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ABSTRACT

This paper identifies the effects of preferential trade agreements on trade volumes and prices using detailed trade and tariff data. It identifies demand elasticities by developing a difference in differences based method that exploits the fact that the additional wedge driven between consumption patterns in a liberalizing versus a non-liberalizing country is directly related to the tariff reduction. Supply elasticities are identified by using tariffs as instruments for observed quantities. Analysis of world-wide trade data for 5,000 commodities shows that NAFTA and CUSFTA have had a substantial impact on international trade volumes, but a modest effect on prices and welfare. NAFTA and CUSFTA increased North American output and prices in many highly-protected sectors by driving out imports from non-member countries.

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1 Introduction

The growing trend towards preferential trade liberalization depicted in Figure 1 and the potentially harmful effects of preferential trade agreements on international trade makes analysis of these agreements important. There are over 200 preferential trade agreements currently in force, and while almost every country is a party to at least one such agreement perhaps a more important fact is that typically 200 countries are not parties to each agreement. This paper seeks to empirically analyze the effects of the second-largest of these agreements, the North American Free Trade Agreement (NAFTA), on trade volumes, prices and welfare of both member countries and non-members. It uses detailed trade data to identify key supply and demand parameters in a simple static model that is then used to analyze NAFTA. The paper finds that both supply and demand are very sensitive to price changes. NAFTA therefore has substantial effects on trade volumes, but price and welfare effects are found to be modest.

On January 1, 1994 the North American Free Trade Agreement (NAFTA) between the United States, Canada and Mexico entered into force and incorporated the prior Canada-US Free Trade Agreement (CUSFTA). For convenience I will often refer to both agreements simply as "NAFTA". NAFTA is by far the largest free trade pact outside of the European Union and is the first reciprocal free trade pact between a substantial developing country and developed economies (Hufbauer and Schott, 1993). While NAFTA is not a "deep" integration like the European Union, it contains provisions that go beyond mere removal of tariffs and quantitative trade restrictions, including disciplines on the regulation of investment, transportation and financial services, intellectual property, government purchasing, competition policy, and the temporary entry of business persons (Hufbauer and Schott, 1993). Since the advent of NAFTA one of the more striking occurrences has been the rapid increase in Mexican trade. Mexico has become the US's second largest trading partner, accounting for 11.5 percent of US merchandise imports in 2001 and 13.9 percent of US exports, up from 6.9 and 9.0 percent respectively in 1993. Only Canada is a partner for more US trade. Mexico now accounts for a larger share of US trade than Korea, Thailand, Singapore, Malaysia, Hong Kong and Taiwan combined.

Despite NAFTA's size, empirical studies often have great difficulty in identifying an effect of NAFTA. The reason for the mixed results in studies of relatively aggregated trade data is very simple. These studies have great difficulty distinguishing NAFTA's impact from the impact of two other events that occurred at a similar time. The first of these events is Mexico's unilateral trade liberalization that began in 1986. In general equilibrium, import liberalization also promotes exports. Mexico's imports and exports therefore began growing prior to NAFTA. This effect is evident in Figure 2. The second event is the Peso devaluation of 1994-95 that also coincided with rapid growth in Mexico's exports.

By contrast, this paper finds that NAFTA has had a substantial impact on trade, though only a modest effect on prices and welfare. It does so by identifying key supply and demand elasticities in detailed trade data, and then using those parameters to estimate the impact of NAFTA on trade volumes and prices. It develops a difference in differences based estimation technique to identify demand elasticities that focuses on where each of the NAFTA partners sources its imports of almost 5,000 6-digit Harmonized System (HS-6) commodities and comparing this to the source of European Union (EU) imports of the *same* commodities. The technique enables identification of NAFTA's effects on trade volumes even when countries' production costs shift. Inverse supply elasticities are identified by regressing observed import prices (excluding duties) on observed quantities, using tariffs as instruments for observed quantities.

The main advantage of using the detailed trade and tariff data is that it enables identification of key supply and demand parameters. Studies of aggregate trade patterns are at the mercy of other factors that affect trade. The potential disadvantage is that product-level studies pay no respect to some general equilibrium considerations such as trade balance conditions, but this need not be the case.

NAFTA's impact on trade at the product level can be simply demonstrated with a few figures. Figure 3A shows that Mexico's share of US imports has increased most rapidly in commodities for which it has been given the greatest increase in tariff preference, defined as the difference between the US tariff on a commodity sourced from Mexico and the US's Most Favored Nation (MFN) tariff rate for the same commodity.[1] For the 389 commodities where the US tariff preference for Mexican goods has

[1]The MFN tariff is the tariff applicable to imports from countries that have normal trade relations with the US.

increased by at least 10 percentage points, the simple average of Mexico's share of US imports has risen by 224 percent since 1993. For the 2663 commodities where Mexico's tariff preference has not increased, its share has risen by a more modest 23 percent. The timing and cross-commodity pattern of Mexico's trade increase are themselves highly suggestive that trade was very responsive to NAFTA's tariff preferences, and Figure 3B further supports the case. Figure 3B shows Mexico's share of EU imports from 1989-2000. Without the benefit of a free trade agreement until late 2000, the evolution of Mexico's trade with the EU has been very different. Its share of EU imports of commodities with high NAFTA preferences declined by 77 percent, while its share of EU imports of commodities where NAFTA did not increase preferences rises by 64 percent. This growing wedge between US and EU import patterns will identify demand elasticities and, when combined with estimated supply elasticities, NAFTA's impact on trade volumes and prices.

Canada's share of US imports has also increased since CUSFTA came into effect in 1989, and Figures 4A to 4C also suggest that CUSFTA was partly responsible. For commodities where there was no increased preference for goods of Canadian origin, Canadian goods now account for a 2 percent smaller share of US imports than they did in 1988. But where the preference increased by at least 10 percentage points, Canada's share of US imports increased by 99 percent. The timing and cross-commodity pattern again suggest that CUSFTA is at work. Figure 4C shows Canada's share of US imports from 1980 to 2000. For most of the 1980s, Canada's share of US imports is declining in all tariff classes, but just before CUSFTA, Canada's share begins to rebound for commodities where large tariff preferences were negotiated. Figure 4B provides a comparison with Canada's trade with the EU, which does not have a preferential trade agreement with Canada. For the commodities with no CUSFTA preferences, Canada's share of EU imports has declined by 6 percent. For commodities with high CUSFTA preferences, Canada's share of EU imports has declined by 40 percent. Figures 3A to 4C together suggest that NAFTA/CUSFTA have had a substantial impact on trade, and even though US tariffs are typically low, trade appears to be quite sensitive to even small trade preferences.

Preferential Trade Areas (PTAs) have received a great deal of analytical and empirical attention since Viner (1950) distinguished between the trade creation and trade diversion effects of preferential tariff liberalization. Much of this attention is driven by the ambiguous welfare implications of PTAs. Favorable effects ("trade creation") result from removing distortions in the relative price between domestically produced commodities and commodities produced in other members of the PTA. Unfavorable effects ("trade diversion") come from the introduction of distortions between the relative price of commodities produced by PTA members and non-members (Frankel, Stein and Wei 1996). Research has also been motivated by the political economy of PTAs, such as whether PTAs help or hinder movement towards the first best of global free trade (for example, Baldwin 1996, Levy 1997, Bagwell and Staiger 1999).

Much empirical work has been devoted towards evaluating trade and welfare effects of PTAs (Baldwin and Venables 1995). One major group of studies of PTA's are ex-ante simulations using Applied General Equilibrium (AGE) models that produce price and welfare predictions in addition to trade volume predictions. The other major group are ex-post studies examining changes in the direction of aggregate trade between countries or regions following the introduction of the PTA. Examples of AGE modelling of NAFTA are Kehoe and Kehoe (1995), Brown, Deardorff and Stern (1995), Cox (1995), Sobarzo (1995) and studies surveyed in Baldwin and Venables (1995). All models predicted welfare gains for NAFTA members, though the welfare estimates are sensitive to whether the models are "first generation" with perfect competition and no dynamics, "second generation" with increasing returns and imperfect competition, or "third generation" with the addition of capital accumulation. Later generation models have more potential for welfare changes and typically suggest greater welfare gains. Examples of ex-post studies that use aggregate trade data for NAFTA are Gould (1998) and Garces-Diaz (2001). Gould finds that NAFTA has increased US-Mexico trade, but has had no effect on US-Canada or Mexico-Canada trade. Garces-Diaz finds that Mexico's export boom is not attributable to NAFTA.

Papers more similar to this are Clausing (2001), Fukao, Okubo and Stern (2003), Krueger (1999, 2000) and Chang and Winters (2002). Clausing was first to exploit tariff variation at the detailed commodity level using US import data from 1989 to 1994. Clausing finds that US import growth was related to tariff preferences conferred on Canada and also concludes that CUSFTA was primarily trade creating. Fukao, Okubo and Stern analyze US imports at the HS 2-digit level for the period 1992-1998. Of the 70 sets of industry regressions they run, NAFTA tariff preferences had a significant effect on US imports in 15 cases. Research at the 3 and 4-digit SIC industry level by Krueger (1999, 2000) finds no evidence that NAFTA has had any impact on intra-North American trade. In a study of MERCOSUR, Chang and Winters (2002) examine export price data for five non-member countries. They find that due to the tariff preference, competition from Argentina, Uruguay and Paraguay has led to significant and substantial reductions in American, Chilean, German, Korean and Japanese export prices to Brazil.

Related papers include Kehoe and Ruhl (2002), who find that growth in the extensive margin following trade liberalizations is an important source of new trade, especially for the previously thin Canada-Mexico trade relationship. Head and Ries (1999) study the industry rationalization effects of tariff reductions and find that on balance, NAFTA has had little net effect on the scale of Canadian firms. Trefler (2001) finds that Canadian industries that experienced the largest tariff cuts under NAFTA experienced substantial labor productivity gains, but a decline in both output and employment. Yeats (1997) finds that the fastest growth in intra-MERCOSUR trade was in commodities in which members did not display a comparative advantage, inferred from the lack of exports of these commodities outside MERCOSUR. This was interpreted as evidence of the trade diversion effects of MERCOSUR.

This paper is organized as follows. Section 2 introduces a simple "first generation" model of preferential trade liberalization that is used to derive the estimating equations and underpin the welfare analysis. Section 3 describes the data. Section 4 presents and discusses the empirical results. Section 5 concludes.

2 Theoretical Framework and Empirical Strategy

This paper seeks to exploit the commodity and time variation in the tariff preference that is afforded to goods originating in NAFTA partners to identify NAFTA's and CUSFTA's effect on trade and welfare. The paper identifies demand elasticities by focusing on where NAFTA members and the EU source their imports of different commodities. It seeks to explain changes in North American import sources using the preference afforded to commodities of North American origin. The idea is that where North American output is afforded no new preference (where the MFN tariff rate is zero, for instance), NAFTA's only impact should come through a general equilibrium effect on output prices, or through reductions in "border effects" due to NAFTA provisions that go beyond tariff liberalization. For commodities where NAFTA causes a new preference to open up for North American goods, the preference should have an additional effect causing North American consumers to substitute towards newly preferred goods and away from other sources of supply. Supply elasticities are identified using tariffs as instruments that, for a given supply price, shift the demand curve. This strategy can be derived from a simple model. The model and the estimated parameters are then used to evaluate NAFTA's effects on trade volumes, prices and welfare.

A. Model Description

Firms produce commodities under perfectly competitive conditions. Trade is driven by preference for variety and by commodities being differentiated by country of origin. Countries may impose ad-valorem tariffs on imports. Countries may then enter into preferential trading agreements whereby each country in the agreement lowers tariffs on imports from partner countries but need not adjust the tariff on imports from other countries. This causes consumers to substitute towards the output of preferred countries and away from all other sources of supply, including domestic production. Factor supplies are not explicitly modelled. The model assumptions are set out in detail below.

1. Countries are denoted by c and time by t.[2]

2. There is a continuum of industries z on the interval [0,1]. In each country, every industry produces a commodity using an industry-specific factor under conditions of perfect competition with marginal cost $a_t\left(q_t^S\left(z_c\right)\right)$ (henceforth often denoted as $a_t\left(z_c\right)$), where $q_t^S\left(z_c\right)$ is production of commodity z in country c. Note that marginal cost depends on the quantity produced and may vary across producing country and time. I assume a constant inverse supply elasticity:

$$\ln a_t\left(q_t^S\left(z_c\right)\right) = \eta\left(z_c\right)\ln q_t^S\left(z_c\right) + \ln \widehat{P}_{ct} + D_{ct} + D_{cz} + \varepsilon_{czt} \tag{1}$$

[2] In the empirical analysis "country" will often mean collection of countries such as the European Union or a "Rest of the World" group of countries. Aggregation is discussed in the Appendix.

where $\eta(z_c)$ is the inverse supply elasticity, $\widehat{P}_{ct}$ is the aggregate price index in country c, D_{ct} is a country-by-year fixed effect, D_{cz} is a country-by-product fixed effect and ε_{czt} is a random supply shock.

3. In every period consumers in each country are assumed to maximize Cobb-Douglas preferences over their consumption of the output of each industry, $Q_{ct}(z)$, with the fraction of income spent on industry z being $b_c(z)$ (Equations 2 and 3). Expenditure shares for each industry are therefore constant for all prices and incomes.

$$U_{ct} = \int_0^1 b_c(z) \ln Q_{ct}(z)\, dz. \tag{2}$$

$$\int_0^1 b_c(z)\, dz = 1. \tag{3}$$

4. The output of each industry is not a homogeneous good. Although firms in the same country produce identical goods, production is differentiated by country of origin. $Q_{ct}(z)$ can be interpreted as a sub-utility function that depends on the quantity of each variety of z consumed. I choose the CES function with elasticity of substitution $\sigma_z > 1$. Let $q^D_{ct}(z_{c'})$ denote the quantity consumed in country c of commodity z produced in country c'. $Q_{ct}(z)$ is defined by Equation 4:

$$Q_{ct}(z) = \left(\sum_{c'=1}^{N} q^D_{ct}(z_{c'})^{\frac{\sigma_Z - 1}{\sigma_Z}} \right)^{\frac{\sigma_Z}{\sigma_Z - 1}}. \tag{4}$$

5. There may be transport costs for international trade. Transport costs are introduced in the convenient 'iceberg' from; $g_{c't}(z_c)$ units must be shipped from country c for 1 unit to arrive in country c'; $g_{ct}(z_c) = 1$, $\forall_c$.

6. Tariffs: $\tau_{c't}(z_c) - 1$ is the ad-valorem tariff imposed by country c' on imports of commodity z from country c; $\tau_{ct}(z_c) = 1$, $\forall_c$. Tariffs are rebated as a lump-sum to consumers.

B. Equilibrium

In equilibrium, consumers maximize utility, firms maximize profits and trade is balanced. Because of the assumption of perfect competition, prices (exclusive of tariffs and transport costs) are equal to marginal cost, $a_t(z_c)$. Consider the consumers in country 1, which will be a NAFTA country and for now we will call the US. Tariffs and transport costs raise the price paid by US consumers for goods imported from country c to $a_t(z_c)\, g_{1t}(z_c)\, \tau_{1t}(z_c)$. Let $T_{1t}(z)$ denote tariff revenue collected in the US on imports of commodity z, let Y_{1t} denote US income, and $q_{1t}^D(z_c)$ denote US consumption of commodity z produced in country c. US income is equal to the sum of firm revenues plus tariff revenue.[3]

$$T_{1t}(z) = \sum_c (\tau_{1t}(z_c) - 1)\, q_{1t}^D(z_c)\, a_t(z_c), \tag{5}$$

$$Y_{1t} = \int_0^1 a_t(z_1)\, q_t^S(z_1)\, dz + \int_0^1 T_{1t}(z)\, dz. \tag{6}$$

US consumers maximize utility subject to expenditure being equal to income in every period:

$$\sum_c q_{1t}^D(z_c)\, a_t(z_c)\, g_{1t}(z_c)\, \tau_{1t}(z_c) = b_1(z)\, Y_{1t}. \tag{7}$$

Differentiating the Lagrangian for the consumers' constrained optimization problem with respect to consumption levels of each commodity, we find that the tariff on imported goods causes domestic consumers to substitute towards domestically produced varieties. The amount of substitution depends on the level of the tariff and on the elasticity of substitution between varieties:

$$\forall z, \forall_c, \forall_t, \quad \frac{q_{1t}^D(z_c)}{q_{1t}^D(z_{c'})} = \left(\frac{\tau_{1t}(z_{c'})}{\tau_{1t}(z_c)}\right)^{\sigma_Z} \left(\frac{a_t(z_{c'})}{a_t(z_c)}\right)^{\sigma_Z} \left(\frac{g_1(z_{c'})}{g_1(z_c)}\right)^{\sigma_Z}. \tag{8}$$

[3]Revenue from firm sales will all accrue to factors of production (inputs), which are assumed to be domestically owned. Underlying factor markets are not modelled.

Equilibrium conditions for all other countries are symmetric, which will be exploited by the empirical work to control for the effect of unobserved movements in marginal cost that may be correlated with tariff movements. Finally, all commodity markets have to clear, taking into account output that melts in transit:

$$\forall z, \forall_c, \forall_t, \quad q_t^S(z_c) = \sum_{c'} q_{c't}^D(z_c)\, g_{c't}(z_c). \tag{9}$$

C. Empirical Strategy

(i) Demand Elasticity

I use Equation 8 to derive estimating equations for demand elasticities. Equivalent equations exist for every other country, specifically, let country 2 be the aggregate of the twelve countries that were always members of the EU for the sample period 1989-1999:

$$\forall z, \forall_c, \forall_t, \quad \frac{q_{2t}^D(z_c)}{q_{2t}^D(z_{c'})} = \left(\frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_c)}\right)^{\sigma_Z} \left(\frac{a_t(z_{c'})}{a_t(z_c)}\right)^{\sigma_Z} \left(\frac{g_{2t}(z_{c'})}{g_{2t}(z_c)}\right)^{\sigma_Z}. \tag{10}$$

Using Equations 8 and 10 we can eliminate the marginal cost terms:

$$\begin{aligned} \ln\frac{q_{1t}^D(z_c)}{q_{1t}^D(z_{c'})} - \ln\frac{q_{2t}^D(z_c)}{q_{2t}^D(z_{c'})} = {} & \sigma_z\left[\ln\frac{\tau_{1t}(z_{c'})}{\tau_{1t}(z_c)} - \ln\frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_c)}\right] \\ & + \sigma_z\left[\ln\frac{g_{1t}(z_{c'})}{g_{1t}(z_c)} - \ln\frac{g_{2t}(z_{c'})}{g_{2t}(z_c)}\right]. \end{aligned} \tag{11}$$

Elimination of the unobserved marginal cost terms is important because relative costs will shift following a trade liberalization. Equation 11 can be transformed into an equation for Cost including Insurance and Freight (CIF) import values, to match how EU trade data are collected:

$$\ln\frac{a_t.g_{1t}.q_{1t}^D(z_c)}{a_t.g_{1t}.q_{1t}^D(z_{c'})}-\ln\frac{a_t.g_{2t}.q_{2t}^D(z_c)}{a_t.g_{2t}.q_{2t}^D(z_{c'})}=\sigma_z\left[\ln\frac{\tau_{1t}(z_{c'})}{\tau_{1t}(z_c)}-\ln\frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_c)}\right]$$
$$+(\sigma_z-1)\left[\ln\frac{g_{1t}(z_{c'})}{g_{1t}(z_c)}-\ln\frac{g_{2t}(z_{c'})}{g_{2t}(z_c)}\right]. \quad (12)$$

So long as I only examine countries c and c' for which the EU does not change its relative tariffs, $\ln\frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_c)}$ is simply a commodity fixed effect. Since I do not have detailed transport cost data for EU trade, to identify σ_Z I assume that relative transport costs of shipping commodities to the US and the EU, $\ln\frac{g_{1t}(z_{c'})}{g_{1t}(z_c)}-\ln\frac{g_{2t}(z_{c'})}{g_{2t}(z_c)}$, is the sum of a commodity fixed effect, a year fixed effect and an error term that is orthogonal to US tariffs.[4] This produces the basic demand elasticity estimating Equation 13 based on CIF import values, where D_z and D_t are full sets of commodity and year dummies respectively, while $\varepsilon_{cc'z}$ is a random disturbance term:

$$\ln\frac{a_t.g_{1t}.q_{1t}^D(z_c)}{a_t.g_{1t}.q_{1t}^D(z_{c'})}-\ln\frac{a_t.g_{2t}.q_{2t}^D(z_c)}{a_t.g_{2t}.q_{2t}^D(z_{c'})}=D_z+D_t+\sigma_z\ln\frac{\tau_{1t}(z_{c'})}{\tau_{1t}(z_c)}+\varepsilon_{cc'z} \quad (13)$$

Now consider country c to be Canada or Mexico and country c' to be any other country. NAFTA's and CUSFTA's increase in the US tariff preferences for Canadian and Mexican goods, $\ln\frac{\tau_{1t}(z_{c'})}{\tau_{1t}(z_c)}$, will increase the share of those goods in US consumption relative to their share of EU consumption. The size of the increased share in an arbitrary industry z depends positively on the size of the increased US tariff preference, and positively on the elasticity of substitution σ between varieties of z.

The choice of EU as "country 2" to identify demand elasticities is of minor importance to the empirical analysis. The EU was chosen for two main reasons. Firstly, its detailed trade data has long been available electronically. Secondly, the European Union is a relatively large trading partner for the US, Canada and Mexico, which

[4]The assumption may not be completely innocuous. The most significant recent feature of international trade costs has been the relative decline in air-freight costs. This is likely to disproportionately benefit some commodities and some trade routes. See Hummels (1999) for a detailed examination of international trade costs.

maximizes the number of products that can be used to estimate demand elasticities and increases the precision of the estimates. The cost of choosing the EU as country 2 is that the EU is excluded from the list of control countries c'. This means that the paper does not directly use some of the substitution between the output of NAFTA countries and EU output to identify demand elasticities. For transparency purposes I also report estimates obtained using all trade involving NAFTA countries or EU countries, including trade between EU members, but note that relative EU tariffs $\ln \frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_c)}$ are no longer a commodity fixed effect.

(ii) Supply Elasticity

In Equation 1 the marginal cost of producing a commodity in country c was allowed to increase with the quantity produced in that country. NAFTA countries may face an elasticity of supply that is less than infinite, so that demand shifts caused by preferential trade liberalization affect equilibrium prices. These price changes are an important ingredient of welfare analysis and it is necessary to estimate how prices respond to preferential trade liberalization. The mean supply elasticity can be estimated in a manner that mostly utilizes very detailed price and quantity data for US imports. Taking Equation 1 and noting that $q_t^S(z_c) = \sum_j q_{jt}^S(z_c)$:

$$\ln a_t(z_c) = \eta(z_c)\left[-\ln \frac{q_{1t}^S(z_c)}{\sum_j q_{jt}^S(z_c)} + \ln q_{1t}^S(z_c)\right] + \widehat{P}_{ct} + D_{ct} + D_{cz} + \varepsilon_{czt} \tag{14}$$

where $\frac{q_{1t}^S(z_c)}{\sum_j q_{jt}^S(z_c)}$ is the share of Country c's output of z_c that is exported to the US, $\eta(z_c)$ is the inverse supply elasticity, D_{ct} and D_{cz} are full sets of country-by-year dummies and country-by-product dummies, and ε_{czt} are random supply shocks. The aggregate price index $\widehat{P}_{ct}$ is absorbed by the fixed effects D_{ct}. Tariff-line level data (15,000 commodities) exists for supply prices $a_t(z_c)$ and quantities $q_{1t}^S(z_c)$ supplied to the US. I estimate the share of Country c's output of z_c that is exported to the US at the HS 6-digit level (5000 commodities). The World Bank's WITS database contains bilateral trade data for most countries at the HS 6-digit level for some years between 1989-1999 (depending on reporting country). For each available reporting country and year, I extract the share of their exports of each HS 6-digit product that are exported to the US. I then multiply this by the fraction of each reporting country's GDP that is exported to estimate the required share. The parameter $\eta(z_c)$ can be identified using tariffs as an instrument since, for a given supply price $a_t(z_c)$, tariffs shift demand. This can be seen from the demand equation. From the model's CES demand assumption, demand for product z_c is given by:

$$\ln q_{1t}^{D}(z_c) = -\sigma_z \ln a_t(z_c) - \sigma_z \ln \tau_{1t}(z_c) - \sigma_z \ln g_{1t}(z_c) + (\sigma_z - 1) \ln \widehat{P}_{1tz} + \ln b_1(z) Y_{1t} \tag{15}$$

where $\widehat{P}_{1tz}$ is the ideal price index for commodity z in the US:

$$\widehat{P}_{1tz} = \left[\sum_c (a_t . g_{1t} . \tau_{1t}(z_c))^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{16}$$

Any change in tariffs imposed by the US on imports of product z from any source will shift the demand curve for z_c, because the tariff changes shift either $\tau_{1t}(z_c)$, the price index $\widehat{P}_{1tz}$ or both. These movements in the demand curve identify the supply curve.

3 Data Description

(i) International trade data

International trade data for almost all of the world is now collected according to the Harmonized System (HS), a schedule that is standard across countries at the 6-digit level, or approximately 5,000 commodities. Most of this data is available from the World Bank's WITS database. For some key countries I use more complete national sources of data. The US International Trade Commission (USITC) maintains a database at the 10-digit level (15,000 commodities) of US imports classified by commodity, country of origin, import program, month and port of arrival. Eurostat and Statistics Canada maintain similar databases for the EU and Canada.

For the purposes of Figures 2 to 4C it is useful to keep a balanced panel of products. Changes in HS commodity classifications lead to some attrition, but I am able to track US and EU trade in 4,655 6-digit commodities annually from 1989 to 2000. Because Canada entered into CUSFTA with the US in 1989, it is useful to collect data for earlier years. Prior to 1989, US trade data was collected according to a different commodity schedule, the TSUSA. Concordances are available for this data, but revisions to the TSUSA also lead to attrition. I am able to track 4,483 commodities continuously from 1988 to 2000, and 3,592 from 1980 to 2000.

The data also contains information on physical quantities imported for most commodities, allowing the calculation of unit price variables. I estimate supply elasticities using these prices.

(ii) Tariff Data

Tariff data is also collected from both national sources and the World Bank's WITS database. Tariff data is based on either tariff schedules or detailed data on import duties collected. US tariff schedules for the years 1997 to the current year are available from the USITC. I extracted US tariff data for 1989 to 1996 from USITC files.[5] US tariffs are almost invariably set at the HS 8-digit level (10,000 commodities). While most tariffs are ad-valorem, there are still several hundred specific tariffs applied. The USITC calculates the ad-valorem equivalent of any specific tariffs. The distribution of US MFN tariffs in 1999 is illustrated in Figure 5A. The simple average of tariff rates is low at 5.2 percent, but importantly there is a large amount of dispersion, with the standard deviation of MFN tariff rates being 12 percent. Under NAFTA, all but a couple hundred of these tariffs have been eliminated for Canada and are in the process of being eliminated for Mexico, creating a large variation in the preference given to goods of Canadian or Mexican origin (Figure 5B). Table 1 shows that much of this variation occurs within fine product classifications. Table 1 reports the percentage of the variance of US MFN tariff rates and tariff preferences for Canada and Mexico at the tariff-line level that can be explained by full sets of dummy variables for broader industry classifications. Much of the tariff variation remains unexplained by these variables, therefore existing industry-level studies of NAFTA ignore most of the tariff variation.

[5] This data was made available by Feenstra, Romalis and Schott (2002).

Preferential treatment for some goods existed prior to CUSFTA/NAFTA. In 1965, Canada and the US negotiated the Auto-Pact, allowing duty-free trade in many automotive goods. The Auto Pact was incorporated into CUSFTA. Mexico was a beneficiary of the Generalized System of Preferences (GSP), under which the US (and other developed countries) gave developing countries preferential access to their markets. The US gave duty free access to the output of developing countries for several thousand HS 8-digit commodities, although goods where developing countries may have gained most from preferential access were often excluded (notably many agricultural items and textiles, clothing and footwear), and the preference could be removed under "competitive needs limitations" to the GSP. Details of the Auto Pact and GSP program are included in the tariff schedules. Although the US engaged in some fine tuning of the GSP program, there are only two changes that affected a significant amount of US trade during the sample period. The first was the expulsion ("graduation") of Hong Kong, Korea, Singapore and Taiwan from the scheme at the end of 1988. This can be accommodated by dropping either pre-1989 data or these four countries from the analysis - I drop the pre-1989 data.[6] The second change was that upon entry into NAFTA, Mexico was no longer entitled to claim GSP benefits for trade with the US.

Tariffs are aggregated from the HS 8-digit level to the 6-digit level in two different ways: by taking simple averages; or by taking trade weighted averages. There are several limitations to using tariff schedules to calculate tariffs. One limitation is the effect of the maquiladoras on Mexican exports to the US. Under 'production sharing' provisions US duty does not have to be paid on the US sourced content of many exports to the US, while the full value of those transactions is recorded in US trade data. Mexico will also not collect duty on many intermediate inputs that are destined to be exported. Tariff schedules will therefore often overstate the NAFTA preferences. A second limitation of the tariff schedule is that preferential tariff arrangements are often circumscribed by restrictive rules of origin that need to be satisfied to qualify for the tariff preference. To partly address these limitations I also calculate tariffs using data on actual import duty paid. The drawback of this approach is that tariff

[6] There is a detailed concordance between the 1988 and 1989 US data detailing the change in trade and tariff schedules. I considered that keeping a broader set of comparison countries was more important than keeping an extra year of data. The substitution elasticity estimates are not very sensitive to this choice.

rates can only be observed when there is trade. Where there is no trade, I revert to the tariff schedule for that item. This alternative set of 8-digit "applied" tariffs are also aggregated to the 6-digit level using simple averages and trade weighted averages. This gives a total of four measures of tariffs at the HS 6-digit level.

Quantitative restrictions on imports of many textile, clothing and footwear commodities under the Multi-Fibre Agreement (MFA) and of many agricultural commodities provide a further complication. Many of these restrictions are binding, although a large number are not (Carolyn Evans and James Harrigan, 2003). They are extremely difficult to account for, since many restrictions encompass many HS commodities and most apply bilaterally. The existence of binding quotas will tend to bias downwards the estimated substitution elasticities. Eliminating commodities subject to quotas did not, however, lead to higher substitution elasticity estimates.

The preferences given to Canadian and Mexican production are systematically related to some of the characteristics of the commodities. This is evident from Figures 3A to 4C showing a systematic negative relationship between the preference and Canada's and, to a lesser extent, Mexico's share of US imports. Canadian and, to a lesser extent, Mexican tariffs are strongly correlated with US tariffs.[7] Given that the most protected sectors are agriculture and simple manufactures like textiles, apparel and footwear, the highest preferences are mostly in these sectors, subject to the existence of quantitative restrictions. The NAFTA preferences are biased towards commodities in which developed countries have a comparative disadvantage. This effect can also be seen in price data in Tables 2A to 2C. The relative price of Canadian and US goods is usually substantially higher in commodities where there are large tariff preferences under NAFTA. This suggests that NAFTA may have caused an expansion of North American production of commodities for which North America is a relatively high cost producer.

Data on Canadian import duties charged is collected for all years and products by Statistics Canada. The ad-valorem component of tariff schedules is also available for most years for many countries, including Canada and Mexico, from the World Bank's WITS database. Canadian tariff data is aggregated to the 6-digit level in the same

[7]The simple correlations of HS 6-digit tariffs is 0.5 for the US and Canada, 0.25 between the US and Mexico, and 0.35 between Canada and Mexico.

way as US tariff data. Mexican trade data is only available at the 6-digit level in the WITS database, so Mexican tariffs were aggregated to the 6-digit level by taking simple averages. I can therefore estimate demand elasticities using the imports of each of the NAFTA partners.

4 Results

A. Demand Elasticity

The mean elasticity of substitution is estimated using Equation 13 and setting $\sigma_z = \sigma$ for all commodities. There is insufficient tariff variation to obtain meaningful substitution elasticity estimates for detailed industries. To recapitulate, $a_t.g_{1t}.q_{1t}^D(z_c)$ is the CIF value of US imports of commodity z from country c at time t; $a_t.g_{2t}.q_{2t}^D(z_c)$ is the CIF value of EU imports of commodity z from country c at time t; $\tau_{1t}(z_c) - 1$ is the US ad-valorem tariff on imports of commodity z from country c at time t; D_z and D_t are full sets of commodity and year dummies respectively; and $\varepsilon_{cc'z}$ is a random disturbance term. The parameter σ is of interest because it is one of the key determinants of the effect of trade impediments on the volume of trade and because it is a critical ingredient of welfare analysis of trade liberalization.

I use HS 6-digit trade and tariff data from 1989-1999. Later years are omitted because the Mexico-EU free trade agreement commenced in 2000. Country c is alternatively Canada or Mexico, country c' is the aggregate of all countries that did not substantially change their preferential trade relations with either the US or the EU between 1989 and 1999. A list of these countries is provided in Appendix Table 1. A discussion of this aggregation appears in the Appendix. Four different measures of tariffs are used; depending on whether the tariff schedule or actual duty paid are used to calculate tariffs at the 8-digit level, and on whether tariffs were aggregated to the 6-digit level using simple averages or trade weights.

Results are reported in Tables 3A and 3B. Table 3A reports results based on changes in the destination of Canadian exports while Table 3B reports results based on the destination of Mexican exports.[8] The estimates of the mean elasticity of substitution range between 6.2 and 10.9 and are reasonably precisely estimated. Moving

[8] OLS estimates only are reported. Earlier drafts of this paper also reported GLS estimates that

across the columns, the estimates are slightly sensitive to the choice of tariff measure - the estimates using Canadian exports are lower when the tariff schedule is used. The estimates based on Mexican exports tend to be higher than those based on Canadian exports. The estimates are very similar whether the 'control' countries c' are limited to those listed in Appendix Table A1 or include all non-NAFTA countries. The estimates are similar in magnitude to elasticities estimated by Clausing (2001) and Head and Ries (2001).

These elasticities of substitution suggest that consumers are very willing to substitute between different sources of a commodity. One implication of this willingness to substitute is that small costs to international trade, whether due to natural barriers such as transport costs or artificial barriers such as tariffs, will have a large effect on trade volumes. With a substitution elasticity of 6, ignoring for a moment terms of trade effects, the median US tariff of 5.5 per cent will reduce consumption of imported varieties relative to domestic varieties by 27 per cent. With a substitution elasticity of 11, this reduction in relative consumption is 45 per cent. But on some products the effect of trade barriers will be much more dramatic; US tariffs range up to 350 per cent.

I also estimate Equation 13 using, alternately, Canada and Mexico as "Country 1". The trade and tariff data were obtained at the HS 6-digit level for Mexico and Canada from the World Bank's World Integrated Trade Solution (WITS) database, and at the tariff-line level for Canada from Statistics Canada. One caveat with these results is that the tariff schedules in the WITS database only include the ad-valorem component of tariffs, and are not available for all years.[9] This is not a severe limitation in the case of Canada, because Canadian data on duties collected are available for all years at the tariff-line level and these "applied" tariffs can also be used to estimate elasticities. Substitution elasticity estimates obtained using Canada's applied tariffs and reported in Tables 3C and 3D ranged from 5.0 to 5.5 when examining the destination of US exports and 7.2 to 8.1 when examining Mexican exports. The estimates obtained using Mexican tariff data and reported in Table 3E are much lower, at 2.0 to 2.5

sought to exploit the serial correlation of the disturbances and Heckman estimates that sought to model the missing observations. These estimates were very similar.

[9] Canadian tariff schedules for 1990-1992 and 1994 had to be estimated from surrounding years' data, as did Mexican tariff schedules for 1990, 1992-1994 and 1996.

when examining US exports and 0.6 to 0.8 when examining Canadian exports. These low estimates partly result from the greater measurement error in the Mexican tariff data, but may also result from a important force driving Mexican imports being the US tariff reductions on Mexican goods containing sufficient North American content, stimulating Mexican imports of components from the US and Canada.

B. Supply Elasticity

I estimate the mean inverse supply elasticity using Equation 14 and setting $\eta(z_c) = \eta$ for all products. I obtain both IV and OLS estimates using the most detailed US import price and quantity data available, the 10-digit level. Estimation of Equation 14 requires estimates of the share of Country c's output of z_c that is exported to the US. The World Bank's WITS database contains bilateral trade data for most countries at the HS 6-digit level for some years between 1989-1999 (depending on reporting country). For each available reporting country and year, I extract the share of their exports of each HS 6-digit product that are exported to the US. I then multiply this by the fraction of each reporting country's GDP that is exported to estimate the required share.

I use four tariff rates as instruments for the observed output quantity in Equation 14. Firstly, I use the US tariff rates on exports from Country c, Canada, Mexico and all other countries. Secondly, I only use the tariff rate on exports from Country c. An increase in this tariff will, conditional on the supply price, shift demand downwards. Thirdly, I omit the tariff rate on exports from Country c but include the other three tariff measures. An increase in these tariff rates will, conditional on the supply price and the tariff on exports from Country c, shift demand for z_c upwards. Tariffs are measured at the 10-digit level using data on duties paid. Where data on duties paid is not available, I use the tariff schedule.[10] I omit all products where there is a specific tariff, because a specific tariff generates a causal link from supply prices to the measured ad-valorem equivalent tariff.

Column 1 of Table 4 contains results where the four tariff rates are used as an instrument for quantity. I estimate the parameter η to be 0.29. This result suggests that supply to the US is fairly elastic, even for products z_c where the US consumes

[10] When the tariff schedule is used the MFN rate is used for the "all other countries" tariff measure.

most of the output. A shock to demand that causes a 1 percent increase in worldwide consumption of z_c will cause the supply price to increase by 0.29 percent. Column 2 reports the results when the tariff on exports from Country c is the only instrument. The estimate of η is unchanged at 0.29. Column 3 reports the results when the tariff on exports from Country c has been omitted from the set of instruments. The estimate of η is less precisely estimated and slightly lower at 0.22. Column 4 reports OLS results purely for inspection, they have no useful interpretation since OLS does not identify the supply curve.

With estimates of demand and supply elasticities at hand we now have the two essential parameters for welfare analysis of NAFTA.

C. Welfare and Trade Volume

With estimates of demand and supply elasticities it is possible to make tentative calculations of NAFTA's and CUSFTA's price and welfare effects without invoking the greatly simplifying "small country" assumption. I use the simple model in Section 2 of the paper. The model, while extremely parsimonious with parameters, will be applied to rich trade and tariff data. This calculation will be incomplete, but it will be consistent with the structure of the model and the estimated parameters. The strategy is to estimate the first-order welfare effects of CUSFTA and NAFTA on the USA, Canada, Mexico and the Rest Of the World ("ROW"). The important ingredients of that calculation are reported in this section, the details of that calculation and additional data requirements are left to the Appendix.

I estimate the effects of each trade agreement on the purchasing power of a country's output, holding output quantities constant. Nominal income is given by Equation 6, and the ideal price index corresponding to the utility function in Equation 2 is:

$$\widehat{P}_{ct} = \prod_{z} \left[\sum_{c'} \left(a_t . g_{ct} . \tau_{ct} \left(z_{c'} \right) \right)^{1-\sigma} \right]^{\frac{b_C(z)}{1-\sigma}} . \tag{17}$$

This measure will understate welfare because it will fail to account for a second-order effect from the reoptimization of production and factor supply following changes in relative prices. The calculations proceed in four steps. Firstly, I estimate how prices and quantities of each product respond to the tariff liberalization, keeping existing aggregate income constant. I then use product prices and industry price indexes to estimate expenditures on each country's goods and the change in aggregate incomes. These new aggregate incomes are then used to recalculate equilibrium product prices. This process is iterated until the estimated changes in prices and incomes are consistent with no change in each countries' trade balance. Welfare calculations are then performed.

(i) Equilibrium

From Equation 1, ignoring fixed effects and supply shocks, the inverse supply curve is:

$$\ln a_t(z_c) = \eta \ln\left(\sum_{c'} q^S_{c't}(z_c)\right) + \ln \widehat{P}_{ct} \tag{18}$$

Totally differentiating Equation 18 yields:

$$d\ln a_t(z_c) = \eta\left(\sum_{c'} s_{c't}(z_c)\, d\ln q^S_{c't}(z_c)\right) + d\ln \widehat{P}_{ct} \tag{19}$$

where $s_{c'}(z_c) = \frac{q^S_{c't}(z_c)}{\sum_j q^S_{jt}(z_c)}$ is simply the proportion of the output of z_c that is supplied to country c'. Totally differentiating the demand Equation 15 yields:

$$d\ln q^D_{c't}(z_c) = -\sigma d\ln a_t(z_c) - \sigma d\ln \tau_{c't}(z_c) - \sigma d\ln g_{c't}(z_c) + (\sigma-1) d\ln \widehat{P}_{c'tz} + d\ln Y_{c't} \tag{20}$$

In equilibrium, the change in demand due to NAFTA will equal the change in supply. Substituting $d\ln q^D_{c't}(z_c)$ from Equation 20 for $d\ln q^S_{c't}(z_c)$ in Equation 19 and ignoring transport costs (that I assume to be unchanged) yields how equilibrium supply prices $a_t(z_c)$ change in response to changed tariffs, industry price indexes $\widehat{P}_{c'tz}$ (defined in Equation 16), aggregate price indexes $\widehat{P}_{ct}$ and aggregate incomes:

$$d\ln a_t(z_c) = \frac{\eta}{1+\eta\sigma}[\sum_{c'} - s_{c'}(z_c)\,\sigma d\ln\tau_{c't}(z_c) + \sum_{c'} s_{c'}(z_c)\,(\sigma-1)d\ln\widehat{P}_{c'tz}$$
$$+\sum_{c'} s_{c'}(z_c)\,d\ln Y_{c't} + \frac{1}{\eta}d\ln\widehat{P}_{ct}] \tag{21}$$

Equation 21 together with Equations 16, 17 and 6 defining $\widehat{P}_{c'tz}$, $\widehat{P}_{ct}$ and $Y_{c't}$ form a non-linear system of equations involving hundreds of thousands of products. I make one modification to the system to make the general equilibrium not too computationally burdensome to solve numerically. I group all non-NAFTA countries into the aggregate ROW. Although I treat the output of each country in the ROW as a separate product, I compute the change in the aggregate income for the ROW and price indexes $\widehat{P}_{c'tz}$ and $\widehat{P}_{ct}$ that are common to every country in the ROW.

The solution is obtained iteratively in four steps. Firstly, the change in tariffs under CUSFTA/NAFTA is inserted into Equation 21 to yield estimates of price changes of individual products $d\ln a_t(z_c)$. This only captures the 'proximate' effect of the tariff reductions on the price of output produced in NAFTA countries. In the second step these new prices are then used to construct the change in price indexes $d\ln\widehat{P}_{c'tz}$ and $d\ln\widehat{P}_{ct}$ using Equations 16 and 17. The change in these price indexes are then used in the third step to reestimate the price changes of individual goods using Equation 21. This time the prices of all goods in an industry are affected if there were any tariff changes in that industry. Iterating the second and third steps quickly leads to convergence of the individual goods prices and the price indexes. In the fourth step these new prices and price indexes are used to estimate the change in income $d\ln Y_{c't}$. I use the fact that in an equilibrium with an unchanged trade balance, the change in a country's income equals the change in expenditures on its output (net of taxes and transport costs) plus the change in taxes collected on imported goods. The change in quantities demanded are estimated by substituting the tariff reductions and the changes in goods prices, price indexes and aggregate incomes into Equation 20. Changed expenditures and trade taxes are then a simple function of the tariff reductions and the estimated price and quantity responses. Iterating the second through fourth steps leads to convergence in the estimates of goods prices, price indexes and national incomes. More details of solving for the change in equilibrium prices are in the Appendix.

(ii) Welfare and Trade Volume

The welfare decomposition for CUSFTA and NAFTA is summarized in Table 6. Increases in the real value of output of NAFTA members is offset by the decline in tariff revenue, leaving small welfare changes in this simple static model. To an extent the welfare result is not surprising, because the model omits many of the potential channels of welfare changes such as entry and exit of varieties, firm heterogeneity, scale economies, and factor accumulation. But the results also suggest that something about the agreements is not altogether wholesome - too much tariff revenue is being forgone for too small a reduction in the price index. In part this reflects the evidence that the biggest tariff preferences are being given on products where North American firms are not low-cost producers. In other words, there is too much trade diversion. On a less negative note the welfare effects for the aggregate ROW are also small.

So why the recent relative popularity of regional agreements? The effects of CUSFTA/NAFTA on the most protected sectors may provide part of the answer. The left panels of Figure 6 show the combined estimated effects of NAFTA and CUSFTA on output prices in 6-digit sectors where the MFN tariff exceeds 10 percent. The median highly-protected sector in the US and Canada appears to expand, though only slightly, while the median highly protected Mexican sector contracts slightly. It should be remembered that these calculations will not account for the effects of more stringent rules of origin, which may further shore up the position of highly protected sectors (Krueger 1999). The reason why many protected sectors benefit is quite simple. The preferential tariff reductions are squeezing out imports from non-member countries in many of these sectors, which on average drives up the price of North American supply. Since there is a high cross-product correlation in tariff rates in the US, Canada and, to a lesser extent, Mexico, there could be a large reduction in imports in these sectors.[11] This trade diversion is confirmed econometrically in the next subsection. If highly protected sectors do in fact benefit from NAFTA and CUSFTA,

[11]The simple correlations of HS 6-digit tariffs is 0.5 for the US and Canada, 0.25 between the US and Mexico, and 0.35 between Canada and Mexico.

then this may make future multilateral liberalization in these sectors more difficult because the price effects of true free trade in these sectors will now be even larger. This is consistent with evidence on tariffs found in Limao (2003). By contrast the alternative of unilateral liberalization where the US, Canada or Mexico drop all their tariffs looks grim for highly-protected industries (Figure 6, right panels), though the price declines if the rest of the world also eliminated its tariffs would be smaller.

Trade volume effects are more substantial. CUSFTA causes a 5 percent increase in two way trade between Canada and the US. NAFTA causes an 23 percent increase in two way trade between Mexico and the US and a 24 percent increase between Mexico and Canada. Aggregate trade with the rest of the world is not greatly affected except for a 10 percent decline in trade between Mexico and the rest of the world. Declines in imports from the rest of the world in some highly-protected sectors is partly offset by increased imports elsewhere.

D. Econometric Confirmation of Trade Diversion

A concern raised by the welfare analysis was the role of trade diversion in reducing static welfare gains and, by often benefitting highly-protected sectors, potentially making multilateral liberalization harder. Trade data enables a direct search for this trade diversion. Consider the value of exports of commodity z from a non-NAFTA country c' to a NAFTA country and to the EU, grossed up for transport costs and tariffs. From the CES demand assumption:

$$\ln \frac{a_t . g_{1t} . \tau_{1t} . q_{1t}^D (z_{c'})}{a_t . g_{2t} . \tau_{2t} . q_{2t}^D (z_{c'})} = -(\sigma - 1) \ln \frac{\tau_{1t} (z_{c'})}{\tau_{2t} (z_{c'})} - (\sigma - 1) \ln \frac{g_{1t} (z_{c'})}{g_{2t} (z_{c'})} + (\sigma - 1) \ln \frac{\widehat{P}_{1tz}}{\widehat{P}_{2tz}} + \ln \frac{b_1 (z) Y_{1t}}{b_2 (z) Y_{2t}} \tag{22}$$

where $\widehat{P}_{1tz}$ $\left(\widehat{P}_{2tz}\right)$ is the ideal price index of all sellers of commodity z in the NAFTA country (EU) inclusive of tariffs and transport costs. Trade diversion results from NAFTA because tariff reductions on North American output directly lower North American price indexes $\widehat{P}_{1tz}$, thereby depressing exports from other countries c' to North America. These tariff reductions also indirectly affect North American (and to a much lesser extent EU) price indexes by affecting the pre-tariff prices that suppliers charge in these markets. A regression of the log-difference between North American and EU imports from the control countries on preferential and MFN tariffs should reveal trade diversion. In the absence of a closed-form solution for how prices respond to tariff changes I estimate the following equation:

$$\ln \frac{M_{1t}\left(z_{c'}\right)}{M_{2t}\left(z_{c'}\right)} = \beta_1 \ln \tau_{US,t}\left(z_{Can}\right) + \beta_2 \ln \tau_{US,t}\left(z_{Mex}\right) + \beta_3 \ln \tau_{Can,t}\left(z_{US}\right) + \beta_4 \ln \tau_{Can,t}\left(z_{Mex}\right)$$
$$+\beta_5 \ln \tau_{Mex,t}\left(z_{US}\right) + \beta_6 \ln \tau_{Mex,t}\left(z_{Can}\right) + \beta_7 \ln \tau_{US,t}\left(z_{MFN}\right) + \beta_8 \ln \tau_{Can,t}\left(z_{MFN}\right)$$
$$+\beta_9 \ln \tau_{Mex,t}\left(z_{MFN}\right) + \beta_{10} \ln \tau_{EU,t}\left(z_{MFN}\right) + D_z + D_t + \varepsilon_{zt} \tag{23}$$

where $M_{1t}\left(z_{c'}\right)$ $\left(M_{2t}\left(z_{c'}\right)\right)$ are North American (EU) imports of product z from the control countries c' measured on a CIF basis (since EU trade data inclusive of actual tariffs paid is unavailable) and the explanatory variables are preferential and MFN tariffs. For example, $\tau_{US,t}\left(z_{Can}\right)$ is the US tariff on product z imported from Canada plus one, and $\tau_{US,t}\left(z_{MFN}\right)$ is the US MFN tariff on product z plus one. I assume that relative transport costs $\ln \frac{g_{1t}(z_{c'})}{g_{2t}(z_{c'})}$ and relative expenditures $\ln \frac{b_1(z)Y_{1t}}{b_2(z)Y_{2t}}$ are captured by full sets of product and year fixed effects and a disturbance term that is orthogonal to the tariffs. The sum of the coefficients on the preferential tariffs (β_1 to β_6) gives some idea about how trade from non-member countries is diverted as a result of NAFTA, as it reveals the decline in exports from the control countries to North America relative to the EU that results from a 1 percent reduction in intra-North American tariffs. The results in Table 5 provide strong evidence that NAFTA/CUSFTA have been trade diverting. Every 1 percent reduction in intra-North American tariffs causes a 2.8 to 3.9 percent decline in exports from c' to North America relative to the EU when c' includes only the Appendix Table A1 countries, and a 1.3 to 2.2 percent decline if c' includes all non-NAFTA countries. Therefore imports into North America tend to decline in highly-protected sectors following NAFTA, with the implication that the price and quantity of North American output tends to rise in these sectors.

Trade diversion has not been found in existing econometric studies of NAFTA, and the finding of trade diversion is in stark contrast to Clausing, who has reasonably precise estimates suggesting no trade diversion. Clausing regresses growth rates of US imports from the rest of the world on the CUSFTA trade preferences, and finds no correlation. The likely reason for this is that rapid growth of emerging market manufacturing exports in the 1980's and 1990's led to substantial growth of US imports of the simple manufactures that these countries excelled at producing. The CUSFTA trade preferences tend to be high on these products. Trade diversion may have been masked by the rapid growth in imports that would have occurred in the absence of CUSFTA. The specification in this paper essentially uses EU trade data to eliminate the bias caused by that correlation.

5 Conclusion

This paper uses detailed world-wide trade data to identify the effects of NAFTA and CUSFTA on international trade. It develops a difference in differences based method to identify demand elasticities using the tariff changes by focusing on where NAFTA members and the European Union source their imports of different commodities from. It identifies supply elasticities using tariffs as instruments for observed quantities. NAFTA and CUSFTA have had a substantial effect on international trade quantities, but less effect on prices and welfare in member and non-member countries. Intra-North American trade increased most rapidly in commodities where the greatest trade preferences were conferred, even though Canada and the US appear to be high cost producers of many of these commodities. The share of EU imports of the same commodities coming from North America declined. Welfare calculations using the estimated parameters and the paper's simple static model suggest almost zero welfare impact on member and non-member countries. Of some concern is the possibility that NAFTA and CUSFTA actually increased North American output and prices in many highly-protected sectors by driving out imports from non-member countries. This development might make future multilateral trade liberalization more difficult because it magnifies the price and output decline these sectors would experience following MFN tariff reductions.

6 Appendix

A. Aggregation

Demand elasticity estimates where the control countries are not aggregated are provided in Appendix Table 2. Applied tariffs are used for this table where available because they capture more nuances of trade policy. The estimates are mostly but not always lower than their counterparts reported in the main tables. The reason for aggregating "control countries" for estimating the demand elasticity is to avoid the elasticity estimates being driven by movements in a very large number of very thin trading relationships. This is much less of a concern for estimating supply elasticities since these are identified from movements in production rather than trade - there are fewer very small observations. The demand elasticity can still be identified from preferential tariff reductions when aggregating across countries and persisting with the assumption that each country produces a distinct variety. From the CES demand assumption, US demand for product z from the aggregate of the control countries c' relative to US demand for product z from country c is given by:

$$\frac{\sum_{c'} q_{1t}^{D}\left(z_{c'}\right)}{q_{1t}^{D}\left(z_{c}\right)}=\sum_{c'}\left(\frac{\tau_{1t}\left(z_{c'}\right)}{\tau_{1t}\left(z_{c}\right)}\right)^{-\sigma_Z}\left(\frac{a_{t}\left(z_{c'}\right)}{a_{t}\left(z_{c}\right)}\right)^{-\sigma_Z}\left(\frac{g_{1}\left(z_{c'}\right)}{g_{1}\left(z_{c}\right)}\right)^{-\sigma_Z} \tag{24}$$

The equivalent equation for relative EU demand is:

$$\frac{\sum_{c'} q_{2t}^{D}\left(z_{c'}\right)}{q_{2t}^{D}\left(z_{c}\right)}=\sum_{c'}\left(\frac{\tau_{2t}\left(z_{c'}\right)}{\tau_{2t}\left(z_{c}\right)}\right)^{-\sigma_Z}\left(\frac{a_{t}\left(z_{c'}\right)}{a_{t}\left(z_{c}\right)}\right)^{-\sigma_Z}\left(\frac{g_{2}\left(z_{c'}\right)}{g_{2}\left(z_{c}\right)}\right)^{-\sigma_Z} \tag{25}$$

Taking the log difference between relative US and EU demand:

$$\ln \frac{q_{1t}^{D}\left(z_{c}\right)}{\sum\limits_{c'} q_{1t}^{D}\left(z_{c'}\right)} - \ln \frac{q_{2t}^{D}\left(z_{c}\right)}{\sum\limits_{c'} q_{2t}^{D}\left(z_{c'}\right)} = \sigma_{z}\left[\ln \tau_{2t}\left(z_{c}\right) - \ln \tau_{1t}\left(z_{c}\right)\right]$$

$$+\sigma_{z}\left[\ln g_{2t}\left(z_{c}\right) - \ln g_{1t}\left(z_{c}\right)\right] \tag{26}$$

$$- \ln \left[\frac{\sum\limits_{c'} \tau_{1t}\left(z_{c'}\right)^{-\sigma_Z} a_{t}\left(z_{c'}\right)^{-\sigma_Z} g_{1}\left(z_{c'}\right)^{-\sigma_Z}}{\sum\limits_{c'} \tau_{2t}\left(z_{c'}\right)^{-\sigma_Z} a_{t}\left(z_{c'}\right)^{-\sigma_Z} g_{2}\left(z_{c'}\right)^{-\sigma_Z}}\right] \tag{27}$$

The demand elasticity could be identified off US and EU tariff changes on the output of country c, but if we aggregated control countries c' into groups that are subject the same tariffs by the US and to the same tariffs by the EU (though the US and EU tariffs may differ) then Equation 27 gets much closer to the estimating equation. For example, for a set of countries c' given MFN treatment but not preferential treatment by both the US and the EU, Equation 27 becomes:

$$\ln \frac{q_{1t}^{D}\left(z_{c}\right)}{\sum\limits_{c'} q_{1t}^{D}\left(z_{c'}\right)} - \ln \frac{q_{2t}^{D}\left(z_{c}\right)}{\sum\limits_{c'} q_{2t}^{D}\left(z_{c'}\right)} = \sigma_{z}\left[\ln \frac{\tau_{1t}\left(z_{c'}\right)}{\tau_{1t}\left(z_{c}\right)} - \ln \frac{\tau_{2t}\left(z_{c'}\right)}{\tau_{2t}\left(z_{c}\right)}\right]$$

$$+\sigma_{z}\left[\ln g_{2t}\left(z_{c}\right) - \ln g_{1t}\left(z_{c}\right)\right] \tag{28}$$

$$- \ln \left[\frac{\sum\limits_{c'} a_{t}\left(z_{c'}\right)^{-\sigma_Z} g_{1}\left(z_{c'}\right)^{-\sigma_Z}}{\sum\limits_{c'} a_{t}\left(z_{c'}\right)^{-\sigma_Z} g_{2}\left(z_{c'}\right)^{-\sigma_Z}}\right] \tag{29}$$

The demand elasticity can again be identified off the preferential tariff reductions and relative EU tariffs $\ln \frac{\tau_{2t}(z_{c'})}{\tau_{2t}(z_{c})}$ are simply product fixed effects as before. Note however that unobserved production costs in the control countries do not entirely disappear and might not be entirely captured by fixed effects if iceberg transport costs change. Most trade between the control countries in Appendix Table 1 and the US and the EU is conducted on an MFN basis. This is not true when "All" countries are used as the control, since intra-EU trade is not conducted on an MFN basis.

B. Solving Industry Equilibrium Prices

The effect of one country's tariff reductions on the supply price of each variety of z, $a_t(z_c)$, and on the price index for all varieties of z was solved iteratively at the HS 6-digit level (5000 commodities). The solution is aided by the price index for industry z in country c', $\widehat{P}_{c'tz}$, having a convenient representation in terms of relative consumption shares when it is normalized by the price of any variety of z. Dividing the price index for product z in Equation 16 by the price of country c''s output of $z_{c'}$ yields:

$$\frac{\widehat{P}_{c'tz}}{a_t(z_{c'})} = \left[\sum_c \left(\frac{a_t.g_{c't}.\tau_{c't}(z_c)}{a_t(z_{c'})}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{30}$$

Under the model's assumptions, all of the elements of this normalized price index other than σ are data. The term $\left(\frac{a_t.g_{c't}.\tau_{c't}(z_c)}{a_t(z_{c'})}\right)^{1-\sigma}$ is simply the share of Country c''s consumption of z that comes from Country c divided by the share that comes from Country c'. This is simply a combination of trade and production data. Let time t and t' denote the pre- and post-liberalization periods respectively. The new price index (normalized by the old price of $z_{c'}$) is a weighted sum of the new tariffs and the new supply prices induced by those tariffs[12]:

$$\frac{\widehat{P}_{c't'z}}{a_t(z_{c'})} = \left[\sum_c \left(\frac{a_t.g_{c't}.\tau_{c't}(z_c)}{a_t(z_{c'})}\right)^{1-\sigma} \left(\frac{a_{t'}\tau_{1t'}(z_c)}{a_t\tau_{1t}(z_c)}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{31}$$

where the weights $\left(\frac{a_t.g_{c't}.\tau_{c't}(z_c)}{a_t(z_{c'})}\right)^{1-\sigma}$ are observable data from the pre-liberalization period. The first step is to calculate the initial impact of the tariff reductions on output prices in the US, Canada and Mexico. Using Equation 21 this impact is:

$$d\ln a_t(z_c) = \frac{\eta}{1+\eta\sigma}\sum_{c'}\left(-s_{c'}(z_c)\,\sigma d\ln\tau_{c't}(z_c)\right) \tag{32}$$

[12]Transport costs are assumed to be invariant to the tariffs and the quantities supplied.

The second step is to use the new tariffs and prices of NAFTA-country output to compute the change in industry price indexes using Equation 31. The change in the aggregate price indexes $\widehat{P}_{ct}$ is estimated from the changes in the industry price indexes using Equation 17, where the expenditure weight $b_c(z)$ is estimated consumption of z in each country or country group c divided by that country's GDP. The estimated change in the price indexes can be inserted into Equation 33 to solve for new supply prices of every variety:

$$d\ln a_t(z_c) = \frac{\eta}{1+\eta\sigma}\sum_{c'}\left(-s_{c'}(z_c)\,\sigma d\ln\tau_{c't}(z_c) + s_{c'}(z_c)(\sigma-1)d\ln\widehat{P}_{c'tz}\right) + \frac{d\ln\widehat{P}_{ct}}{1+\eta\sigma} \tag{33}$$

These prices are in turn used to recalculate all price indexes. The price estimates converge after a few iterations. I then use the fact that in an equilibrium with an unchanged trade balance, the change in a country's income equals the change in expenditures on its output (net of taxes and transport costs) plus the change in taxes collected on imported goods. The change in quantities demanded are estimated by substituting the tariff reductions and the changes in goods prices and price indexes into Equation 20. Changed quantities and prices give changed expenditures on each country's output. Changed tariff revenue is calculated using the tariff reductions and the estimated price and quantity responses. The change in aggregate incomes can be inserted into Equation 34 to solve for new supply prices of every variety:

$$\begin{aligned} d\ln a_t(z_c) = {} & \frac{\eta}{1+\eta\sigma}\sum_{c'}(-s_{c'}(z_c)\,\sigma d\ln\tau_{c't}(z_c) + s_{c'}(z_c)(\sigma-1)d\ln\widehat{P}_{c'tz} \\ & + s_{c'}(z_c)\,d\ln Y_{c't}) + \frac{d\ln\widehat{P}_{ct}}{1+\eta\sigma} \end{aligned} \tag{34}$$

These prices are in turn used to recalculate the price indexes and aggregate incomes. This process is iterated until the estimated changes in prices and aggregate incomes generate no change in the trade balance.

C. Additional Data Description for Model Solution

Data is for the year preceding each trade agreement unless unavailable, in which case the closest year is used. The tariff data used for the US and Canada are applied tariffs because they are conveniently arranged with the trade data in the Feenstra database of US trade data and the Canadian trade data from Statistics Canada and because they capture more nuances of trade policy than the tariff schedules alone. Tariff schedules are used for Mexico because applied tariffs are unavailable.

$s_c(z_c)$: important data for the model are the shares of each country's output of each product that are consumed domestically. Production data for US manufacturing sectors is from the NBER Productivity Database and was merged with US import and export data at the 4-digit SIC level produced by Feenstra (1996, 1997). US consumption of US output by industry is calculated as US shipments less US exports. The estimates of $s_c(z_c)$ for the US from the SIC data are applied to every 6-digit HS code that falls within a 4-digit SIC code. Where a 6-digit HS code maps into more than one SIC code, I use 10-digit HS import data for the US to select the SIC code that matches the largest amount of trade at the 6-digit level.[13] The equivalent production, import and export data for US non-manufacturing sectors and for Canada and Mexico at the 2-4-digit ISIC level (depending on product) came from the OECD's STAN database and the estimates of $s_c(z_c)$ are mapped into HS 6-digit codes using a concordance provided by Mary Amiti of the IMF. $s_c(z_c)$ for other countries is estimated simply as the share of each country's GDP that is not exported to North America (other countries are combined into the "ROW").

$s_{c'}(z_c)$: the share of each country's output of each product that is consumed by other countries is calculated using trade data and the estimates of $s_c(z_c)$. $s_{c'}(z_c)$ is simply the share of each product that is exported multiplied by the share of exports that go to country c':

$$(1 - s_c(z_c)) \frac{q_{c't}(z_c)}{\sum\limits_{c' \neq c} q_{c't}(z_c)} \tag{35}$$

[13]The 10-digit import data for the US includes a concordance to (import based) SIC.

The export shares come from the World Bank's WITS database at the HS 6-digit level.

Production at the HS 6-digit level is estimated as exports at the HS 6-digit level from the WITS database divided by the coarser estimates of the share of each product that is exported $(1 - s_c(z_c))$. Consumption at the HS 6-digit level is imports minus exports from the WITS database plus estimated production.

$b_c(z)$: expenditure weights in the utility functions for each country or country group, $b_c(z)$, is simply the consumption in country c of each HS 6-digit product (regardless of source) divided by the GDP of that country from the World Bank's World Development Indicators.

I set the value of σ at 6 which is close to the median estimate. Higher values of σ lead to a greater trade volume response but have a small effect on welfare estimates. The inverse supply elasticity η is taken from the more precisely estimated values in Table 4 of 0.29.

D. Caveat on Model Results for Mexico

Mexican tariff schedules overstate tariff collection due to duty exemptions for Maquiladoras. The model therefore overpredicts the decline in Mexican tariff revenues (which according to the World Bank World Development Indicators were just over 1 percent of GDP in 1993), overpredicts the decline in the Mexican price index, and overpredicts the increase in the real value of pre-NAFTA output. Without detailed applied tariff data this can only be addressed with an ad-hoc adjustment to Mexican tariffs which I have not made. The impact of this caveat on other countries is very limited. The change in trade resulting from NAFTA is also overstated, but by less since much of the increase in trade is driven by US tariff reductions which are much more accurately measured.

References

[1] Armington P. (1969), "A Theory of Demand for Products Distinguished by Place of Production", *IMF Staff Papers* 16 (March), pp.159-78.

[2] Arndt, Sven W. (2003), "Global Production Sharing Networks and Regional Integration", *mimeo*, Claremont McKenna College.

[3] Bagwell K. and R. Staiger (1999), "An Economic Theory of GATT", *American Economic Review*, Vol. 89, No.1, pp.215-248.

[4] Baldwin R. (1996), "A Domino Theory of Regionalism", in Baldwin R., P. Haaparanta and J. Kiander eds., *Expanding the Membership of the EU*, Cambridge University Press.

[5] Baldwin R.E. and A. J. Venables (1995), "Regional Economic Integration", in Grossman G.M. and K. Rogoff eds., *Handbook of International Economics*, Volume 3, North-Holland.

[6] Brown D.K., A.V. Deardorff and R.M. Stern (1995), "Estimates of a North American Free Trade Agreement", in Kehoe P.J. and Kehoe T.J. (eds.), *Modeling North American Integration*, Kluwer Academic Publishers, Dordrecht.

[7] Chang, Won and L. Alan Winters (2002), "How Regional Blocs Affect Excluded Countries: The Price Effects of MERCOSUR", *American Economic Review*, 92(4), pp.889-904.

[8] Clausing K. A. (2001), "Trade Creation and Trade Diversion in the Canada-United States Free Trade Agreement", *Canadian Journal of Economics*, 34(3), August 2001, pp.677-696.

[9] Cox D.J. (1995), "An Applied General Equilibrium Analysis of NAFTA's Impact on Canada", in Kehoe P.J. and Kehoe T.J. (eds.), *Modeling North American Integration*, Kluwer Academic Publishers, Dordrecht.

[10] Deardorff A. and R. Stern (1994), "Multilateral Trade Negotiations and Preferential Trading Arrangements" in A. Deardorff and R. Stern (eds), *Analytical and Negotiating Issues in the Global Trading System*, The University of Michigan Press, Ann Arbor.

[11] Evans, Carolyn L. and James Harrigan (2003); "Tight Clothing: How the MFA Affects Asian Apparel Exports", NBER Working Paper No. 10250, January 2003.

[12] Feenstra Robert C., John Romalis and Peter K. Schott (2002); "U.S. Imports, Exports, and Tariff Data, 1989-2001", NBER Working Paper No. 9387, December

2002.

[13] Frankel J., E. Stein and S. Wei (1996), "Improving the Design of Regional Trade Agreements. Regional Trading Arrangements: Natural or Supernatural?", *AEA Papers and Proceedings*, Vol. 86, No. 2, pp.52-56.

[14] Fukao K., T. Okubo, and R.M Stern (2003), "An Econometric Analysis of Trade Diversion under NAFTA", *North American Journal of Economics and Finance*, 14(1), March 2003, pp.3-24.

[15] Garces-Diaz D. (2001), "Was NAFTA Behind the Mexican Export Boom (1994-2000)?", mimeo (on SSRN), Banco de Mexico, February.

[16] Gould D. (1998), "Has NAFTA Changed North American Trade?", *Federal Reserve Bank of Dallas Economic Review*, First Quarter, pp.12-22.

[17] Head K. and J. Ries (1999), "Rationalization effects of tariff reductions", *Journal of International Economics*, Vol. 47(2), pp.295–320.

[18] Heckman J. (1976), "The common structure of statistical models of truncation, sample selection, and limited dependent variables and a simple estimator for such models", *The Annals of Economic and Social Measurement*, Vol. 5, pp.475-492.

[19] Hufbauer G. and J. Schott (1993), *NAFTA: An Assessment*, (Washington DC, Institute for International Economics).

[20] Hummels D. (1999), "Have International Trade Costs Declined?", mimeo.

[21] Kehoe P.J. and Kehoe T.J. (1995), "Capturing NAFTA's Impact with Applied General Equilibrium Models", in Kehoe P.J. and Kehoe T.J. (ed.), *Modeling North American Integration*, Kluwer Academic Publishers, Dordrecht.

[22] Kehoe, Timothy J. and Kim J. Ruhl (2002), "How important is the New Goods Margin in International Trade?", *mimeo*, University of Minnesota, October 2002.

[23] Kemp M. and H. Wan (1976), "An Elementary Proposition Concerning the Formation of Customs Unions", *Journal of International Economics*, Vol. 6, pp.95-97.

[24] Krueger A. (1999), "Trade Creation and Trade Diversion Under NAFTA", NBER Working Paper No. 7429.

[25] Krueger A. (2000), "NAFTA's Effects: A Preliminary Assessment", *World Economy*, Vol. 23, No.6, pp.761-75.

[26] Levy P. (1997), "A Political-Economic Analysis of Free-Trade Agreements", *American Economic Review*, Vol. 87, No.4, pp.506-519.

[27] Limao Nuno (2003), "Preferential Trade Agreements as Stumbling Blocks for

Multilateral Trade Liberalization: Evidence for the U.S.", mimeo, University of Maryland, June 2003.

[28] Sobarzo H.E. (1995), "A General Equilibrium Analysis of the Gains from NAFTA for the Mexican Economy", in Kehoe P.J. and Kehoe T.J. (eds.), *Modeling North American Integration*, Kluwer Academic Publishers, Dordrecht.

[29] Trefler D. (2001), "The Long and Short of the Canada-U.S. Free Trade Agreement", mimeo (on SSRN), University of Toronto, April.

[30] Viner J. (1950), *The Customs Union Issue*, (New York: Carnegie Endowment).

[31] Wall H. (2000), "NAFTA and the Geography of North American Trade", mimeo (on SSRN), Federal Reserve Bank of St. Louis, November.

[32] Yeats A. (1997), "Does Mercosur's Trade Performance Raise Concerns about the Effects of Regional Trade Arrangements?", World Bank Policy Research Working Paper No. 1729.

[33] Office of the United States Trade Representative (1999), *U.S. Generalized System of Preferences Guidebook*, Executive Office of the President, Washington D.C., March 1999.

Figure 1: Preferential Trade Agreements in Force by Date Notified

Source: World Trade Organization

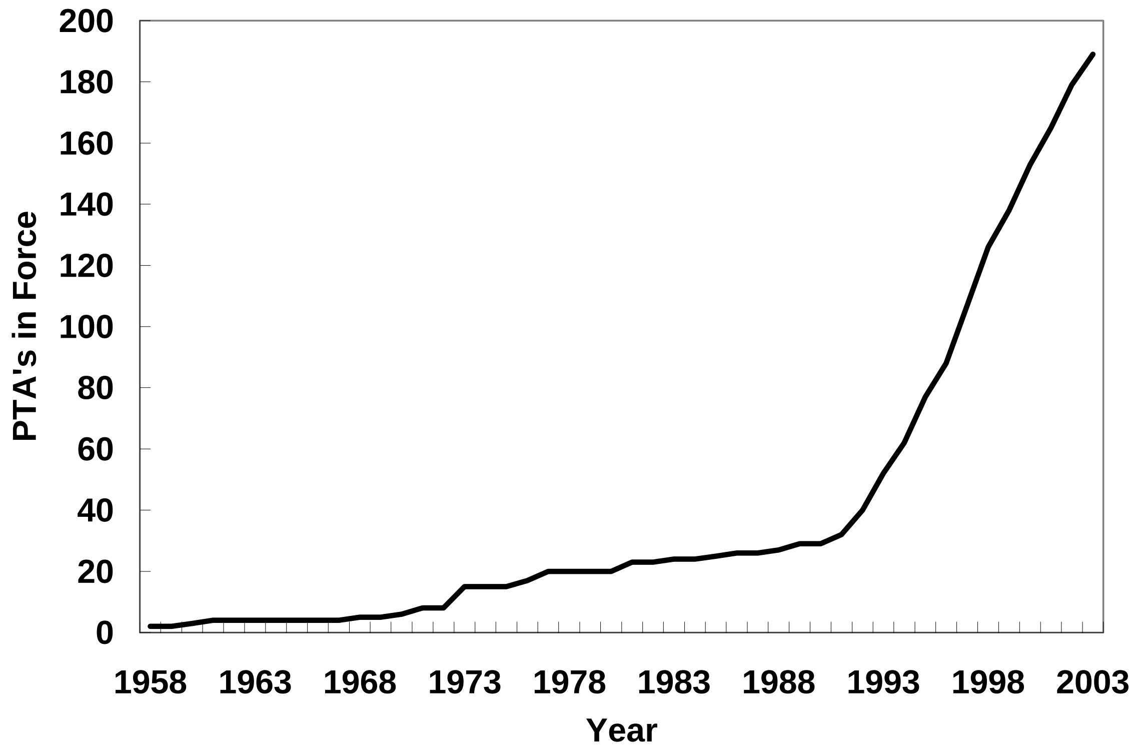


Figure 2: Mexico's and Canada's Share of US Imports 1980-2000

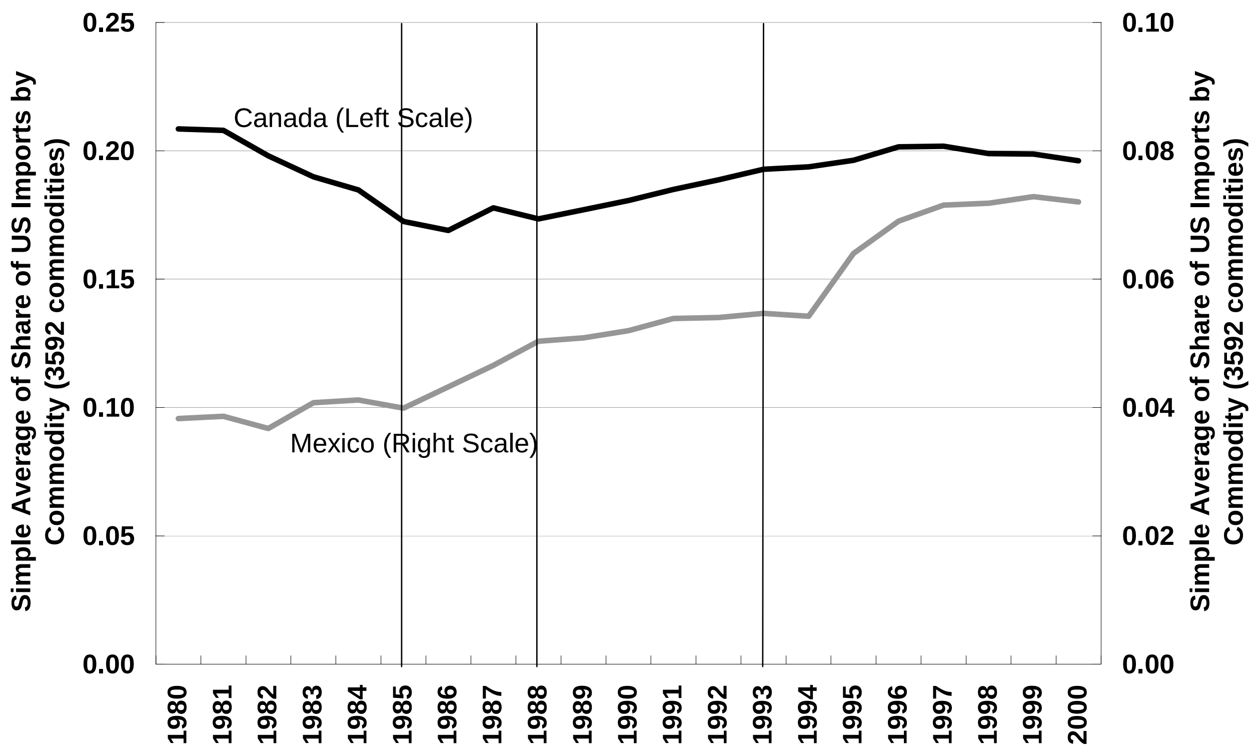


Figure 3A: Mexico's Share of US Imports 1989-2000

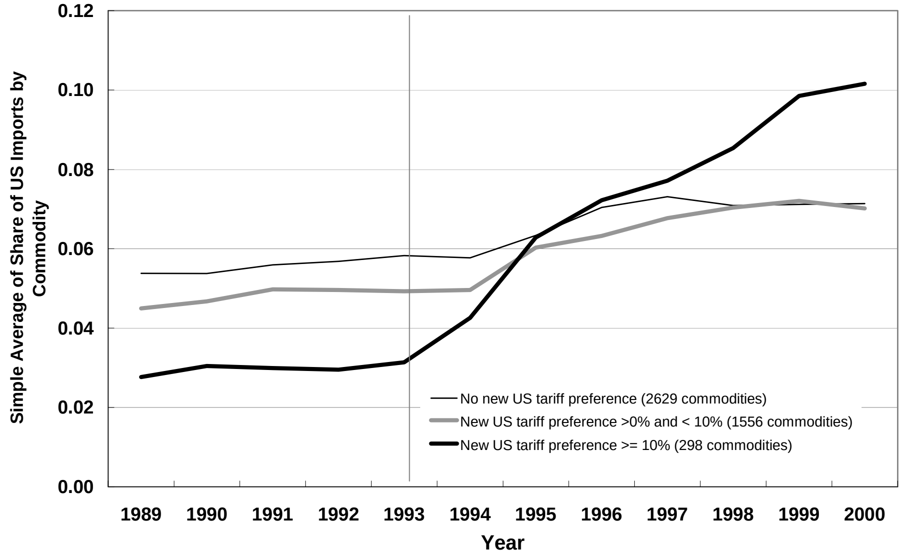


Figure 3B: Mexico's Share of EU Imports 1989-2000

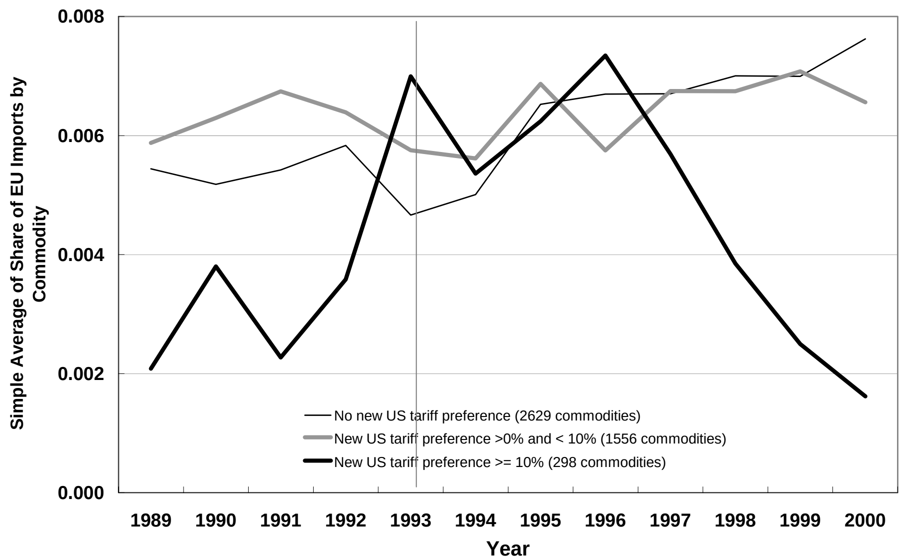


Figure 3C: Mexico's Share of US Imports 1980-2000

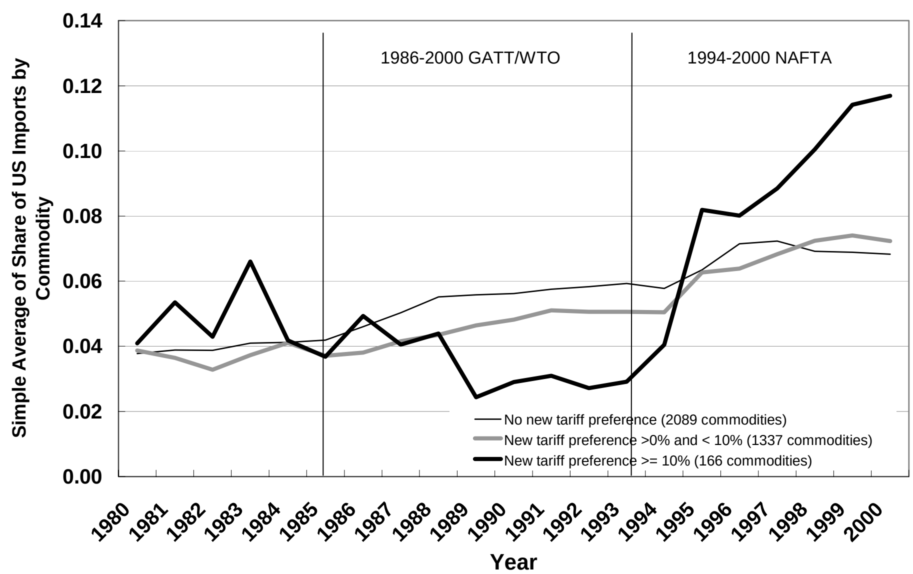


Figure 4A: Canada's Share of US Imports 1988-2000

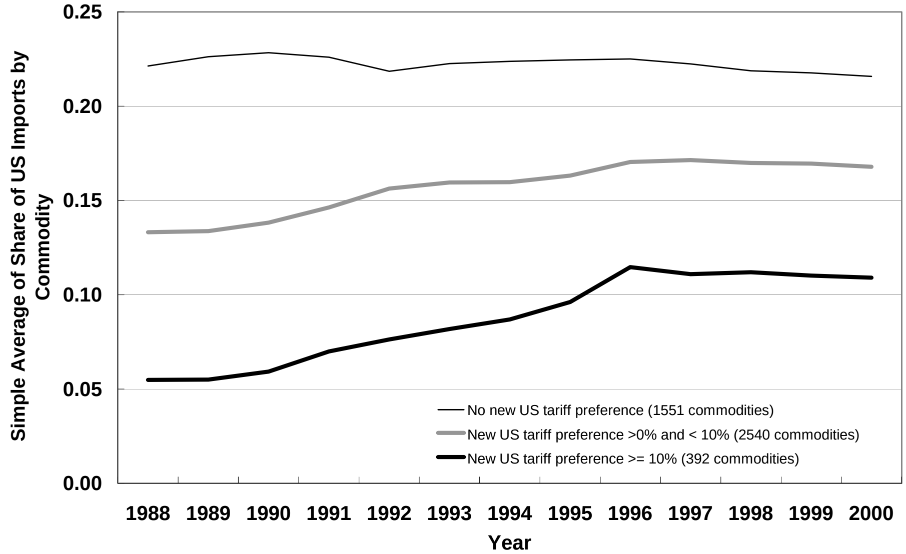


Figure 4B: Canada's Share of EU Imports 1988-2000

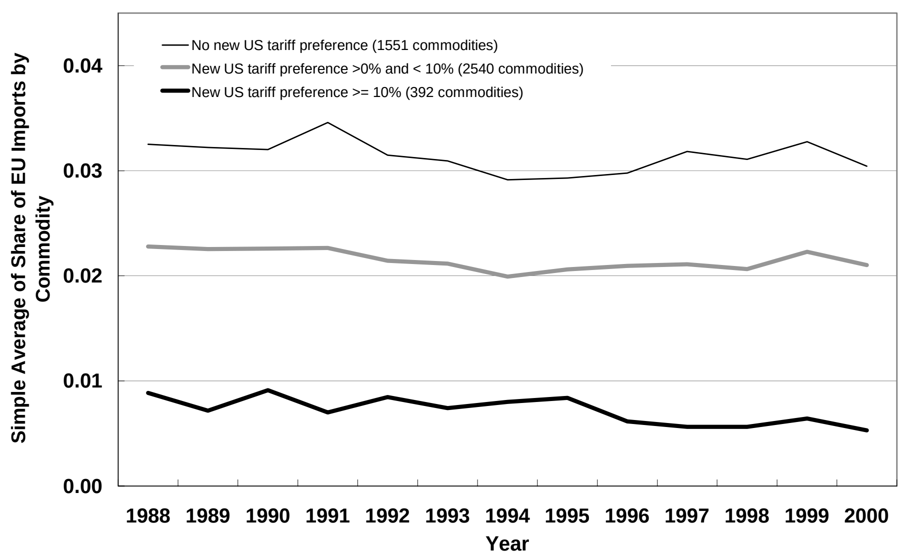


Figure 4C: Canada's Share of US Imports 1980-2000

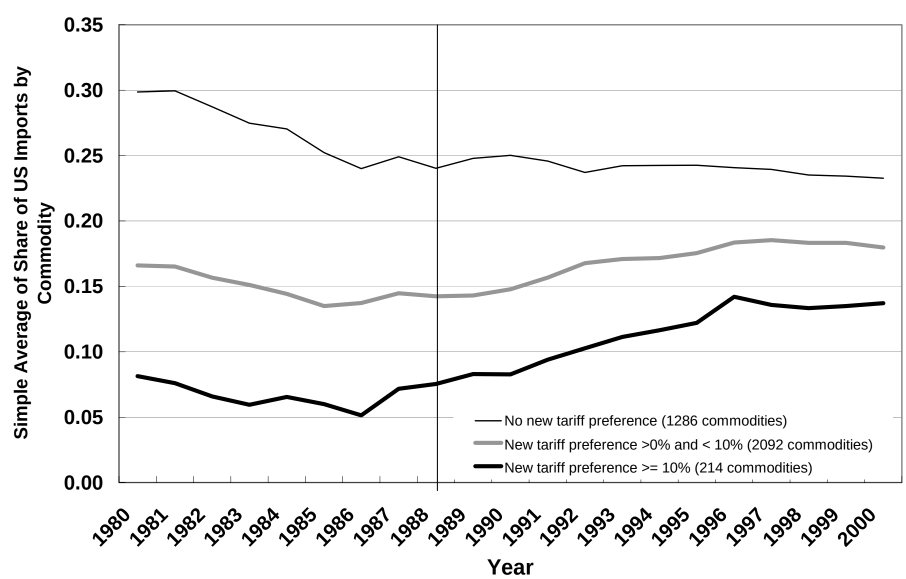


Figure 5A: US Import Tariffs in 2000

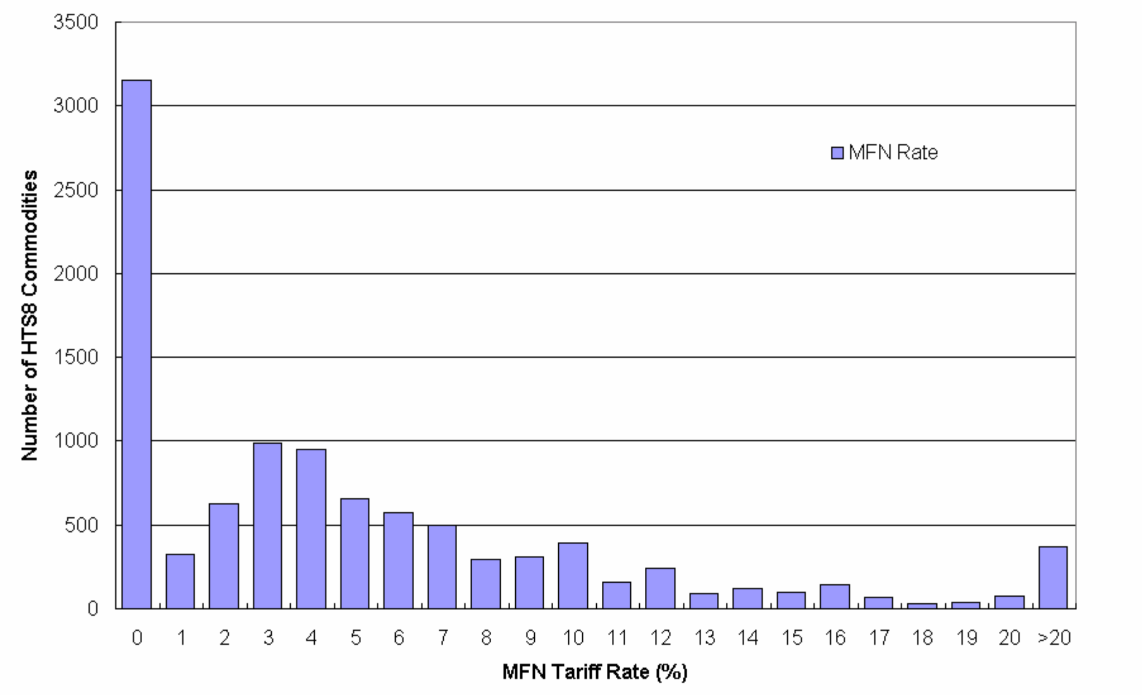


Figure 5B: US Tariff Preferences for Canadian and Mexican Goods in 2000

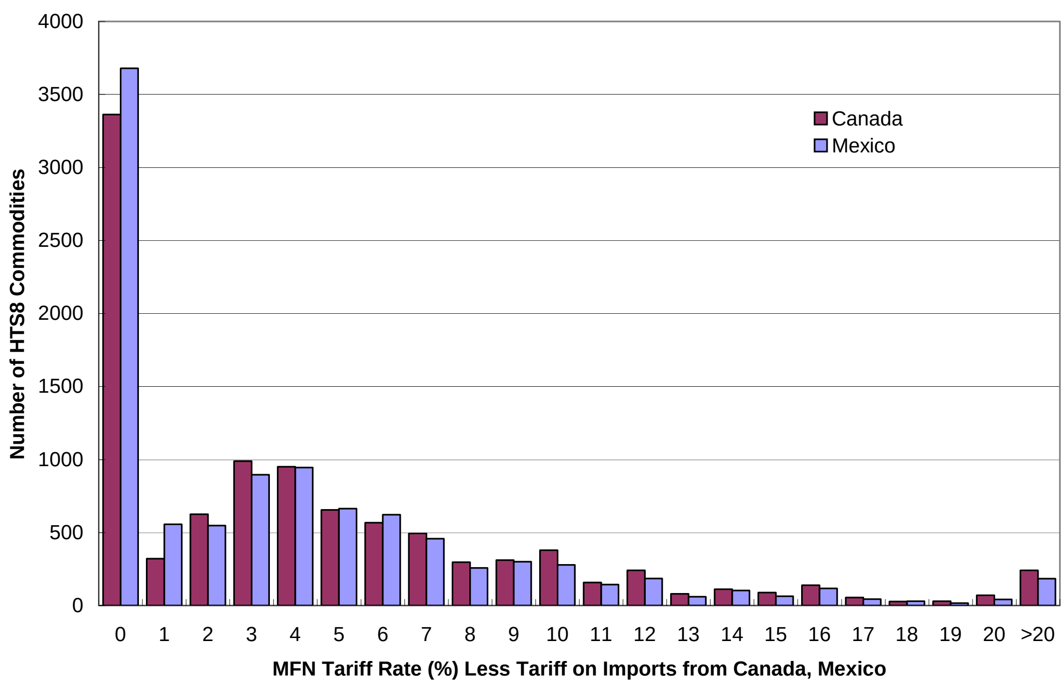
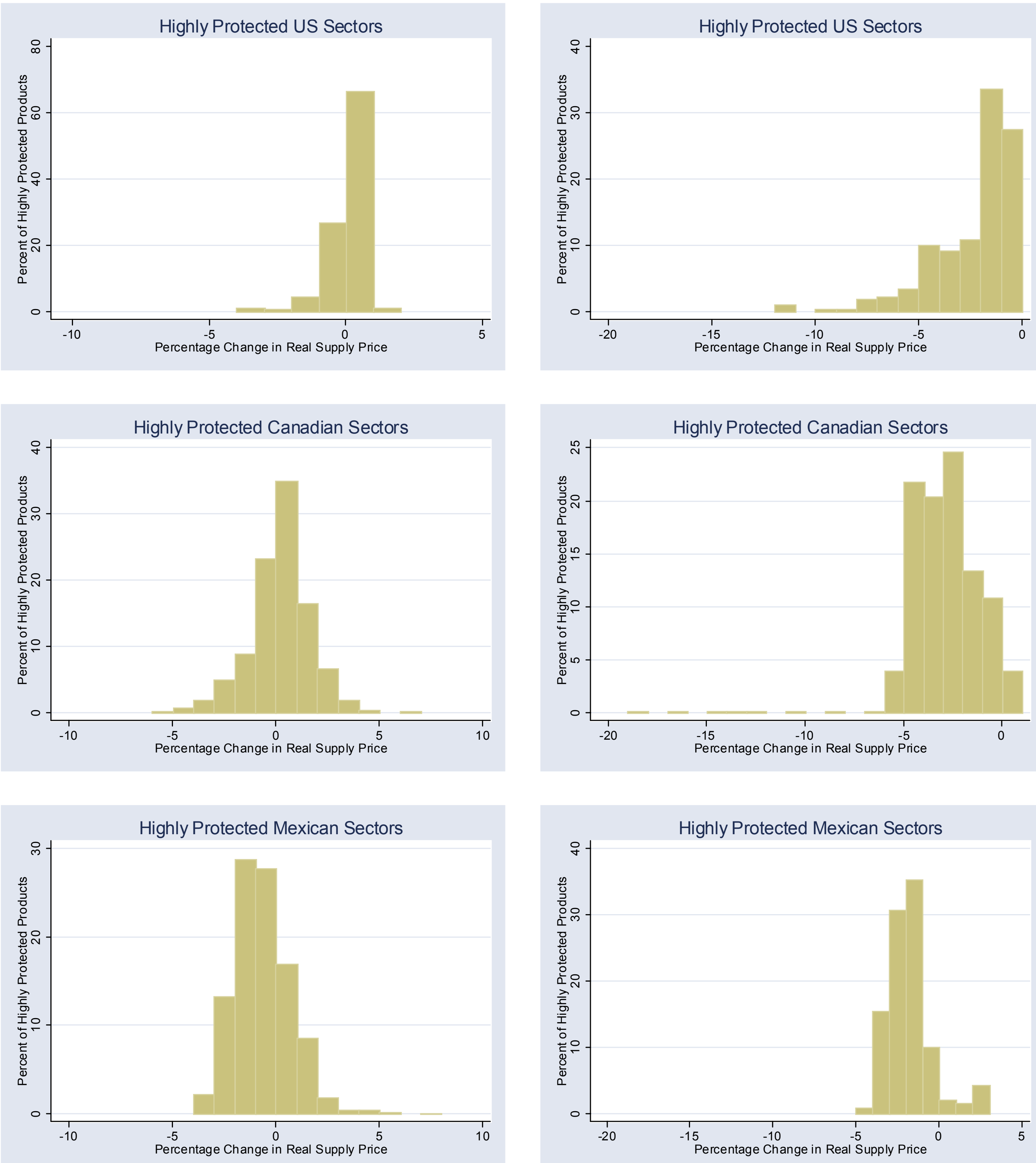


Figure 6: Highly Protected Sectors

(A) Effect of CUSFTA/NAFTA   (B) Effect of Unilateral Liberalization



Notes: ‘Unilateral Liberalization’ means the dropping of all tariffs by the relevant country. ‘Real Supply Price’ is the output price exclusive of tariffs and transport costs divided by the aggregate price index for that country.

Table 1: Proportion of HTS 8-digit Tariff Variation Captured by Broader Classifications

Classification	MFN Tariff	Canada Preference	Mexico Preference
HS-2 (97 categories)	0.387	0.389	0.370
HS-4 (1258 categories)	0.557	0.573	0.522
HS-6 (5115 categories)	0.684	0.705	0.651

Notes: Table 1 reports the percentages of the variance in US MFN and preferential tariffs at the HTS 8-digit level (10082 products) for the year 1999 that are captured by broader product classifications. Each tariff measure is regressed on full sets of dummy variables for the broader classifications. The R-squared from each regression is reported in Table 1. The 25 products with MFN tariffs above 50 percent are excluded from the calculations.

Table 2A: Tariff Preferences and Relative Prices of US Imports from Canada and Mexico

Year 1999 Tariff Preference (%)	Median Log Relative Price of US Imports from Canada				Median Log Relative Price of US Imports from Mexico			
	1989	1993	1999	N	1989	1993	1999	N
0	0.082	0.088	0.168	1457	-0.094	0.014	-0.059	663
(0,10]	0.154	0.175	0.201	2496	-0.121	-0.033	0.007	1327
>10	0.423	0.533	0.602	521	-0.127	0.005	-0.057	234

Notes: For each HTS10-digit product the FOB unit price of US imports from Canada, Mexico and the aggregate of all other countries has been calculated for the years 1989, 1993 and 1999. The log price of imports from Canada and Mexico relative to imports from all other countries is then calculated. The median log relative price is then tabulated for 3 arbitrary ranges of tariff preference given by the US to imports from Canada and Mexico. Products are only included if they are imported in all three years. The number of products for each calculation is reported.

Table 2B: Tariff Preferences and Relative Prices of Canadian Imports from US and Mexico

Year 1999 Tariff Preference (%)	Median Log Relative Price of Canadian Imports from US				Median Log Relative Price of Canadian Imports from Mexico			
	1989	1993	1999	N	1989	1993	1999	N
0	-0.065	-0.036	-0.001	1257	-0.048	-0.011	0.016	76
(0,10]	0.018	0.012	0.039	1228	-0.182	0.203	0.126	136
>10	0.338	0.391	0.383	706	-0.245	0.269	0.207	36

Notes: For each HTS10-digit product the FOB unit price of Canadian imports from the US, Mexico and the aggregate of all other countries has been calculated for the years 1989, 1993 and 1999. The log price of imports from the US and Mexico relative to imports from all other countries is then calculated. The median log relative price is then tabulated for 3 arbitrary ranges of tariff preference given by Canada to imports from the US and Mexico. Products are only included if they are imported in all three years. The number of products for each calculation is reported.

Table 2C: Tariff Preferences and Relative Prices of Mexican Imports from US and Canada

Year 1999 Tariff Preference (%)	Median Log Relative Price of Mexican Imports from US				Median Log Relative Price of Mexican Imports from Canada			
	1989	1993	1999	N	1989	1993	1999	N
[0,10]	-	-0.226	-0.263	1547	-	0.002	0.105	640
(10,20]	-	-0.257	-0.441	2081	-	0.098	0.037	813
>20	-	-0.076	0.000	709	-	0.426	0.464	232

Notes: For each HS 6-digit product the FOB unit price of Mexican imports from the US, Canada, and the aggregate of all other countries has been calculated for the years 1993 and 1999 (1989 data being unavailable). The log price of imports from the US and Canada relative to imports from all other countries is then calculated. The median log relative price is then tabulated for 3 arbitrary ranges of tariff preference given by Mexico to imports from the US and Canada. These tariff ranges differ from Tables 2A and 2B because there are almost no observations where the preference is zero. Products are only included if they are imported in both years. The number of products for each calculation is reported.

Table 3A: Substitution Elasticity Estimates based on US and EU Imports from Canada and Control Countries, 1989-1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
σ	6.52 (0.80)	6.68 (0.90)	9.38 (0.88)	8.73 (1.06)	6.25 (0.77)	6.30 (0.85)	8.49 (0.84)	7.72 (0.97)
Commodity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Countries	Table A1	Table A1	Table A1	Table A1	All	All	All	All
Tariff Measure	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average
N	35537	35533	35536	35532	36089	36085	36088	36084
Commodities	4631	4631	4631	4631	4694	4694	4694	4694

Notes: Dependent variable is ln(US imports from Canada/US imports from control countries) - ln(EU12 imports from Canada/EU12 imports from control countries) by year and HS 6-digit commodity. The substitution elasticity estimate comes from regressions of this variable on a measure of the tariff preference that the US gives to goods of Canadian origin. The EU12 includes the 12 countries that were members of the EU in 1989. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. There is a small difference between the number of observations in columns for the same set of control countries because a small number of observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded.

Table 3B: Substitution Elasticity Estimates based on US and EU Imports from Mexico and Control Countries, 1989-1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
σ	9.90 (1.02)	10.15 (1.15)	10.90 (1.19)	9.59 (1.25)	9.88 (1.00)	10.04 (1.08)	10.88 (1.16)	9.61 (1.20)
Commodity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Countries	Table A1	Table A1	Table A1	Table A1	All	All	All	All
Tariff Measure	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average
N	19335	19335	19334	19333	19414	19414	19413	19412
Commodities	3415	3415	3415	3415	3427	3427	3427	3427

Notes: Dependent variable is ln(US imports from Mexico/US imports from control countries) - ln(EU12 imports from Mexico/EU12 imports from control countries) by year and HS 6-digit commodity. The substitution elasticity estimate comes from regressions of this variable on a measure of the tariff preference that the US gives to goods of Mexican origin. The EU12 includes the 12 countries that were members of the EU in 1989. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. There is a small difference between the number of observations in columns for the same set of control countries because a small number of observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded.

Table 3C: Substitution Elasticity Estimates based on Canadian and EU Imports from USA and Control Countries, 1989-1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
σ	5.51 (0.47)	5.07 (0.45)	2.99 (0.44)	2.84 (0.46)	5.31 (0.42)	4.96 (0.41)	3.09 (0.39)	2.95 (0.39)
Commodity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Countries	Table A1	Table A1	Table A1	Table A1	All	All	All	All
Tariff Measure	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average
N	44280	44277	44278	44278	49038	49035	49038	49038
Commodities	5150	5150	5150	5150	5242	5242	5242	5242

Notes: Dependent variable is ln(Canadian imports from US/Canadian imports from control countries) - ln(EU12 imports from US/EU12 imports from control countries) by year and HS 6-digit commodity. The substitution elasticity estimate comes from regressions of this variable on a measure of the tariff preference that Canada gives to goods of US origin. The EU12 includes the 12 countries that were members of the EU in 1989. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. There is a small difference between the number of observations in columns for the same set of control countries because a small number of observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded.

Table 3D: Substitution Elasticity Estimates based on Canadian and EU Imports from Mexico and Control Countries, 1989-1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
σ	8.06 (1.14)	7.85 (1.16)	6.80 (1.24)	7.32 (1.31)	7.64 (1.10)	7.20 (1.14)	6.63 (1.19)	7.02 (1.28)
Commodity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Countries	Table A1	Table A1	Table A1	Table A1	All	All	All	All
Tariff Measure	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average
N	13137	13137	13139	13139	13219	13219	13220	13220
Commodities	2674	2674	2674	2674	2695	2695	2695	2695

Notes: Dependent variable is ln(Canadian imports from Mexico/Canadian imports from control countries) - ln(EU12 imports from Mexico/EU12 imports from control countries) by year and HS 6-digit commodity. The substitution elasticity estimate comes from regressions of this variable on a measure of the tariff preference that Canada gives to goods of Mexican origin. The EU12 includes the 12 countries that were members of the EU in 1989. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. There is a small difference between the number of observations in columns for the same set of control countries because a small number of observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded.

Table 3E: Substitution Elasticity Estimates based on Mexican and EU Imports from USA, Canada and Control Countries, 1990-1999

	(1)	(2)	(3)	(4)
σ	2.50 (0.48)	1.98 (0.41)	0.77 (0.88)	0.56 (0.82)
Commodity Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Imports from USA/Canada	USA	USA	Canada	Canada
Control Countries	Table A1	All	Table A1	All
Tariff Measure	Schedule; simple average	Schedule; simple average	Schedule; simple average	Schedule; simple average
N	38002	42457	19692	20314
Commodities	4684	4844	3430	3524

Notes: Dependent variable in columns 1-2 is ln(Mexican imports from US/Mexican imports from control countries) - ln(EU12 imports from US/EU12 imports from control countries) by year and HS 6-digit commodity. Dependent variable in columns 3-4 is ln(Mexican imports from Canada/Mexican imports from control countries) - ln(EU12 imports from Canada/EU12 imports from control countries) by year and HS 6-digit commodity. The substitution elasticity estimate comes from regressions of the dependent variable on a measure of the tariff preference that Mexico gives to goods of US or Canadian origin. The EU12 includes the 12 countries that were members of the EU in 1989. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. A small number of observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded.

Table 4: Inverse Supply Elasticity Estimates 1989-1999

	(1) IV	(2) IV	(3) IV	(4) OLS
η	0.29	0.29	0.22	-0.31
	(0.02)	(0.02)	(0.04)	(0.00)
Commodity x Country Fixed Effects	Yes	Yes	Yes	Yes
Year x Country Fixed Effects	Yes	Yes	Yes	Yes
Estimation Technique	IV	IV	IV	OLS
Instruments (see notes)	Set 1	Set 2	Set 3	-
N	1,099,097	1,099,097	1,099,097	1,099,097

Notes: the dependent variable is the observed FOB unit price of each country's exports in HS 10-digit US import data. This is regressed on an estimate of the total quantity produced of each product by each exporting country. That quantity estimate is produced using: the quantity exported to the US at the 10-digit level; the share of each country's exports at the HS 6-digit level that are exported to the US; and the share of each country's GDP that is exported. Four US tariff measures are used as instruments for the (estimated) quantity: US tariff rates on exports from the exporting country, Canada, Mexico, and all other countries. Instrument "Set 1" includes all these tariffs; "Set 2" only includes the tariff on exports from the exporting country; and "Set 3" includes the tariffs on exports from Canada, Mexico, and all other countries. Standard errors are reported in parentheses.

Table 5: Trade Diversion inferred from North American and EU Imports from Control Countries (c')

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade Diversion	**2.84** **{0.000}**	**2.96** **{0.000}**	**3.37** **{0.000}**	**3.87** **{0.000}**	**1.44** **{0.004}**	**1.33** **{0.009}**	**2.23** **{0.000}**	**2.11** **{0.000}**
Tariff								
ln $\tau_{US\text{-}Can}$	0.06	0.34	0.49	0.40	-0.71	-0.69	0.24	0.06
	(0.93)	(0.82)	(0.54)	(0.53)	(0.75)	(0.81)	(0.37)	(0.42)
ln $\tau_{US\text{-}Mex}$	1.27	1.30	1.44	1.38	1.26	1.41	0.90	0.98
	(0.60)	(0.57)	(0.44)	(0.45)	(0.49)	(0.48)	(0.34)	(0.33)
ln $\tau_{Can\text{-}US}$	2.02	1.91	1.26	1.75	0.19	0.11	0.26	0.44
	(0.52)	(0.54)	(0.45)	(0.47)	(0.35)	(0.37)	(0.34)	(0.30)
ln $\tau_{Can\text{-}Mex}$	-0.95	-1.00	-0.30	-0.07	0.33	0.08	0.42	0.38
	(0.42)	(0.44)	(0.29)	(0.57)	(0.32)	(0.30)	(0.24)	(0.23)
ln $\tau_{Mex\text{-}US}$	-1.32	-1.31	-1.10	-1.21	-0.61	-0.61	-0.48	-0.54
	(0.55)	(0.54)	(0.50)	(0.51)	(0.42)	(0.41)	(0.38)	(0.38)
ln $\tau_{Mex\text{-}Can}$	1.76	1.71	1.57	1.61	0.98	1.03	0.89	0.96
	(0.55)	(0.55)	(0.51)	(0.52)	(0.42)	(0.43)	(0.38)	(0.39)
MFN Tariffs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commodity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Countries	Table A1	Table A1	Table A1	Table A1	All	All	All	All
Tariff Measure	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average	Schedule; import weighted	Schedule; simple average	Applied; import weighted	Applied; simple average
N	42630	42454	42734	42447	43756	43633	43930	43626
Commodities	5312	5313	5321	5313	5349	5345	5354	5345

Notes: Dependent variable is ln(North American imports from control countries) - ln(EU12 imports from control countries) by year and HS 6-digit commodity, where North America is the sum of the US, Canada and Mexico. The EU12 includes the 12 countries that were members of the EU in 1989. The dependent variable is regressed on measures of the tariffs that North American countries levy on goods from within North America and on the MFN tariffs of the US, Canada, Mexico and the EU. For example, $\tau_{US\text{-}Can}$ is the tariff that the US levies on goods from Canada plus 1. The first row "Trade Diversion" reports the sum of the coefficients on tariffs levied by North American countries on imports from their NAFTA partners (the six coefficients reported below) – the p-value for the test that this sum is zero is reported in braces. A significant positive number is evidence of trade diversion resulting from preferential tariffs. The "Table A1" control countries are listed in Appendix Table A1. When "All" countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity are in parentheses. There is a small difference between the number of observations in columns for the same set of control countries because a small number of observations with extreme values of the calculated tariff (where ln(1+tariff) exceeds 0.5) are discarded. Data on actual duties collected is not available for Mexico so regressions always include the Mexican tariff schedule. Since Mexican tariffs on US and Canadian goods are very similar the separate effects of these two tariffs may difficult to empirically disentangle.

Table 6: Model Results

Change in Welfare due to CUSFTA (% of GDP)

Country	Real Value of Existing Output	Real Tariff Revenue	Welfare
USA	0.01	-0.02	-0.01
Canada	0.28	-0.28	0.00
Mexico	0.00	0.00	0.00
Rest of World	0.00	-	0.00

See text for an explanation of the decomposition

Change in Welfare due to NAFTA (% of GDP)

Country	Real Value of Existing Output	Real Tariff Revenue	Welfare
USA	0.03	-0.03	0.00
Canada	0.02	-0.02	0.00
Mexico*	1.09	-1.39	-0.30
Rest of World	0.00	-	0.00

*See Appendix for a caveat on Mexican results.

See text for an explanation of the decomposition.

Change In Bilateral Trade Due to CUSFTA (billions 1988 USD \ %)

Partners	USA	Canada	Mexico	ROW
USA		5.35%	0.08%	0.11%
Canada	8.32		-2.38%	-0.49%
Mexico	0.04	-0.05		0.01%
ROW	0.64	-0.32	0.00	

Note: Elements below principal diagonal are in billions of 1988 USD, other elements are percentage changes.

Change In Bilateral Trade Due to NAFTA (billions 1993 USD \ %)

Partners	USA	Canada	Mexico	ROW
USA		-0.17%	23.38%	-0.34%
Canada	-0.34		23.74%	-0.49%
Mexico	18.47	0.81		-9.58%
ROW	-2.48	-0.32	-1.97	

Note: Elements below principal diagonal are in billions of 1993 USD, other elements are percentage changes.

Appendix Table 1

Countries with no substantial change in preferential trade relations with the EU

Afghanistan	Gabon	Norfolk Is
Angola	Gambia	North Korea
Antigua Barbuda	Ghana	Norway
Argentina	Greenland	Oman
Aruba	Grenada Is	Pakistan
Australia	Guatemala	Palau
Bahamas	Guinea	Panama
Bahrain	Guinea-Bissau	Papua New Guin
Bangladesh	Guyana	Paraguay
Barbados	Haiti	Peru
Belize	Honduras	Philippines
Benin	Hong Kong	Pitcairn Is
Bermuda	India	Qatar
Bhutan	Indonesia	Rwanda
Bolivia	Iran	Samoa
Botswana	Jamaica	Saudi Arabia
Brazil	Japan	Senegal
Brunei	Kenya	Seychelles
Burkina Faso	Kiribati	Sierra Leone
Burundi	Korea	Singapore
Cambodia	Laos	Solomon Is
Cameroon	Lesotho	Somalia
Cape Verde	Liberia	Sri Lanka
Cayman Is	Libya	St Kitts-Nevis
Cen African Rep	Macao	St Lucia Is
Chad	Madagascar	St Vinc & Gren
Chile	Malawi	Sudan
China	Malaysia	Suriname
Christmas Is	Maldive Is	Swaziland
Cocos Is	Mali	Switzerland
Colombia	Marshall Is	Taiwan
Comoros	Mauritania	Tanzania
Congo (DROC)	Mauritius	Thailand
Congo (ROC)	Mongolia	Togo
Cook Is	Montserrat Is	Tonga
Costa Rica	Mozambique	Trin & Tobago
Cote d'Ivoire	Namibia	Tuvalu
Cuba	Nauru	Uganda
Djibouti	Nepal	United Arab Em
Dominica Is	Netherlands Ant	Uruguay
Dominican Rep	New Caledonia	Venezuela
Ecuador	New Zealand	Vietnam
El Salvador	Nicaragua	Yemen
Eq Guinea	Niger	Zambia
Ethiopia	Nigeria	Zimbabwe
Fiji	Niue	

Appendix Table 2: Substitution Elasticity Estimates when Control Countries are not Aggregated, 1989-1999

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Importing Country	USA	USA	USA	USA	Canada	Canada	Canada	Canada	Mexico	Mexico	Mexico	Mexico
σ	5.50 (0.25)	5.26 (0.17)	7.83 (0.31)	6.72 (0.21)	3.23 (0.21)	3.12 (0.13)	5.01 (0.36)	4.80 (0.24)	2.80 (0.27)	2.50 (0.17)	1.99 (0.42)	2.16 (0.29)
Commodity x Control Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Preferred Country	Canada	Canada	Mexico	Mexico	USA	USA	Mexico	Mexico	USA	USA	Canada	Canada
Control Countries	Table A1	All	Table A1	All	Table A1	All	Table A1	All	Table A1	All	Table A1	All
Tariff Measure	Applied; import weighted	Applied; import weighted	Applied; import weighted	Applied; import weighted	Applied; import weighted	Applied; import weighted	Applied; import weighted	Applied; import weighted	Schedule; simple average	Schedule; simple average	Schedule; simple average	Schedule; simple average
N	331993	743763	241892	514474	269207	589519	150356	306060	169278	377015	128734	277266
Commodities x Control Countries	62607	137520	51771	109596	56578	122129	39337	81109	44087	94176	36392	76180

Notes: Dependent variable is ln(importing country imports from preferred country/importing country imports from control country) - ln(EU12 imports from preferred country/EU12 imports from control country) by year and HS 6-digit commodity and control country. The substitution elasticity estimate comes from regressions of this variable on a measure of the tariff preference that the importing country gives to goods from the preferred country. The EU12 includes the 12 countries that were members of the EU in 1989. The “Table A1” control countries are listed in Appendix Table A1. When “All” countries are used as a control, this includes all countries (including intra-EU international trade) with the exception of NAFTA countries. Robust standard errors adjusted for clustering on each commodity*Control Country are in parentheses. Observations with extreme values for the calculated tariff preference (where ln(1+preference) is greater than 0.5) are discarded. Mexican import data is only available from 1990 onwards.