and equipment	**0.077**	**78.25**	**92.67**	**18.42%**
9	Recreation, education and reading	**0.063**	**58.32**	**76.41**	**31.01%**
	Average tradability by good categories	**0.128**			

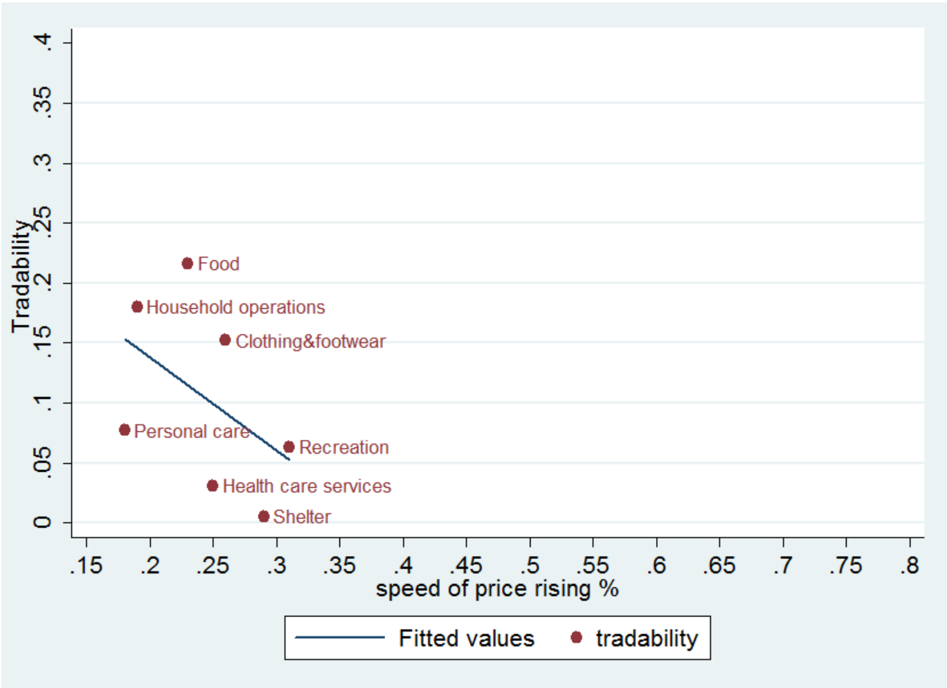
Notes: The sample period is from January 1982 to December 1993. Canadian CPI is from CANSIM Table 326-0020 and input-output data are from CANSIM Table 386-0003. The provinces and territories in Canada includes: Alberta, British Columbia, Quebec, Ontario, Manitoba, Saskatchewan, Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Whitehorse, Yukon and Yellowknife, Northwest Territories. Tradability is calculated using Equation (3.5.4). Speed of CPI rising is calculate by $\frac{mean\ CPI\ piror\ to\ the\ FTA - mean\ CPI\ post\ to\ the\ FTA}{mean\ CPI\ prior\ to\ the\ FTA}$.

Figure 4: Correlation between speed of price rising and tradability
(Panel A)



Note: Using the statistics in Table 4-2, Figure 4 shows the negative correlation between tradability and speed of price rising, that is, the higher the value of tradability, the slower the speed of price rising is. The correlation coefficient is -0.32.

Panel B



Note: In Figure 4 (b), I drop two Private Transportation and Alcohol & Tobacco, two outliers. The scatter plot shows that there is still a negative correlation. Correlation Coefficient is -0.47.

Table 4-3: Categories of Disaggregate Tradable Goods in Provincial Consumer Price index

	Good
1	Meat
2	Fish, seafood and other marine products
3	**Dairy products (NS)**
4	Bakery products
5	Cereal products (excluding infant food)
6	Fruit, fruit preparations and nuts
7	Vegetables and vegetable preparations
8	Other food products and non-alcoholic beverages
9	Homeowners' maintenance and repairs
10	Household cleaning products
11	Paper, plastic and foil supplies
12	Furniture
13	Household textiles
14	Household equipment
15	Clothing
16	Footwear
17	Clothing accessories, watches and jewellery
18	**Purchase of passenger vehicles (NS)**
19	Gasoline
20	**Health care goods (NS)**
21	Personal care supplies and equipment
22	Tuition fees
23	Reading material and other printed matter (excluding textbooks)
24	Alcoholic beverages
25	Tobacco products and smokers' supplies

Note: the sample period is from January 1980 to December 1993. The goods in bold letter with NS in the parenthesis are regarded FTA-non-sensitive goods in this dataset. The provinces are listed in Table 4-2. Source: CANSIM Table 326-0020

4.2 Results

The estimation results of Equation (3.6.1) are reported in Table 4-4. In the column (1), I exploit the first group of provincial data for 36 good categories and use dichotomous variables for tradable and non-tradable goods to examine the impact of the FTA on consumer goods. In the column (2), I make use of second group of provincial data for 9 goods categories and use continuous tradability variables to estimate the Equation (3.6.1). In the column (3), I use FTA non-sensitive goods as the control groups to analysis the impact of the FTA on tradable goods.

Table 4-4: Regression results for the main specification

Control Group	(1) Non-tradable goods		(2) Non-tradable goods (continuous)		(3) Non-FTA-sensitive goods	
$\boldsymbol{\beta_1}$	-0.106^a	-0.120^a	-1.132^a	-0.609^b	-0.035	-0.068
	(0.015)	(0.022)	(0.185)	(0.299)	(0.031)	(0.058)
$\boldsymbol{\beta_2}$	-0.082^a	-0.222^a	-2.033^a	-2.138^a	-0.259^a	-0.218^a
	(0.031)	(0.047)	(0.402)	(0.677)	(0.066)	(0.122)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Good Year FE	No	Yes	No	Yes	No	Yes
Province Year FE	No	Yes	No	Yes	No	Yes
Good×Region FE	Yes	Yes	Yes	Yes	Yes	Yes
N	58060	58060	15088	15088	41952	41952
Adjust $\boldsymbol{R^2}$	0.88	0.88	0.85	0.85	0.87	0.86

Note: Table 4-4 reports regression of log CPI on the second order of interaction of level of tradability, level of access to the U.S. market and FTA mandated tariff concessions. Numbers in the brackets are robust standard errors. Significance: a: 1 percent; b: 5 percent.

I separately report the results of the specifications containing only year fixed effect and good×province effects as well as all the four fixed effects. Robust standard errors are reported in the parenthesis. These results for two specifications are statistically significant and their differences are small. My following interpretation is based on the specification with all the four effects.

To quantify the magnitude of the estimates presented in Table 4-4, I calculate the percentage change in price reduction implied by the percentage point increase in average FTA mandate tariff concession for tradable goods in the open trade province. For example, in column (1), the estimated effect of reducing protection from the U.S. competition (β_1 = -0.120) implies that for a good with average exposure to trade with U.S. market (0.33), one percentage point increase in the FTA mandate Canadian tariff concession lowers the consumer price of tradable goods ($Trade_i = 1$) by 3.96% (0.12× 0.33%) following the introduction of the FTA. Likewise, the estimated effect of increasing access to the U.S. market (β_2 = -0.222) implies that for a good with average exposure to trade with U.S. market (0.33), one percentage point increases in the FTA mandate U.S. tariff concession lower the consumer price of tradable goods ($Trade_i = 1$) by 7.33% (0.222×0.33%) following the introduction of the FTA. Together, these estimations suggest that the one percentage point increase in the FTA tariff concession decreases the prices of tradable goods with average exposure to the U.S. market by 11.29%.

Similarly, when using continuous tradable and non-tradable goods as my control group, the estimated effect of reducing protection from the U.S. competition (β_1 = -0.609) implies that for a good with average tradability (0.128) and the average openness to the US market (0.33), one percentage point increase in the FTA mandate Canadian tariff concession lowers the consumer price of tradable goods by 2.57% (0.609×0.128×0.33%). Likely, the estimated effect of increasing access to the U.S. market (β_2 = -2.138) implies that for a good with average tradability (0.128) and the average openness to the US market (0.33), one percentage point increase in the FTA mandate U.S. tariff concession decreases the consumer price of tradable goods by 9.03% (2.138×0.128×0.33%). Together, one percentage point increase in the FTA tariff concession decreases the price of tradable goods with average tradability in the province with average openness to the U.S. market by 11.60%.

In terms of the control group of the FTA non-sensitive goods (purchase of vehicle, medical cares, dairy products), the estimated effect of reducing protection from the U.S. competition (β_1 = -0.068) implies that for a good with average exposure to trade with U.S. market (0.33), one percentage point increase in the FTA Canadian tariff concession lowers the consumer price of FTA sensitive tradable goods (FTA $\text{Sensitve}_i = 1$) by 2.24% (0.068×0.33%). But this result is **not** statistically significant. Likely, the estimated effect of increasing access to the U.S. market (β_2 = -0.218) implies that for a good with average openness to the US market (0.33), one percentage point increase in the FTA mandated U.S. tariff concession decreases the consumer price of FTA sensitive tradable goods (FTA $\text{Sensitve}_i = 1$) by 7.19% (0.218×0.33%). Together, one percentage point increase in the FTA tariff concession reduces the price of FTA sensitive tradable goods in the province with average openness to the U.S. market by 7.19%.

In summary, the three results above show that one percentage point increase in the FTA tariff concession decreases the consumer price of tradable goods in the provinces with average exposure to trade with U.S. by at least 7.19% to at most 11.60%. The effect of increasing access to the U.S. market has a more significant influence on the consumer price declining in Canada than the effect of reducing protection from the U.S. competition. This seems to conflict from what we expect. After the FTA, the average Canada tariff against U.S. decreased from 9.2 percent to 4.2 percent while the average U.S. tariff against Canada decreased from 5 percent to 2.1 percent. The larger magnitude of tariff elimination in Canada may have a larger effect on the price declining. One reason for this conflict may come from the tariff data I use in the paper. The perfect tariff data is the average tariff by each product while what I use is the tariff data across all the products. This is because on one hand, I do not have the access to the detail tariff by product; on the other hand, since I use consumer prices, there is no tariff data that perfectly match the good categories of consumer prices.

4.3 Robust Tests

I make two robust checks in this section. One is to drop some good categories which are disputed to classify as tradable or non-tradable goods. Another is to cover longer data period. I extend the data period from December 1993 before the implementation of NAFTA to December 1996. Detail discussion of the two robust checks is presented in the following.

1) *Robust Check 1*: According to the Equation (3.5.4), the tradability value of alcoholic beverages and tobacco products, and personal care supplied and equipment is low compared with other tradable goods such as food and household operations, furnishings and equipment. To save from the suspicion of misclassifying them into tradable goods, I drop the personal care supplies and equipment, alcoholic beverages and tobacco products and smoker's supplies from my data set when using tradable goods as my control group. The result after the drop is presented in the Column 1 in Table 4-5. The coefficients in the specification with province×year and good×year fixed effects do not change much while the coefficients in the specification without the two fixed effects increase. It seems to be more robust to contain all four fixed effect variable in the specification.

Table 4-5: Regression results for the Robust Check 1

Control Group	(1) Non-tradable goods		(2) Non-tradable goods (continuous)	
$\boldsymbol{\beta_1}$	-0.157^a	-0.122^a	-1.71^a	-2.51^a
	(0.014)	(0.024)	(0.290)	(0.731)
$\boldsymbol{\beta_2}$	-0.124^a	-0.242^a	-3.45^a	-7.81^a
	(0.031)	(0.052)	(0.634)	(1.60)
Year FE	Yes	Yes	Yes	Yes
Good Year FE	No	Yes	No	Yes
Province Year FE	No	Yes	No	Yes
Good×Region FE	Yes	Yes	Yes	Yes
N	52888	52888	13364	13364
Adjust $\boldsymbol{R^2}$	0.87	0.87	0.83	0.84

Note: Table 4-5 reports the result of regression that drop the alcoholic beverages, tobacco products and smoker's supplies and personal care supplies and equipment (1); private transportation (2) in the data set. Numbers in the brackets are robust standard errors. Significance: a: 1 percent.

I make another change in the method of continuous treatment. The good categories of private transportation include a sub-category, purchase of passenger vehicles. Because auto and automotive equipment were already liberalized in the agreement of Auto Pact in 1960s, I drop private transportation from the nine good categories so as to exclude the interference of possible FTA non-sensitive goods. The result is reported in the Column 2 of Table 4-5. The sign of coefficients in both specifications remains negative showing that relative to the non-tradable goods, the prices of tradable goods still decline after the FTA. But the magnitude of price declining increases a lot after dropping the private transportation. One of the reasons may come from the fact that private transportation accounts much in consumers' expenditure. Dropping the category of private transportation, the large proportion of consumer's expenditure may have a big effect on the results.

Table 4-6: Regression results for the Robust Check 2

Control Group	(1) Non-tradable goods		(2) Non-tradable goods (continuous)		(3) Non-FTA-sensitive goods	
$\boldsymbol{\beta_1}$	-0.074^{a}	-0.096^{a}	-1.028^{a}	-0.514^{b}	-0.023	-0.044^{b}
	(0.015)	(0.019)	(0.175)	(0.247)	(0.030)	(0.023)
$\boldsymbol{\beta_2}$	0.018	-0.145^{a}	-1.686^{a}	-1.670^{a}	-0.208^{a}	-0.148^{a}
	(0.029)	(0.041)	(0.369)	(0.542)	(0.062)	(0.050)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Good Year FE	No	Yes	No	Yes	No	Yes
Province Year FE	No	Yes	No	Yes	No	Yes
Good×Region FE	Yes	Yes	Yes	Yes	Yes	Yes
N	73576	73576	18976	18976	53112	53112
Adjust $\boldsymbol{R^2}$	0.88	0.88	0.85	0.85	0.87	0.86

Note: Table 4-6 reports the result of regression that extends the period to December 1996. Numbers in the brackets are robust standard errors. Significance: a: 1 percent; b: 5 percent.

2) *Robust Check 2*: In the main specification, the data period is from January 1982 to December 1993. I choose 1982 as the beginning year because my tariff data is available from1982. The data ends in 1993 so as to exclude the impact of free trade between Canada and Mexico through the NAFTA on the consumer prices. However, one may be concern about that the trade between Canada and Mexico only accounts for 1% in terms of import and 5% in terms of export. This amount of international trade between the two countries may not significantly affect Canada's consumer price. In this robust check, I extend the data period to December 1996. I choose the year of 1996 because the tariff data I have ends in December 1996. And also, in 1996 the FTA has been effect for eight years. The ten-year schedule to reduce bilateral tariff almost comes to the end. Hence, in this robust check, I extend the data period from 1993 to 1996 and redo the main specification (Equation 3.6.1) keeping all other things constant. The result is reported in

the Table 4-6.

In the Table 4-6, there is not much difference especially in the specification controlling time-varying good and province fixed effect compared with Table 4-4. Basically, results in Table 4-6 are a little smaller after the extension to 1996. It is natural to understand because since Mexico joined in the free trade with Canada, Canada mandated FTA tariff concession, the difference between the preference tariff for Canada and the U.S. and the tariff to the rest of the world, becomes smaller. Such tariff trend is also observed in the Figure 1 in Chapter Two. After the 1994, Canadian tariff against the rest of world went down. The smaller tariff reduction lowers the consumer prices less than the tariff reduction induced by the FTA. In summary, robust check 2 again suggests that the result of main specification in Table 4-4 is robust especially for the specification controlling all the four fixed effects.

Chapter Five: Conclusion

The impact of trade liberalization on the welfare of household has been focused on by the trade economists. Yet, there has been little evidence of how Canada-US Free Trade Agreement affects the consumer prices and price difference between Canada and the U.S.

In this thesis, I provide the empirical evidences of how the FTA affects the prices using two approaches. 1) I make use of six good categories for Canadian provinces and U.S. metropolis to examine the impact of the FTA on border costs. I find that the border cost between Canada and the U.S. still exists after the FTA went into effect in 1989. 2) To examine the impact of the FTA on consumer prices in Canada, I make use of three provincial disaggregate CPI data sets and employ a continuous difference-in-difference-in-difference (DIDID) approach that exploits variation in protection across time, goods and provinces. The treatment group in my DIDID framework is tradable goods that is highly affected or liberalized by FTA in the open provinces. I use two different control groups. First, I treat non-tradable goods (basically services) as the control group. To distinguish tradable and non-tradable goods, I construct the tradability to avoid arbitrarily attribute goods into tradable or service categories. Another control group comes from variation from protection. Auto and automobile equipment were already liberalized before the enforcement of the FTA and medical care goods and dairy products are still protected from the free trade. Hence these goods named as the FTA-non-sensitive goods are another control group. Third variation, the exposure to trade with the U.S. by provinces, is used to mitigate the confounding trends between treatment and control group.

Using the approaches, I find that the FTA had significant effects on the price of tradable goods faced by the local consumers. In my thesis, my results show one percentage point increase in the FTA tariff concession decreases that the consumer prices of tradable goods in the provinces with average exposure to the U.S. markets by at least 7.19% to at most 11.60%. With the objective of reducing the price gap for certain products between Canada and the U.S., report of the Canada-USA Price Gap issued from Senate recommends that the Minister of Finance conduct a comprehensive review of Canadian tariffs especially focusing on tariff's impact on domestic manufacturing. As a response for the recommendation in the report, my results suggest that eliminate of trade barriers such as bilateral tariffs has a significant effect particularly on the consumer price of tradable goods.

In the future work, first, I would use real detail price data instead of price index to explore the impact of the FTA on consumer prices, if possible. Because any disaggregate CPI is measured by the weighted average price of a basket of good, real detail price could get rid of the aggregation bias induced by the CPI. Second, in the study, I use average tariff data over all industries. It would provide a more convincing result to utilize the tariff by industry. Finally, Canadian consumer has often been wondered why there are significant price differences in some similar goods between Canada and the United States. In my study, I do not fully or directly answer why the price dispersion exists between the two countries. Is it possible to further explore the mechanism leading to the price difference between the two countries? This will be my next step.

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Appendix

Aggregate CPI data: Because there is no data available for the categories of tradable and non-tradable goods, I have to construct the CPI of tradable and non-tradable goods so as to show their trend in Figure 2. Following the method of Engels (1999), I construct the log CPI of tradable and non-traded using five goods categories all items (AI), all goods less food (AGLF), food (F), services less rent (SLR), and rent (R). The weights in the price indexes are constructed from the following regression:

(7) $\Delta(\mathrm{ai} - \mathrm{r}) = \emptyset_1 \Delta(aglf - r) + \emptyset_2 \Delta(f - r) + \emptyset_3 \Delta(slr - r) + \varepsilon$

where Δ denotes the first difference operator and small letter is the natural logarithms of the corresponding good categories. Then the aggregate CPI of tradable and non-traded goods are constructed according to the weights in the regression (7):

$$p^T = \left(\frac{\emptyset_1}{\emptyset_1 + \emptyset_2}\right) * \mathrm{aglf} + \left(\frac{\emptyset_2}{\emptyset_1 + \emptyset_2}\right) * f$$

and

$$p^N = \left(\frac{\emptyset_3}{1 - \emptyset_1 - \emptyset_2}\right) * slr + \left(\frac{1 - \emptyset_1 - \emptyset_2 - \emptyset_3}{1 - \emptyset_1 - \emptyset_2}\right) * r$$

where $p^T$and p^Ndenotes the aggregate price of tradable goods and non-traded goods separately.