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THE LONG AND SHORT OF THE CANADA-U.S. FREE TRADE AGREEMENT

Daniel Trefler

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ABSTRACT

The Canada-U.S. Free Trade Agreement (FTA) provides a unique window on the effects of trade liberalization. It was an unusually clean trade policy exercise in that it was not bundled into a larger package of macroeconomic or market reforms. This paper uses the 1989-96 Canadian FTA experience to examine the short-run adjustment costs and long-run efficiency gains that flow from trade liberalization.

For industries subject to large tariff cuts (these are typically 'low-end' manufacturing industries), the short-run costs included a 15% decline in employment and about a 10% decline in both output and the number of plants. Balanced against these large short-run adjustment costs were long-run labour productivity gains of 17% or a spectacular 1.0% per year.

Although good capital stock and plant-level data are lacking, an attempt is made to identify the sources of FTA-induced labour productivity growth. Surprisingly, this growth is not due to rising output per plant, increased investment, or market share shifts to high-productivity plants. Instead, half of the 17% labour productivity growth appears due to favourable plant turnover (entry and exit) and rising technical efficiency.

Daniel Trefler
Institute for Policy Analysis
University of Toronto
140 St. George Street, Suite 707
Toronto, ON M5S 3G6
and NBER
Tel: (416) 978-1840
Fax: (416) 978-5519
Email: trefler@chass.utoronto.ca

The central tenet of international economics is that free trade is welfare improving. We express our conviction about free trade in our textbooks and we sell it to our politicians. "It is through the gradually increasing exposure of Canadian producers to competitive world-market forces that the Canadian economy, as a whole, has become more productive," states Canada's implementing legislation for NAFTA (Government of Canada 1994, page 70). Yet the fact of the matter is that we have one heck of a time communicating this to the larger public, a public gripped by Free Trade Fatigue.

Why is the message of professional economists not more persuasive? I think that there are two reasons. First, in examining trade liberalization we treat short-run transition costs and long-run efficiency gains as entirely separate areas of inquiry. On the one hand are those who study the long-run productivity benefits of free trade policies e.g., Levinsohn (1993), Harrison (1994), Tybout and Westbrook (1995), Krishna and Mitra (1998), and Pavcnik (2000). On the other hand are those who study the short-run impacts of freer trade on employment, earnings, and inequality e.g., Gaston and Trefler (1994, 1995), Feenstra and Hanson (1996a, 1997), Revenga (1997), and Hanson and Harrison (1999).[1] Only Currie and Harrison's (1997) study of Morocco examines both labour market outcomes and productivity. We are thus thin on research that integrates long-run benefits and short-run costs of liberalization into a single framework. Nowhere is this more apparent than for the Canadian experience with the Canada-U.S. Free Trade Agreement (FTA) and its extension to Mexico. The FTA triggered on-going and heated debates about freer trade. This heat was generated

[1]These papers deal with the impact of free trade policies. There are other papers that examine the effect of increased trade without asking why trade increased e.g., Freeman and Katz (1991), Abowd and Lemieux (1991), Revenga (1992), Bernard and Jensen (1995, 1997), Feenstra and Hanson (1996b, 1999), and Borjas, Freeman, and Katz (1997).

by the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed plants) and those who garnered the *long run efficiency gains* (consumers and stakeholders of efficient plants).

There is another reason why the free trade message is not more persuasive. While case-study evidence abounds about efficiency gains from liberalization (e.g., Krueger 1997), solid econometric evidence for industrialized countries remains scarce. When I teach my students about the effects of free trade on productivity I turn to high-quality studies for Turkey (Levinsohn 1993), Cote d'Ivoire (Harrison 1994), Mexico (Tybout and Westbrook 1995), India (Krishna and Mitra 1998), and Chile (Pavcnik 2000) among others. Even though I find these studies to be compelling, I wonder whether they can be expected to persuade policy makers in *industrialized* countries such as Canada or the United States. What is needed is at least some research focussing on industrialized countries.

The Canada-U.S. Free Trade Agreement offers several advantages for assessing the short-run costs and long-run benefits of trade liberalization in an industrialized country. First, the FTA policy experiment is clearly defined. In developing countries, trade liberalization is typically part of a larger package of market reforms, making it difficult to isolate the role of trade policy. Further, the market reforms themselves are often initiated in response to major macroeconomic disturbances. Macroeconomic shocks, market reforms, and trade liberalization are confounded. Indeed, Helleiner (1994, page 28) uses this fact to argue that "Empirical research on the relationship between total factor productivity (TFP) growth and ... the trade regime has been inconclusive." His view is widely shared e.g., Harrison and Hanson (1999) and Rodriguez and Rodrik (1999). In contrast, the FTA was not implemented as part of a larger package of reforms or as a response to a macroeconomic crisis. Second, as Harrison and Revenga (1995, page 1) note, "Trade policy is almost never measured using the most obvious indicators – such as tariffs." See also Tybout (2000). This study of the FTA is particularly careful about constructing pure policy-mandated tariff measures.

Third and perhaps most important, this paper examines the impacts of the FTA on a large number of performance indicators in the manufacturing sector. These include imports, value added, output, number of plants, plant size, labour productivity, total factor productivity, employment, skill upgrading, wages, hours of work, earnings, and income inequality. Since each of these outcomes is examined using a common econometric framework, I am better able to assess whether all my empirical ducks have lined up in a way that is consistent with trade theory. In particular, I am better able to assess whether the results on *long-run benefits* and *short-run costs* are consistent.

The FTA was implemented on January 1, 1989. I assess its impacts using 'pre' and 'post' Canadian data extending from 1980 to 1996. The data suffer two drawbacks. First, capital stock is poorly measured which complicates productivity analysis. Second, plant-level data are inaccessible so that I must work with manufacturing data at the industry level. However, at some points of the paper I am able to exploit sub-industry level data on plants grouped by plant size. These data form a balanced panel of 1,026 industry-plant size observations in each year.

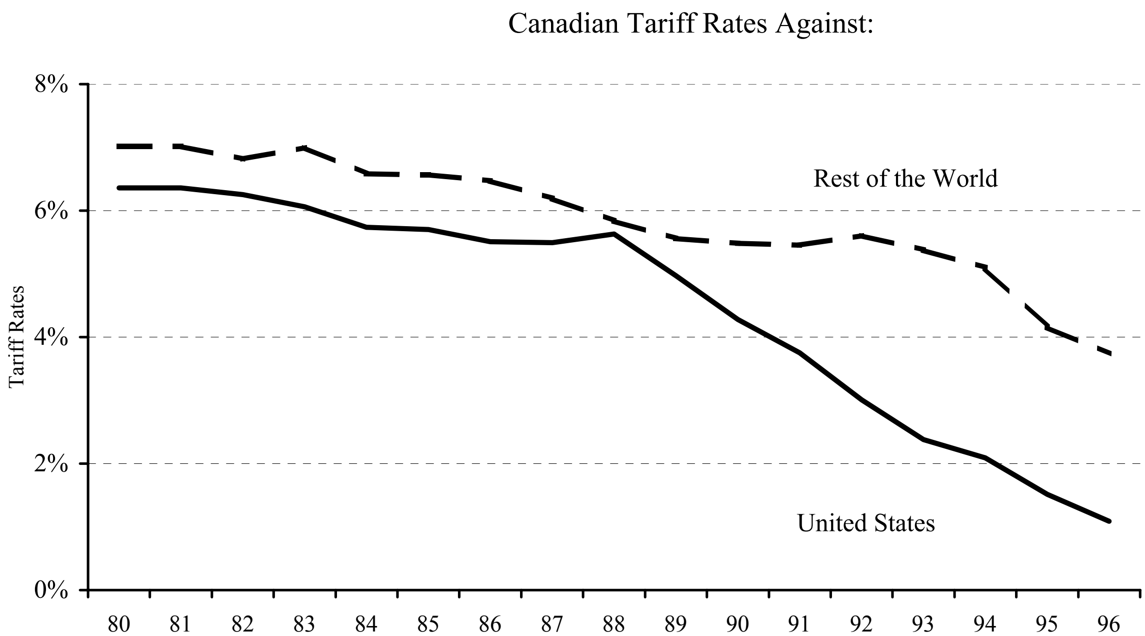
There is a body of econometric research on various aspects of the FTA (Beaulieu 2000, Claussing 1995, Gaston and Trefler 1997, Government of Canada 1997, Head and Ries 1997, 1999a,b, Schwanen 1997, and U.S. Congress 1997). Each of these represents only one piece of a larger puzzle whose picture depicts the many impacts of the FTA. For example, Claussing (1995) focuses on trade effects, Gaston and Trefler (1997) only explore employment effects, and Head and Ries (1999b) only examine plant size effects. Thus, none of the existing studies can address the trade-offs between long-run efficiency gains and short-run adjustment costs. In addition, this paper offers a large number of refinements that improve on existing approaches.

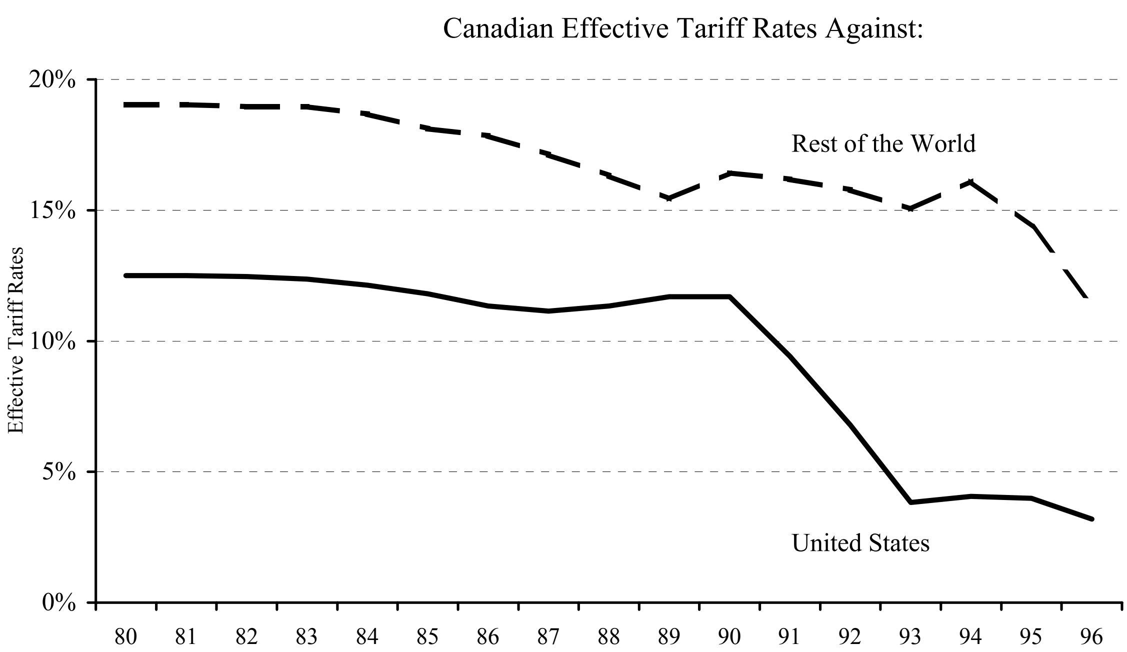
This paper does not provide the silver bullet that makes the case either for or against free trade. I offer clear evidence that the FTA created substantial long-run productivity benefits. However, the short-run worker-displacement costs were also substantial. There is thus a question of net benefits left hanging, but whose answer has been considerably refined by the research to be presented. I hope that the results here take us one step closer to understanding how freer trade can be implemented in an industrialized economy in a way that recognizes both the long-run gains and the short-run adjustment costs borne by workers and others.

1. The FTA Tariff Cuts: Too Small to Matter?

This paper deals with the impact of the FTA tariff cuts in manufacturing. It is therefore natural to start by asking whether the FTA tariff cuts were deep enough to have mattered. Recall that the FTA was implemented on January 1, 1989. The top panel of figure 1 plots Canada's average tariff rate against the United States in manufacturing. In 1988 it was 5.6 percent, a level too low to have had much effect. There are two problems with this claim. First, tariffs tend to be lowest on less-processed manufactures and highest on processed ones.

Figure 1. Canadian Tariff and Effective Tariff Rates





For Canada this means that the tariff rate understates the effective rate of protection. The bottom panel of figure 1 plots the effective rate of protection against the United States in manufacturing. Effective rates of protection against the United States were twice as high (11.3 percent in 1988) and have fallen more dramatically than nominal tariff rates.[2]

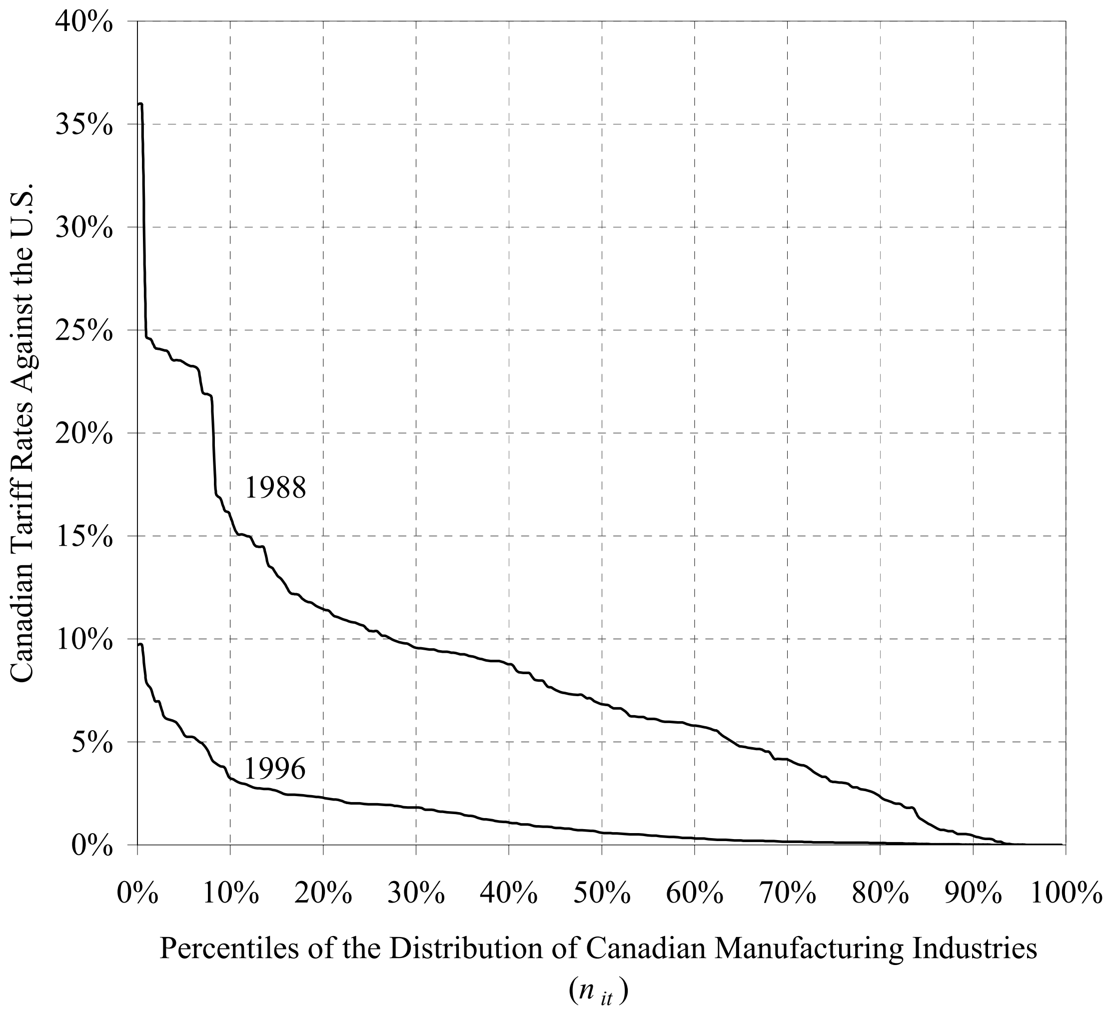
Second, low average tariffs disguise enormous differences in tariffs across industries. Figure 2 plots a Lorenz curve for industry-level tariffs in 1988 and 1996. To derive this plot in any year, say 1988, industries were sorted by their tariff rates. Let τ_{it}^{US} be the Canadian tariff against the United States in industry i in year t where $i < i+1$ implies $\tau_{it}^{US} > \tau_{i+1,t}^{US}$. Let n_{it} be the percentage of Canadian 4-digit SIC industries with tariffs in excess of τ_{it}^{US}. There are 213 industries so that, for example, an n_{it} of 33 percent corresponds to 71 industries. The figure plots τ_{it}^{US} against n_{it}. In 1988 almost 30 percent of all Canadian manufacturing industries were sheltered behind a tariff in excess of 10 percent. By 1996 this number was zero.

It is important to emphasize that figure 2 depends crucially on the level of aggregation. If one moves from the plotted 4-digit data (213 industries) to 3-digit data (104 industries) almost no industries had 1988 tariffs in excess of 10 percent. Thus the sample variation associated with 4-digit disaggregation is a key feature of this study.

Another point to note is that the FTA called for reductions in U.S. tariffs against Canada. I do not have U.S. tariff data at the level of disaggregation of interest. However, the correlation between U.S. and Canadian bilateral tariffs in 1988 was very high (Magun *et*

[2]Both the nominal and effective tariff rates were calculated at the 4-digit level as duties paid divided by imports. They were aggregated up to all of manufacturing using 1980 Canadian production weights. Appendix 1 provides details of my (standard) formula for the effective rate of protection.

Figure 2. Distribution of Tariffs Across Industries



al. 1988, Gaston and Trefler 1997, Head and Ries 1997). That is, Canada and the United States were protecting the same industries. It is thus not surprising that with 2-digit SIC data Gaston and Trefler (1997) found that once the Canadian tariff changes against the United States are incorporated, it makes little difference if the U.S. tariffs against Canada are added in. In addition, tariffs are positively correlated with effective tariffs and non-tariff barriers to trade. In a regression setting this means that the tariff regressor will be picking up the effects of U.S. tariffs, effective tariffs, and non-tariff barriers. This is precisely what I want: When I analyze tariff reductions I am actually capturing a wider set of liberalizing FTA policies.

2. The Data

In outlining a comprehensive assessment of the FTA the chief obstacle has been data preparation. Without high quality data all conclusions must be tentative. The database spans the years 1980-96 and is at the 4-digit SIC level (213 manufacturing industries). The database includes the most up to date information available and is unique in combining data from a large number of disparate sources. All Canadian data are from Statistics Canada without whose collective expertise nothing would have been possible. The variables may be divided up into the following groups. (*i*) Imports, exports, and tariff duties from special tabulations of the International Trade Division. (*ii*) Gross output, value added, number of plants, employment, annual earnings, wages, and hours from special tabulations by the Canadian Annual Survey of Manufactures (ASM) Section. (*iii*) The above ASM data by plant size, again by special tabulation. (*iv*) Output and value-added deflators from the Input-Output

Division and the Prices Division. (v) Concordances from U.S. SIC (1987) and Canadian SIC (1970) to Canadian SIC (1980) from the Standards Division.

Most of the U.S. data through 1994 are from the NBER Manufacturing Productivity Database (Bartelsman and Gray 1996). The database was augmented and updated to 1996 using data from special tabulations done by the Bureau of Economic Analysis (BEA) and from data available on the BEA and Bureau of Labor Statistics websites.

I will be working with industry-level data and industry-level data disaggregated by the employment size of plants. I would have preferred using plant-level data. However, for legal reasons these data have not yet been made publicly available.[3]

3. Econometric Strategy

Let i index industries, let t index years, and let Y_{it} be an outcome of interest such as employment or productivity. The FTA was implemented on January 1, 1989. I have data for the FTA period 1989-96 and the pre-FTA period 1980-88. For reasons to be explained, it is useful to define the FTA and pre-FTA periods without reference to data availability. For choice of years t_0 and $t_1$with $1980 < t_0 < 1989 < t_1$, I will define the FTA period as the years 1989 to t_1 and the pre-FTA period as the years 1980 to t_0. Let Δy_{is} be the average annual log change in Y_{it} over period s where $s = 1$ indexes the FTA period and $s = 0$ indexes the pre-FTA period. That is,

[3] Note that Levinsohn (1993), Harrison (1994), Tybout and Westbrook (1995), Krishna and Mitra (1998), and Pavcnik (2000), who use plant-level data, all work with industry-level trade-policy data (e.g., tariffs) that are at much higher levels of aggregation.

$$\Delta y_{is} \equiv \begin{cases} (\ln Y_{i,t_1} - \ln Y_{i,1988})/(t_1 - 1988) & \text{for } s = 1 \\ (\ln Y_{i,t_0} - \ln Y_{i,1980})/(t_0 - 1980) & \text{for } s = 0 \end{cases} . \tag{1}$$

Δy_{is} approximates the annual compound growth rate of Y_{it} during period s. I am interested in a regression model explaining the impact of the FTA tariff cuts on industry outcomes of interest:

$$\Delta y_{is} = \beta \Delta \tau_{is}^{FTA} + \gamma \Delta x_{is} + \varepsilon_{is}, \qquad s = 0, 1 \tag{2}$$

where $\Delta \tau_{is}^{FTA}$ is a measure of the FTA mandated tariff concessions and Δx_{is} collects all other determinants of Δy_{is}. The remainder of this section is devoted to a discussion of the regression controls appropriate for equation (2).

3.1. The FTA Tariff Concessions

Interest in equation (2) focuses on the tariff term. It is tempting to measure $\Delta \tau_{is}^{FTA}$ as the change in Canadian tariffs against the United States during period s. However, as figure 1 above shows, tariffs were coming down against the rest of the world (i.e., against non-U.S. trading partners) over this period. Thus, Canadian tariffs against the United States have a strong trend that coincides with larger globalization trends. They thus potentially pick up much more than just the FTA. Further, even in the absence of the FTA, tariffs would have come down as a result of the Uruguay Round. One can see this in figure 1 as the sharp drop in Canadian tariffs against the rest of the world beginning in 1994. Let τ_{it}^{US} be the Canadian tariff against the United States in industry i in year t and let τ_{it}^{ROW} be the Canadian tariff against the rest of the world. Then $\tau_{it}^{US} - \tau_{it}^{ROW}$ is the FTA mandated preferential tariff concession extended to the United States. Its average annual change during the FTA period ($s = 1$) is

$$\Delta\tau_{i1}^{FTA} \equiv \left((\tau_{i,t_1}^{US} - \tau_{i,t_1}^{ROW}) - (\tau_{i,1988}^{US} - \tau_{i,1988}^{ROW})\right) / (t_1 - 1988) \ . \tag{3}$$

Appendix table A1 lists the industries with the largest $|\ \Delta\tau_{i1}^{FTA}\ |$. In terms of the top panel of figure 1, $\Delta\tau_{i1}^{FTA}$ measures how the distance between the two lines changed between 1988 and year t_1.

For the pre-FTA period, one expects the two lines to coincide because tariff rates were primarily extended on a Most Favoured Nation (MFN) basis prior to 1988. One does not see this for two reasons. First, the 1965 Canada-U.S. Auto Pact was a major exception to MFN. I therefore let $\Delta\tau_{i0}^{FTA} = ((\tau_{i,t_0}^{US} - \tau_{i,t_0}^{ROW}) - (\tau_{i,1980}^{US} - \tau_{i,1980}^{ROW}))/\,(t_0 - 1980)$ when i is an automotive industry.[4] Second, while the underlying tariff rates on about $15,000$ commodities usually obey MFN, they have been highly aggregated using import and production weights. Aggregation causes the two lines to diverge. This raises a set of issues addressed in appendix 2. Since I do not want the results to be driven by aggregation bias, I impose $\Delta\tau_{i0}^{FTA} = 0$ when i is not an automotive industry.

As a tariff measure, $\Delta\tau_{is}^{FTA}$ has two advantages. First, it captures the core textual aspect of the FTA. Second, its trend component is weak, indeed zero in the pre-FTA period. Thus, much of the tariff data variability comes from the FTA period cross section. Implicitly, I

[4] All results are the same with $\Delta\tau_{i0}^{FTA} = 0$ for the automotive sector or with the automotive sector excluded from the analysis.

am comparing the performance of industries that were subjected to large tariff cuts with the performance of industries that received small or zero tariff cuts.[5]

3.2. The Secular Growth Control

I return now to the choice of Δx_{is} in equation (2). For political economy reasons, one expects declining industries to have high tariffs (e.g., Trefler 1993) and hence deep FTA tariff cuts. One must therefore be careful not to attribute the effects of secular industry decline to the FTA tariff cuts. Columns 1 and 2 of table 1 offer evidence on this by reporting the cross-industry correlation of FTA period growth Δy_{i1} with tariff cuts $\Delta\tau_{i1}^{FTA}$ and pre-FTA growth Δy_{i0}. The correlations are all positive, indicating that sluggish FTA period growth coincided both with sluggish pre-FTA growth and with large FTA period tariff cuts.

To prevent secular growth trends from being imputed to the FTA tariff cuts, I introduce a growth fixed effect α_i into equation (2):

$$\Delta y_{is} = \alpha_i + \beta\Delta\tau_{is}^{FTA} + \gamma\Delta x_{is}^{'} + \varepsilon_{is}, \qquad s = 0, 1. \tag{4}$$

where $\Delta x_{is}^{'}$ is all other controls except α_i. As a result, $\Delta\tau_{i1}^{FTA}$ can only pick up FTA impacts on growth that are departures from trend growth. I now turn to the choice of $\Delta x_{is}^{'}$.

[5]It would be nice to exploit more of the within-industry changes in tariffs over time. In a previous draft this was done by looking at specifications in which all changes where annual i.e., there were 16 observations per industry, one for each of the years in 1980-96. This means that there were 16 tariff changes recorded for each industry. These annual-change results were similar to what will be repeated below. I no longer report the annual change results because it is impossible to combine the annual change estimator with adequate controls for business fluctuations. As will become clear, controlling for business fluctuations is more important than squeezing out extra time-series variation in the data.

3.3. The U.S. Control

The 1990's was a period of accelerating changes in technology as well as other determinants of supply and demand. Thus, the secular growth captured by α_i is not always a reliable predictor of current growth. Further, these 1990's changes were probably not confined to Canada - they likely affected the United States as well. I thus control for underlying supply and demand changes by introducing a U.S. control Δy_{is}^{US} into regression equation (4). Δy_{is}^{US} is the U.S. counterpart to Δy_{is}. For example, if Δy_{is} is Canadian employment growth, Δy_{is}^{US} is U.S. employment growth. Column (3) of table 1 reports the correlation of FTA period Canadian growth Δy_{i1} with U.S. growth Δy_{i1}^{US}. The correlations are large and positive which indicates that FTA period innovations in Canada and the United States shared a common component.[6]

It is tempting to argue that Δy_{is}^{US} is endogenous. That is, when Canadian industries do well it is at the expense of their U.S. counterparts. If true, we should see it in one of two ways. First, Canadian and U.S. growth should be negatively correlated. Yet I just showed in column (3) of table 1 that these bivariate correlations are positive. Further, Gaston and Trefler (1997) found positive multivariate correlations. (They looked at employment growth using 2-digit data for the period 1980-93.) Thus, endogeneity is not evident in bivariate

[6] The U.S. database is at the 4-digit level of 450 U.S. SIC industries whereas the Canadian data are at the level of 213 Canadian SIC industries. I have converted the U.S. data into Canadian SIC using a Statistics Canada electronic concordance called COMIND92 which is related to Statistics Canada's catalogue 12-574 publication. Because some U.S. SIC industries do not go uniquely into a single Canadian SIC industry, I have had to augment the Statistics Canada converter with more detailed U.S. data. Where there is no uniqueness, U.S. industries were allocated to Canadian industries based on 5-digit U.S. value of shipment weights. (The first 4 digits are SIC industries, the last digit is a product code.) The weights used for year t were year t data on either shipments, value added, or employment depending on the series being converted. Data on 5-digit shipments are from the BEA website. With these data I was able to build a converter that 'steps down' from over 1000 U.S. industry/products to 213 Canadian industries. I am indebted to my research assistant Susan Zhu for taking on this mind-numbing, lengthy task.

or multivariate correlations of Δy_{i1} with Δy_{i1}^{US}. Second, if Δy_{is}^{US} is endogenous because it was effected by FTA tariff cuts then Δy_{is}^{US} must be correlated with $\Delta\tau_{i1}^{FTA}$. In fact, the correlation is virtually zero for each of the table 1 variables. The explanation for the zero correlations is simple: The U.S. market is so large that the effect of the FTA was swamped by more fundamental movements in industry demand and supply. It is exactly these movements that I wish to proxy with Δy_{is}^{US}. I therefore amend equation (4) as follows:

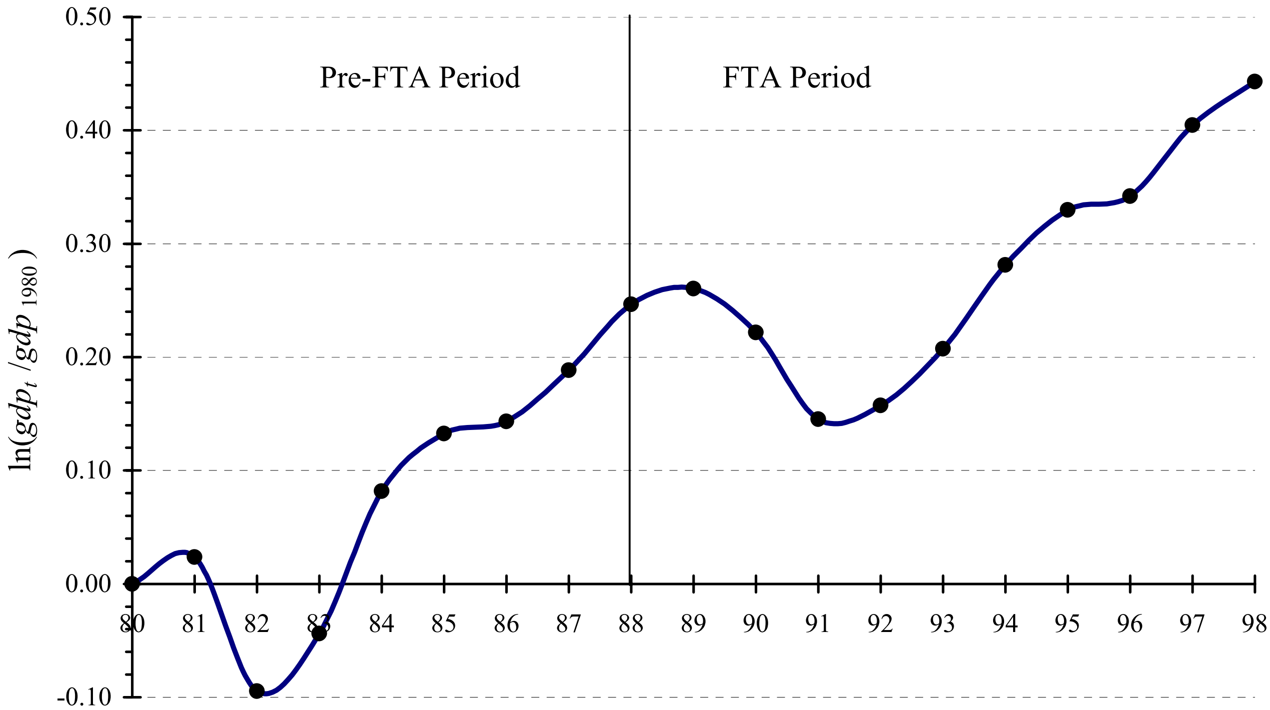
$$\Delta y_{is} = \alpha_i + \beta\Delta\tau_{is}^{FTA} + \gamma\Delta y_{is}^{US} + \delta\Delta x_{is}^{''} + \varepsilon_{is}, \qquad s = 0, 1. \tag{5}$$

where $\Delta x_{is}^{''}$ is all other controls except α_i and Δy_{is}^{US}. I now turn to the choice of $\delta\Delta x_{is}^{''}$.

3.4. The Business Conditions Control

A key issue for examining the FTA is the treatment of the early 1990's recession. Figure 3 plots gross domestic product (gdp) for Canadian manufacturing. The data are in logs relative to a 1980 base i.e., $\ln(gdp_t/gdp_{1980})$. The FTA period recession stands out. General business conditions can be introduced into equation (5) by including a regressor Δz_s that measures movements in gdp, the exchange rate, Canada-U.S. interest rate differentials, and other macro variables. However, one needs to allow industries to vary in their sensitivity to general business conditions. That is, equation (5) needs a term Δz_s whose coefficient δ_i is industry subscripted. Otherwise, if tariff cuts are deepest for the most cyclically sensitive industries (e.g., low-end manufacturing), then the estimate of the tariff effect will be biased

Figure 3. Real Canadian Manufacturing GDP



Notes : Data are from the series 'gdp at factor cost, 1992 dollars' from Statistics Canada's CANSIM database.

upward. I therefore amend equation (5) as follows:

$$\Delta y_{is} = \alpha_i + \beta \Delta \tau_{is}^{FTA} + \gamma \Delta y_{is}^{US} + \delta_i \Delta z_s + \varepsilon_{is}, \qquad s = 0, 1 \tag{6}$$

where I have replaced $\delta \Delta x_{is}^{''}$ with $\delta_i \Delta z_s$. α_i, $\Delta \tau_{is}^{FTA}$, Δy_{is}^{US}, and $\delta_i \Delta z_s$ are my regression controls.

Estimating both the δ_i and the α_i is a difficult problem, not least because it involves estimating these 2×213 parameters with only 2×213 observations. Fortunately, there is a simpler approach based on matching the FTA and pre-FTA business cycles. From figure 3, there are a number of similarities between the 1980-88 and 1988-98 periods. Each begins a year before the peak, enters a deep recession in the third year, and ends with a prolonged expansion. This is not to minimize differences in the depth of the recessions or the pace of their recoveries, but to point out useful similarities. By experimenting with the choice of pre-FTA and FTA periods (i.e., t_0 and t_1 in equation 1), it is possible to place industries at about the same point on the business cycle in each of the two periods. In this way, the pre-FTA period data on business cycle sensitivity can be used to control for FTA period business cycle sensitivity.

My preferred choice of periods uses $t_0 = 1986$ and $t_1 = 1996$ so that FTA changes cover 1988-96 and pre-FTA changes cover 1980-86. Relative to 1980-86, the 1988-96 period is one year ahead as judged by the number of years into the expansion and less than one year behind as judged by gdp growth. Clearly, there is some question about how best to choose the periods. Fortunately, the empirical results are not particularly sensitive to this choice, a fact that will be shown at length below. I therefore postpone further discussion of timing.

By the way, *it is no coincidence that there were sufficient data for lining up the pre-FTA and FTA business fluctuations.* In a previous draft I only had data back to 1984 because that was the year that Statistics Canada changed its industrial classification from SIC(1970) to SIC(1980). Obtaining data back to 1980 in order to match business fluctuations involved custom runs by Statistics Canada as well as the construction of a concordance between Canadian SIC (1970) and Canadian SIC (1980) which, remarkably, existed previously only in limited form.[7]

3.5. Estimation

Moving to the formal estimation framework, I will difference equation (6) across the two periods and use the fact that industries are at the same point on the business cycle in each period ($\delta_i \Delta z_1 = \delta_i \Delta z_0$). Then

$$(\Delta y_{i1} - \Delta y_{i0}) = \beta(\Delta\tau_{i1}^{FTA} - \Delta\tau_{i0}^{FTA}) + \gamma(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) + \upsilon_i. \tag{7}$$

Such differencing eliminates 2×213 parameters from equation (6). Not only do the δ_i fall out, but so do the α_i along lines related to the Heckman and Hotz (1989) random growth estimator. Equation (7), with an intercept, is my primary regression specification:

$$(\Delta y_{i1} - \Delta y_{i0}) = \theta + \beta(\Delta\tau_{i1}^{FTA} - \Delta\tau_{i0}^{FTA}) + \gamma(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) + \upsilon_i. \tag{8}$$

[7] I am indebted to Paul Beaudry, Janet Currie, Paul Romer, Alwyn Young and other CIAR workshop participants for insisting that I control for business cycles. I am also indebted to Richard Barnabé, Director General of the Standards Division at Statistics Canada, for helping me to construct an SIC(1970) to SIC(1980) converter.

The intercept is derived by adding a period dummy θ_s to equation (6) and defining $\theta \equiv \theta_1 - \theta_0$.

I will also consider a simpler regression that eliminates the equation (6) secular growth and business condition controls (α_i and $\delta_i \Delta z_s$):

$$\Delta y_{is} = \theta + \beta \Delta \tau_{is}^{FTA} + \gamma \Delta y_{is}^{US} + \varepsilon_{is}, \qquad s = 0, 1. \tag{9}$$

This specification helps pinpoint the impact of these controls on the estimate of β. I emphasize that equation (9) is used only for regression diagnostic purposes.

3.6. Endogeneity of Tariffs

Tariff cuts are not exogenous. They depend on industry characteristics e.g., Brock and Magee (1978) and Trefler (1993). In the change-in-changes equation (8) setting, it is not clear why endogeneity should be an issue.[8] However, one can always work up some story about endogeneity. As such, I also consider instrumental variables (IV) estimates. The instrument set consists of 1988 values for hourly wages (capturing protection for low-wage industries as in Corden's 1974 conservative social welfare function), the proportion of non-production workers (capturing protection for unskilled industries), the level of output (capturing protection for large industries as in Finger, Hall, and Nelson's 1982 high track protection for large industries), imports, and exports. I also include all the cross–products. Since all these

[8] $\Delta \tau_{i1}^{FTA} - \Delta \tau_{i0}^{FTA}$ approximately equals $\Delta \tau_{i1}^{FTA}$ (see the discussion following equation 3), and $\Delta \tau_{i1}^{FTA}$ is largely determined by the tariff level in 1988. This in turn depends on industry characteristics in 1988. There are two types of such characteristics, those expressed as levels in 1988 such as average wages and those expressed as changes leading up to 1988 such as output growth. It is not clear why such levels or changes should be correlated with changes in changes i.e., with the dependent variable $\Delta y_{i1} - \Delta y_{i0}$ in equation (8).

variables are in 1988 levels, the assumption that they are uncorrelated with the double-differenced error term is comfortable. Finally, I include $\Delta y_{i1}^{US} - \Delta y_{i0}^{US}$ since this already appears as an exogenous variable. I do not include any Canadian *growth* characteristics such as Δy_{i0} or $\Delta y_{i1} - \Delta y_{i0}$ since these are arguably endogenous.

I have mixed feelings about the IV estimates. On the one hand, a number of factors argue for emphasizing them. (*i*) The IV results invariably imply larger FTA impacts than do the ordinary least squares (OLS) results. They thus strengthen my conclusions. (*ii*) The IV estimates are robust in that they are insensitive to the choice of instruments i.e., to different variables, to the omission of cross-products, and to the omission of $\Delta y_{i1}^{US} - \Delta y_{i0}^{US}$. (*iii*) The first-stage R^2s are always close to 0.4 which is arguably not 'too' high. On the other hand, there are factors that argue against emphasizing the IV results. First, IV methods require strong assumptions about instrument validity. Second and more important, the Hausman test (Wu's T2 test) rejects endogeneity for 17 of the 22 variables to be considered. For these reasons, I will present the IV results, but not have much to say about them.

4. Empirical Results: Employment

Unlike most assessments of the impact of trade liberalization, this paper examines impacts on a large number of performance indicators. I begin with employment. The results appear in table 2. Since tables of this form will appear repeatedly, I carefully review it. Consider the top block of rows which deal with the employment of all workers. The 'Regression Specification' columns state whether equation (8) or equation (9) is being estimated and how the pre-FTA and FTA period changes are defined. For example, the first line presents estimates of equation (8) with the pre-FTA period changes defined over 1980-86 and the FTA period changes defined over 1988-96. This is my preferred specification.

Returning to the first line, the coefficient on the FTA tariff concessions is $\widehat{\beta} = 1.51$ which indicates that the FTA reduced employment. The coefficient on the U.S. control is $\widehat{\gamma} = 0.20$. The intercept is not reported. There are 213 observations and the $\overline{R}^2$ is a modest 0.071. In the second line, the pre-FTA period changes are re-defined to cover 1980-88 and in the third line the FTA period changes are re-defined to cover 1988-94. As is apparent, our results are only modestly sensitive to the choice of periods and hence to the implicit choice of business-cycle control.

The last line gives estimates of the regression diagnostic equation (9). In this line there are 426 (=2×213) observations because I have stacked the 2 periods. When the secular growth and business conditions controls are omitted, the FTA effect is much larger ($\widehat{\beta} = 2.29$). This shows that in the absence of proper controls, it is easy to overstate the employment effects of the FTA. It thus vindicates the lengthy theoretical discussion of controls in section 3.

The fourth row gives the IV estimate $\widehat{\beta} = 2.70$. As will generally be the case in this paper, it is larger in magnitude than the OLS estimate. The column "Wu's T2" gives the p-value for the Wu-Hausman exogeneity test. The value of 0.106 indicates that endogeneity is just rejected at the 10 percent level. Given the low power of the test, I will use *Wu's* $T2 < 0.01$ as a criterion for rejecting exogeneity.

The data distinguish between workers employed in manufacturing activities and non-manufacturing activities. I will refer to these as production and non-production workers since the distinction broadly follows that used in the U.S. Annual Survey of Manufactures (ASM). In 1988, production workers earned 30 percent less than non-production workers. An internal Statistics Canada memo also verifies that non-production workers are more educated than production workers. Table 2 reports results separately for production and non-production workers. The results for production workers are very similar to those of all workers. Thus, the results for total employment are driven by production workers. The FTA appears to have had almost no impact on non-production workers ($\widehat{\beta} = 0.48$ and $t = 0.55$). However, exogeneity is rejected and the IV estimate indicates that the FTA raised non-production worker employment.

A common measure of average industry skill is the ratio of non-production workers to production workers. Hence the change in this ratio is often referred to as 'skill upgrading.' The OLS results indicate that the FTA did not significantly contribute to skill upgrading ($\widehat{\beta} = -1.35$ and $t = -1.35$). However, the IV results paint a picture of statistically significant FTA induced skill upgrading. This is consistent with a Feenstra and Hanson (1996a) story involving Canadian outsourcing to low-wage, less-unionized Southern U.S. states. This was an issue raised during the FTA negotiations.

5. Economic Impacts

For industry i, $\widehat{\beta}\Delta\tau_{i1}^{FTA}$ is the log-point change in an outcome of interest such as employment that is explained by the FTA mandated tariff cuts. To calculate the log-point change for all of manufacturing one must compute the weighted average of the $\widehat{\beta}\Delta\tau_{i1}^{FTA}$ where the weights depend on industry size. See appendix 5 for details. The change in employment for all of manufacturing appears in table 2. Consider the last line in the block of rows dealing with the employment of all workers: '*Observed Change* = (-16%, -25%), *Due to FTA* = (-5%, -15%).' *Observed Change* is the log point change in employment during 1988-96. In what follows I will interpret these log point changes as percentage changes. The first number in parentheses (-16 percent) is the manufacturing-wide percentage change in employment. Employment fell by 16 percent. *Due to FTA* is the log point change in employment estimated to have been caused by the FTA mandated tariff cuts. With $\widehat{\beta} = 1.51$, I estimate that the FTA tariff cuts reduced employment by 5 percent. Re-stated, about one-third (= 5/16) of the 1988-96 manufacturing employment losses are due to the FTA.

Of course, some industries experienced particularly large tariff cuts. I ranked the 213 manufacturing industries in my sample by the size of the FTA mandated tariff cuts (i.e., by the $\Delta\tau_{i1}^{FTA}$) and examined the one-third of industries that experienced the deepest tariff cuts. This group has 71 (= 213/3) industries. For these industries the production-weighted average tariff cut was 10 percent, the smallest tariff cut was 5 percent and the largest tariff cut was 33 percent. I will refer to these industries as *the most impacted industries.* The industries are listed in table A1. As is apparent from table A1, these are 'low-end' manufacturing industries. Log point changes for these industries appear as the second number in the parentheses following *Observed Change* and *Due to FTA*. For these industries, employment fell by 25 percent and I estimate that the FTA reduced employment by 15 percent. Re-stated, about two-thirds (= 15/25) of the employment losses in the most impacted industries were due to the FTA. *These numbers point to the very large transition costs of moving out of low-end, heavily protected industries. They are the most obvious of* *the short-run costs associated with trade liberalization.*

6. Earnings

Most commentators expected Canadian wages to suffer from competition from less-unionized, less educated workers in the Southern United States. I assess this using annual earnings data from ASM payroll statistics. See table 3. For all workers, the *Observed Change* row provides some evidence of downward earnings pressure. Earnings growth in the most impacted industries was a scant 2 percent over 8 years compared to 5 percent for all industries. This makes it particularly surprising that when inferences are based on a model with adequate controls (i.e., equation 8), the FTA tariff concessions appear to have *raised* earnings. From table 3, the tariff coefficient estimate is $\widehat{\beta} = -0.50$ with a t-statistic of -2.61. For the most impacted industries this translates into a modest, but positive 5 percent rise in earnings over 8 years.

Inspection of table 3 reveals that the FTA earnings gains were completely driven by earnings for production workers rather than non-production workers. This implies that the FTA led to declining inequality as measured by the ratio of non-production worker earnings to production worker earnings. This is confirmed by the table 3 results for 'Earnings Inequality.' However, the reduction in inequality is not statistically significant.

Finally, table 4 shows that all of the earnings effect for production workers is due to FTA effects on wages, not hours.

7. Imports

Table 5 presents results for the impact of the FTA tariff concessions on imports. The import regressions do no include U.S. controls because this would make no sense. More sensible controls can be introduced by scaling. In particular, I consider Canadian imports from the United States as a share of Canadian output. I also consider Canadian imports from the United States as a share of total Canadian imports. This captures import substitution.

From table 5, the FTA tariff cuts are a statistically significant determinant of these import shares. From the *Observed Change* row, the FTA tariff cuts explain most of the huge change in import shares experienced by the most impacted industries. For example, the ratio of imports to output rose by 72 percent for the most impacted industries, a number which is very similar to the 67 percent due to the FTA. Needless to say, the FTA cannot explain the import surge among industries such as autos that were not effected by the FTA. That is, the *Due to FTA* numbers for aggregate manufacturing are small.

For intra-industry trade, the results suggest that if anything, the FTA reduced such trade. This is indicative of modest comparative advantage specialization. It is consistent with the fuller discussion of specialization in Head and Ries (1999a). Note that my conclusion is not statistically significant.

8. Output, Value Added and Number of Plants

Table 6 reports results for real output. Output is the value of shipments adjusted for changes in inventories, goods in process, and goods for resale. Data are from a special

Statistics Canada run. I will discuss deflation issues in the next section. For now I note that there is little sensitivity to choice of deflators. With an eye to later results on productivity, I also prefer to work with output generated by production activities since it excludes non-production activities such as in-house marketing, book-keeping and other service activities for which productivity concepts are less clear. This said, results for production activities and all activities are invariably similar. From the *Observed Change* row of table 6, output rose by 9 percent during 1988-96 for all of manufacturing while it fell by 10 percent for the most impacted industries. This is potentially strong evidence about the harm caused by the FTA. However once controls for secular trends, business conditions, and U.S. movements are added, this relationship is weakened ($\beta = 1.08$ and $t = 1.76$). The FTA reduced output by a statistically insignificant 11 percent for the most impacted industries.

Table 6 also reports results for real value added in production activities. Again, deflation is discussed below. The most impacted industries experienced a 5 percent reduction in value added compared to a 6 percent expansion in value added for all of manufacturing. However, this relationship is neither statistically significant ($t = 0.37$) nor economically large in the multivariate regression setting of equation (8).

Over the 1988-96 period, the number of plants declined by 12 percent for all of manufacturing and by a staggering 23 percent for the most impacted industries. (See the *Observed Change* row.) Once controls are added, the FTA effect becomes statistically small ($t = 1.74$), but remains economically large. For the most impacted industries, the FTA reduced the number of plants by 8 percent. Thus, there remains evidence that the FTA led to plant rationalization by accelerating exit.

To conclude, although the most impacted industries experienced large declines in output, value added, and number of plants, FTA culpability appears to be only partial.

9. Labour Productivity

Ideally, one wants to examine productivity using a total factor productivity (TFP) measure. Unfortunately, the Canadian ASM does not record capital stock or investment information. There is thus little alternative but to work with labour productivity. The most common measure of labour productivity is real value added per worker. This is the third measure reported in table 7. There are several defects with this measure, two of which are easily addressed.

The first deals with the measurement of labour input. In Canada, but not in the United States, there has been a strong trend towards part-time employment. By not correcting for Canadian hours, measure 3 has a downward trend. Since this trend will be spuriously correlated with the downward trend in tariffs, the estimated effect of the FTA on productivity ($\widehat{\beta}$) will be downward biased. The Canadian data allow for an hours correction. Unlike the U.S. data, value added is reported for production activities alone and thus can be directly compared with the data reported for hours worked. Measure 1 of table 7 reports $\widehat{\beta}$ using Canadian real value added in production activities per hour worked and U.S. real value added in all activities per employee. As expected, $\widehat{\beta}$ is larger for measure 3 than for measure 1 (though both are large). Clearly, measure 1 is preferred.

The second data issue deals with deflators.[9] In table 7, measures 1 and 3 use output

[9] I am indebted to Alwyn Young for encouraging me to examine this issue carefully.

deflators while measure 2 uses value-added deflators. Value-added deflators would have been preferable had the U.S. deflator not been seriously flawed for present purposes. It is at the 2-digit level (20 industries) and even at this highly aggregated level there are imputations for instruments (SIC 38) and electric and electronic equipment (SIC 36). Measure 2 of table 7, the value-added deflated measure, thus has serious problems. This said, the $\widehat{\beta}$ based on value-added deflators are very similar to the $\widehat{\beta}$ based on output deflators. This can be seen by comparing measures 1 and 2 in table 7.[10]

I now turn to a detailed review of the labour productivity results. Independent of the measure of labour productivity, FTA tariff concessions raised labour productivity both statistically and economically. For my preferred specification (the first line of table 7), the estimate of the FTA tariff effect is $\widehat{\beta} = -1.56$ with a t-statistic of -3.17. From the *Due to FTA* row, this implies that the FTA raised labour productivity by 4.7 percent for manufacturing as a whole and by 16.6 percent for the most impacted industries.

More generally, consider all the equation (8) OLS specifications in table 7 that I have reviewed so far i.e., the first 3 lines for each measure. The $\widehat{\beta}$ range from -0.88 to -1.59 which implies FTA induced productivity effects of 2.6 to 4.8 percent for manufacturing as a whole and 9.3 to 16.9 percent for the most impacted industries. Thus, no matter which estimate is used, large productivity gains obtain.

These numbers leave a greater impression when put on a compound annual basis. For all of manufacturing, the FTA tariff concessions raised labour productivity by between 0.3 and 0.6 percent per year. For the most impacted industries, the tariff concessions raised

[10] There are other problems with the deflators used in this study, but as an empirical matter these turn out to be minor. I thus relegate them to appendix 4.

labour productivity by between 1.2 and 2.1 percent per year. Further, my preferred measure 1 puts the gains at the upper end of these intervals. These are enormous numbers. The idea that an international trade policy could raise productivity so dramatically is to my mind remarkable.

9.1. Some Additional Sensitivity

To further investigate robustness, I considered several additional specifications for the measure 1 of labour productivity. These appear as the new block of 4 lines under measure 1. (Similar conclusions emerge for the other measures.) In the first of these lines ($\widehat{\beta} = -1.52$), I exclude Δy_{i1}^{US} as a regressor on the grounds that U.S. productivity growth in the high-tech sector might be an inappropriate control for Canada. In the next line ($\widehat{\beta} = -1.56$), the 9 industries (observations) that comprise the automotive sector are deleted on the grounds that this sector is distorted by the 1965 Auto Pact. In the next line ($\widehat{\beta} = -1.38$), I deleted the 2 industries (observations) which, from table A1, might be viewed as having unusually large FTA mandated tariff cuts. In the last line ($\widehat{\beta} = -1.95$), only those industries that were among the 71 most impacted industries are included. (Here the sample size is down to 71.) The similarity between the $\widehat{\beta}$ for the most impacted industries and for all of manufacturing means that the estimates reported in table 7 adequately represent the former. Looking across the 4 specifications that I have reviewed in this subsection, it is clear that the conclusions about large FTA induced increases in labour productivity are robust.

10. What Underlies Rising Labour Productivity?

Rising labour productivity could be driven by any number of factors. For example, capital deepening and within-industry shifts to high productivity firms are obvious explanations. In this section I take a systematic look at these and other explanations. I begin with a few familiar equations. Let $Q = A \cdot F(L, K, M)$ be the production function for a representative firm where Q is output, L is labour, K is capital, M is materials plus fuel, and A is a measure of technical efficiency. Let α_i $(i = l, k, m)$ be factor shares. For example, $\alpha_m = P_m M/(PQ)$ where P is the product price and P_m is the price of materials plus fuel. I allow for imperfect competition with zero profits. Let μ be the elasticity of scale or, equivalently, the mark-up of price over marginal cost. I will use lower case letters to denote log changes. For example, $a \equiv dA/A$. Following Hall (1988), totally differentiate the log of the production function to obtain

$$a = q - \mu(\alpha_l l + \alpha_k k + \alpha_m m). \tag{10}$$

a is a common measure of productivity growth.

Now consider labour productivity growth. Value added is defined as $V \equiv PQ - P_m M$. Totally differentiating $\ln V - \ln L$, equating marginal revenue $\partial PQ/\partial Q$ with marginal cost MC, and using $MC = P(P/MC)^{-1} = P\mu^{-1}$, one obtains an expression for labour productivity growth $v - l$:

$$v - l = \frac{q - \mu\alpha_m m - \mu(1 - \alpha_m)l}{\mu(1 - \alpha_m)}. \tag{11}$$

Consider the relationship between productivity growth a and labour productivity growth $v - l$. In equation (10), substitute out α_l using the zero-profit condition $\alpha_l + \alpha_k + \alpha_m = 1$ and substitute out $q - \mu\alpha_m m$ using equation (11) to obtain

$$a = \mu \{(1 - \alpha_m)(v - l) - \alpha_k(k - l)\} . \tag{12}$$

This equation provides a reference point for thinking about why labour productivity growth $v-l$ differs from productivity growth a. Interest focuses on the impact of trade liberalization $d\tau$ on productivity i.e., on $da/d\tau$. From equation (12), $da/d\tau$ depends on how μ, α_m, $(v-l)$, α_k, and $(k - l)$ vary with $d\tau$.

What follows is full of details so let me summarize it in advance. First, I will argue empirically that $d(k-l)/d\tau$ and $d\mu/d\tau$ are close enough to zero to be treated as second-order effects. I will then compute $da/d\tau$ using data on the remaining terms. Empirically, the only large term in the expression for $da/d\tau$ will be $\mu(1 - \alpha_m)d(v - l)/d\tau$. Since $\mu(1 - \alpha_m) \approx 1/2$ and $d(v - l)/d\tau$ is my estimate of the effect of the FTA on labour productivity, the effect of the FTA on productivity is approximately half as large as its effect on labour productivity. Finally, I will use data grouped by industry and plant size to argue that these productivity effects are not due to shifts in market shares from low- to high-productivity plants. Rather, they are due to plant turnover (entry and exit) together with rising technical efficiency.

10.1. Capital ($d(k - l)/d\tau$)

4-digit capital stock does not exist for Canada. What is available is a wealth survey at the 3-digit level for 1984-95. There are a number of problems with these data. First, at the 3-digit level of 104 industries, much of the tariff variability disappears. Second, wealth surveys are based on ownership rather than use so that most of the capital stock is assigned to the financial sector. (See Statistics Canada 1996). Third, the U.S. capital stock data from the NBER productivity database are constructed very differently from the Canadian data. With these caveats in mind, I proceed to estimation.

I estimate the usual equation (8) with Δy_{is} and Δy_{is}^{US} defined as changes in the log of the Canadian and U.S. capital-labour ratios, respectively. The pre-FTA period changes cover either 1984-86 or 1984-88 and the FTA period changes cover 1988-95.[11] Table 8 reports the results. As is apparent, the FTA had no effect on the capital-labour ratio. To refine matters, I also defined the Canadian capital-labour ratio on something closer to a production activity basis: machinery and equipment divided by hours worked by production workers. Again, there is no effect of the FTA tariff cuts on the capital to labour ratio. Note that I am precisely estimating zero effects.[12]

None of this will surprise those involved in Canadian public policy where it is well known that over the 1988-96 period, real fixed investment grew by 74 percent in the U.S. compared to only 15 percent in Canada. It is thus unlikely that the FTA labour productivity effect is driven by capital deepening.

[11] For this paper I updated the NBER productivity database from 1994 to 1996. However, I could not update the capital stock data. Thus, for 1995 the U.S. capital stock data were extrapolated based on 1993-94 growth rates. This appears not to be important as judged by the fact that almost identical results obtain when the FTA period changes cover 1988-94, thus excluding 1995.

[12] Specifically, let $\widehat{\sigma}$ be the standard error of $\widehat{\beta}$. If one replaces $\widehat{\beta}$ with $\widehat{\beta} \pm \widehat{\sigma}$ in the calculation of *Due to FTA*, one still obtains effects that are less than 0.1 percent.

10.2. Scale ($d\mu/d\tau$)

From equation (12), the difference between productivity a and labour productivity $v - l$ depends on the scale of operations or mark-up μ. Work by Levinsohn (1993), Harrison (1994), Krishna and Mitra (1998), and Pavcnik (2000) indicates that trade liberalization has reduced mark-ups in developing countries. For the purpose of this section, which is to investigate whether the FTA labour productivity results are driven by changes in μ, the changes in μ documented by these authors are small. For example, one would need μ to fall from 2.0 to 1.0 in order to argue that the FTA had no impact on productivity a. A more realistic fall in μ, say from 1.1 to 1.0, would make little difference to my conclusions. This point is explored in detail below.

Unfortunately, in the absence of good capital stock data, I cannot directly estimate either μ or $d\mu/d\tau$. Nevertheless, there are some interesting insights to be garnered by examining the effects of the FTA on proxies for μ. Very poor and dated proxies that hark back to the pre-1980's industrial organization literature are output per plant and value added per plant. I estimate the usual equation (8) using these scale proxies. Note that I am back to using 4-digit SIC data and that I do not have U.S. data for these scale proxies because U.S. number-of-plants data are published only at 5-year intervals. The results appear in table 8. As is apparent, the FTA impact on these proxies is statistically insignificant and sensitive to the choice of proxy.

I was initially surprised by the absence of FTA effects on output per plant. It contrasts *sharply* with the computable general equilibrium literature. In many of those models it is precisely scale effects that lead to much of the gains from trade. It is thus reassuring that

I arrive at the same conclusions as Head and Ries (1999b). It is all the more reassuring in that I use a very different set of modelling assumptions. Tybout and Westbrook (1995) and Tybout (2000) echo this theme of limited scale effects.

Mark-ups μ are the ratio of price to marginal cost. It is thus relevant to examine prices. Returning to 3-digit data, the bottom of table 8 reports results for the impact of the FTA on shipments deflators. The reduction in prices associated with the FTA tariff cuts is statistically insignificant and economically small.

To conclude, while I am confident that the FTA had no impact on prices or output per plant, I can only tentatively conclude from this that the FTA had no impact on scale or mark-ups i.e., on μ.

10.3. Productivity ($da/d\tau$)

The caveat-ridden conclusions of the last two subsections are that the FTA had little or no effect on capital-labour ratios or scale economies. If so then a simple calculation relates FTA induced productivity growth $da/d\tau$ to FTA induced labour productivity growth $d(v-l)/d\tau$. Differentiating equation (12) with respect to τ and using $d(k-l)/d\tau = d\mu/d\tau = 0$ yields

$$\frac{da}{d\tau} = \mu(1-\alpha_m)\frac{d(v-l)}{d\tau} - \mu\left\{(v-l)\frac{d\alpha_m}{d\tau} + (k-l)\frac{d\alpha_k}{d\tau}\right\}. \qquad (13)$$

Table 9 calculates $da/d\tau$ for a particular set of assumptions about the terms in equation (13). $d\tau$ is just a continuous version of the discrete change $\Delta\tau_{i1}^{FTA}$. $d(v-l)/d\tau$ is the *Due to FTA* labour productivity effect from measure 1 of table 7.[13] $v-l$ is the *Observed*

[13] v is nominal value added growth. However, since we find no evidence that the FTA effected value

Change data from measure 1 of table 7. $k - l$ is the *Observed Change* data for machinery and equipment per hour worked from table 8. For $d\alpha_m/d\tau$ and $d\alpha_k/d\tau$, I use the observed change in α_m and α_k during 1988-96 (times -1). This will overstate $d\alpha_m/d\tau$ and $d\alpha_k/d\tau$, but the associated terms are so small that any bias will have only second-order effects. For the mark-up μ, Basu and Fernald (1997) and others argue that μ is small, close to unity and no larger than 1.10. It makes no difference which $\mu \, \epsilon \, (1.00, 1.10)$ I use so that I settle for $\mu = 1.05$. The reader can readily re-compute $da/d\tau$ for any value of μ by using equation (13), table 9, and a hand-held calculator.

From table 9, the effect of the FTA on labour productivity is about twice as large as on a i.e., on TFP. It raised TFP by 1.9 percent for all of manufacturing and by 7.7 percent for the most impacted industries. On an annualized basis, the FTA raised TFP by a compounded 1.0 percent per year in the most impacted industries. To my mind, *this number paints a picture of very large long-run efficiency gains from trade liberalization.*

Now that the reader has seen equation (13) and table 9, it is easy to show that it makes little difference if the empirically motivated assumption $d\mu/d\tau = 0$ is relaxed. For the most impacted industries (which are basically low-end manufacturing and hence subject to constant returns to scale), a large change in μ would be 0.1 i.e., $d\mu/d\tau = -0.1$. Under this assumption, it is easy to show that the FTA effect for the most impacted industries falls from 7.7 percent to 6.7 percent.[14] That is, our estimate of the effect of the FTA tariff cuts on TFP is not particularly sensitive to the assumption made about the effect of the FTA

added deflators, the change in nominal value added due to the FTA equals the change in real value added due to the FTA.

[14]From equation (12), $\partial a/\partial \mu = (1 - \alpha_m)(v - l) - \alpha_k(k - l) \approx 0.10$ for the most impacted industries. If $d\mu/d\tau = -0.1$ then $\partial a/\partial \tau \equiv (\partial a/\partial \mu)(d\mu/d\tau) \approx -0.010$ or -1.0 percent.

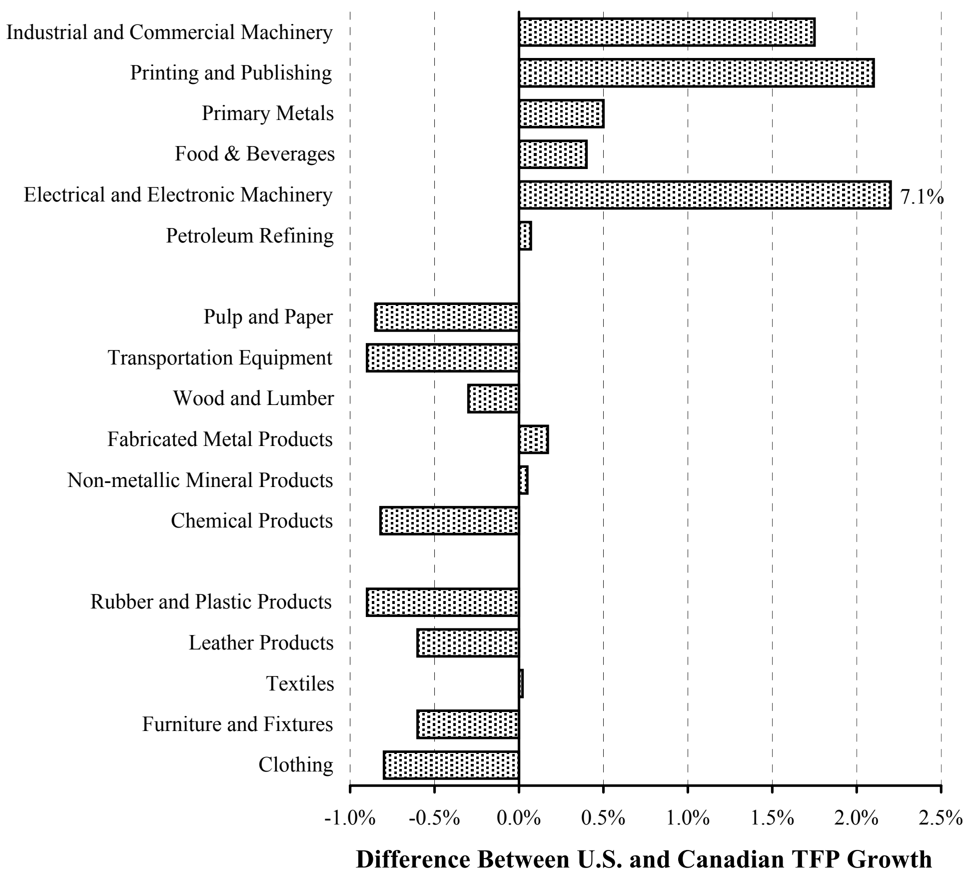
tariff cuts on mark-ups.

Finally, one might ask if there is more direct evidence on TFP. The answer is yes. Using some heroic assumptions about Canadian and U.S. data comparability, Statistics Canada published 1990-95 TFP growth rates for 17 Canadian and U.S. industries. U.S. TFP growth rates minus Canadian TFP growth rates appear in figure 4. I have ordered industries by the depth of the FTA mandated tariff cuts: The most impacted industries are at the bottom and the least impacted industries are at the top. Every one of the top 5 industries experienced more rapid TFP growth in the United States than in Canada. Further, almost every one of the bottom 5 industries experienced more rapid TFP growth in Canada than in the United States. Figure 4 shows that Canadian TFP rose relative to U.S. TFP in those industries that were most impacted by the FTA. This is exactly the same conclusion arrived at econometrically in table 9.

10.4. Heterogeneity

It seems likely that part or most of the estimated FTA impact on productivity is not a gain in technical efficiency, but industrial reallocation from low productivity to high productivity plants. In this section I offer some informal evidence about the decomposition of FTA labour productivity growth into its technical (within-plant) and allocative (between-plant) components. I have 1988 and 1995 data on labour productivity grouped by industry and plant size where plant size is defined by the number of employees e.g., all plants in SIC industry 1011 with between 10 and 19 employees. The data are from special tabulations by Statistics Canada and cover 204 of the 213 industries in my sample. There are 1,026

Figure 4. Annual TFP Growth Rate Differences, 1990-95



Notes : The figure plots the annual percentage change in U.S. TFP less the annual percentage change in Canadian TFP. Industries are sorted by the depth of the 1988-96 FTA-mandated tariff cuts. Industries at the bottom of the figure experienced the deepest tariff cuts. For Electrical and Electronic Machinery, the change of 7.1% is plotted as 2.2% in order to make the figure clearer. Data are from Statistics Canada's *The Daily* , March 23, 1999.

industry-plant size cells and the median industry has 6 plant size groups. It is thus a rich source of data. Let i continue to index industries and let j index plant size classes. Let y_{ijt} be the log of some outcome of interest. The usual decomposition of total growth into its within and between components is

$$\sum_{i,j} y_{ij,95}\omega_{ij95} - \sum_{i,j} y_{ij,88}\omega_{ij,88} = \sum_{i,j}(y_{ij,95} - y_{ij,88})\omega_{ij,88} + \sum_{i,j}(\omega_{ij,95} - \omega_{ij,88})y_{ij,95} \qquad (14)$$

where ω_{ijt} is the usual cell weight for the industry-plant size cell ($\Sigma_{ij}\omega_{ijt} = 1$).[15] The three terms in equation (14) are the 'total,' 'within' and 'between' changes, respectively. I will denote them by Δy^T, Δy^W, and Δy^B, respectively.

Table 10 reports Δy^W, Δy^B, Δy^T and $\Delta y^W/\Delta y^T$ for variables of interest. The first observation is that 78 percent of labour productivity growth is within industry-plant size cells. This is almost identical to the plant-level results reported by Baily *et al.* (1992) for 1982-87 U.S. TFP growth. Thus, most of FTA period labour productivity growth occurred within industry-plant size cells. A secondary conclusion pointed to by the value added and hours rows is that the productivity gains are coming from labour 'shedding': Within industry-plant size cells, value added is not changing, but hours are falling.

It is still possible that the industries which experienced the deepest tariff cuts tended to have share shifts favouring the most productive plants. To investigate the possibility of large between-cell effects for the most impacted industries, I considered a variance decomposition

[15] In the case of labour productivity, ω_{ijt} is (i,j)'s share of manufacturing value added. In the case of output per plant, ω_{ijt} is (i,j)'s share of manufacturing output.

for *each* industry. That is, fix industry i and compute

$$\sum_j y_{ij,95}\omega'_{ij95} - \sum_j y_{ij,88}\omega'_{ij,88} = \sum_j (y_{ij,95} - y_{ij,88})\omega'_{ij,88} + \sum_j (\omega'_{ij,95} - \omega'_{ij,88}) y_{ij,95} \qquad (15)$$

where ω'_{ijt} is the usual plant size weight for plant size j ($\Sigma_j \omega'_{ijt} = 1$). The three terms in equation (15) will be denoted by Δy_i^T, Δy_i^W, and Δy_i^B, respectively. The correlation of $\Delta\tau_{i1}^{FTA}$ with $\Delta y_i^B / \Delta y_i^T$ is a statistically insignificant 0.04. That is, the most impacted industries did not experience greater share shifting towards productive plants. *Restated, FTA induced labour productivity growth is unlikely to have been driven by shifts in market share from low- to high-productivity plants.*

There is another interesting result in table 10. For output per plant, growth between industry-plant size cells accounts for 73 percent of total growth. This confirms what we discussed before, namely, that any trend towards increased output per plant is associated with a shift in market share to larger plants. By adding a plant size dimension, this result extends the Head and Ries (1999b) observation that the FTA did not drive firms down their average cost curves. It also extends the Tybout and Westbrook (1995) observations for Mexico into a developed-country context.

Does the fact that most of the labour productivity growth was within industry-plant size cells tell us that the observed labour productivity growth primarily reflects growth in technical efficiency rather than growth in allocative efficiency? Not quite. I have ignored entry and exit. While it is not *a priori* clear whether plant turnover belongs in the 'between' or 'within' categories, Baldwin (1995) argues at length using 1970-79 Canadian plant data that Canadian productivity growth due to plant turnover mostly occurred within industry-plant size cells. Baldwin further finds that entering plants tended to be more productive than exiting plants. Bernard and Jensen (1999) report a similar finding for the United States.[16] Thus, labour productivity growth associated with entry and exit is likely part of what is driving the observed labour productivity growth within industry-plant size cells. This position is buttressed by the table 6 results which document that the FTA induced large net exit.

Where is the rising technical efficiency coming from? Baldwin and Beckstead (2001) argue that plants responded to the FTA tariff cuts by reducing the number of product lines. Other sources of technical efficiency are also possible, including efficiency gains related to the skill upgrading documented in table 2 above.

To conclude, FTA labour productivity growth does not appear to be caused by shifting market share from low- to high-productivity plants. Rather, it appears to be explained both by plant turnover (entry and exit) and rising technical efficiency within plants.[17]

10.5. Productivity Conclusions

I examined the role of scale, capital deepening, materials usage, and plant heterogeneity for my conclusions about labour productivity. If one is prepared to put aside the serious problems caused by lack of good capital-stock data, then it appears that scale and capital

[16] This may be related to Griliches and Regev's (1995) 'shadow of death.' See Tybout (2000) for a review of the literature that indicates how common is the finding that entering plants are more productive than exiting plants.

[17] We cannot be sure which is most important. Both Baily *et al.* (1992) and Griliches and Regev (1995) find that productivity gains are primarily due to within-plant gains rather than entry and exit.

deepening are not part of the FTA productivity story. If so, then half of the FTA impact on labour productivity is attributable to an FTA impact on industry-level TFP. This latter impact is large. Further, this change in industry-level TFP likely reflects a mix of plant turnover and rising technical efficiency within plants.

While the absence of plant-level and capital stock data dampens my certainty about these conclusions, the big picture is clearer. The most impacted industries are best characterized as low-end manufacturing industries. See table A1. Thus, unless low-end manufacturing experienced unusually high investment rates or enormous declines in mark-ups, the FTA must have induced TFP growth. There is sufficient evidence at the 3-digit SIC level to be confident that low-end manufacturing did not experience an investment boom. Further, the fact that low-end manufacturing typically has small mark-ups makes it impossible for low-end manufacturing to have experienced enormous declines in mark-ups. Thus, it seems likely that the FTA induced significant TFP growth through a combination of plant turnover and rising technical efficiency within plants.

11. Conclusions

The FTA lives in two different worlds. For some, it is integral to employment losses and eroding productivity relative to the United States. To others, it brought explosive trade growth and large gains in manufacturing gdp. Both these views rest on aggregate numbers for manufacturing. Neither is supported by a careful sectoral analysis. The following are the main conclusions of sectoral analysis. I summarize these conclusions separately for manufacturing as a whole and for the most impacted industries. The latter are the one-third of industries which experienced the largest tariff cuts over the 1988-96 period. For this group the tariff cuts ranged between 5 and 33 percent and averaged 10 percent.

(1) For the most impacted industries, the tariff cuts reduced employment by 15 percent, reduced output by 11 percent, and reduced the number of plants by 8 percent. For manufacturing as a whole, the numbers are 5, 3, and 4 percent, respectively. These numbers capture the large adjustment costs associated with reallocating resources out of protected, inefficient, low-end manufacturing. The fact that manufacturing employment and output have largely rebounded since 1996 suggests that some and perhaps most of the reallocation has been to high-end manufacturing.

(2) The tariff cuts raised labour productivity by a compounded annual rate of 2.1 percent for the most impacted industries and by 0.6 percent for manufacturing as a whole. The tariff cuts also raised total factor productivity by a compounded annual rate of 1.0 percent for the most impacted industries and by 0.2 percent for manufacturing as a whole. We argued that rising total factor productivity is not due to scale effects, capital deepening, or market share shifts towards high productivity firms. Rather, it is due to a mix of plant turnover and rising technical efficiency within plants. Dramatically higher productivity in low-end manufactures and resource re-allocation to high-end manufactures are the key gains from the FTA.

(3) Surprisingly, the tariff cuts slightly raised annual earnings, primarily by raising production worker wages by 0.8 percent per year for the most impacted industries and by 0.3 percent per year for manufacturing as a whole. The tariff cuts did not effect earnings of non-production workers or weekly hours of production workers. The FTA thus reduced

inequality, albeit minimally.

(4) For the most impacted industries, the tariff cuts explain almost all of the increased trade with the United States and the increased U.S. share of Canadian trade.

Most of the effects of the FTA tariff cuts are smaller than one would imagine given the heat generated by the debate. This heat is generated by the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed plants) and those who are garnering the *long run productivity gains* (consumers and stakeholders of efficient plants). One cannot understand current debates about freer trade without understanding this conflict. The results here thus take us one step closer to understanding how freer trade can be implemented in an *industrialized* economy in a way that recognizes both the *long-run gains* and the *short-run adjustment costs* borne by workers and others.

Appendix

1. The Effective Rate of Protection: Let υ_j be value added in industry j per dollar of output in the absence of tariffs. Let a_{ij} be the value of input of good i per dollar value of the output of j in the absence of tariffs. Let τ_j be the tariff rate against products in industry j. The effective tariff τ_j^e is the amount by which the tariff structure $(\tau_1, ..., \tau_j, ..., \tau_J)$ raises value added in industry j. Following Basevi (1966),

$$\tau_j^e = \tau_j + (\tau_j - \overline{\tau}_j) \sum_i a_{ij}\tau_i / \upsilon_j \qquad \text{where } \overline{\tau}_j = \sum_i a_{ij}\tau_i / \sum_i a_{ij}.$$

For post-1992 effective rates of protection, the 1992 input-output table was used. In all years, the effective rate of protection is calculated at the input-output 'M' level (which is roughly at the 3-digit SIC level) and aggregated using production weights. The aggregated data of figure 1 use 1980 production weights for aggregation and were smoothed using a 3-year moving average to eliminate a spike in 1993-94.

2. Tariff Aggregation Bias: Aggregation bias (the use of imports as weights for aggregating tariffs to the 4-digit level) leads to violations of the Most-Favored Nation (MFN) equality $\tau_{it}^{US} = \tau_{it}^{ROW}$ for $t \leq 1988$. Aggregation bias is only a problem in the present context if it *changes* over time. Imposing $\tau_{i,1988}^{US} = \tau_{i,1988}^{ROW}$ in equation (3) exacerbates such *change* because it implicitly uses arbitrary aggregation weights for 1988 that are unrelated to the import aggregation weights used for year t_1. That is, it forces the aggregation weights to change dramatically between 1988 and t_1. This increases the *change* in aggregation bias in the FTA period. As a result, I do not impose $\tau_{i,1988}^{US} = \tau_{i,1988}^{ROW}$ in equation (3). To investigate further, I also considered specifications with $\Delta\tau_{i0}^{FTA} = 0$ replaced by $\Delta\tau_{i0}^{FTA} \equiv ((\tau_{i,t_0}^{US} - \tau_{i,t_0}^{ROW}) - (\tau_{i,1980}^{US} - \tau_{i,1980}^{ROW}))/(t_0 - 1980)$. This had little or no effect on the results.

3. List of Industries in Each Tariff Group: See table A1. Note that 12 of Canada's 225 4-digit SIC industries were either excluded from the analysis because of incomplete data or aggregated in order to ensure consistency over time. The aggregated industries are (new name in parentheses): 1094 and 1099 (1098); 1511 and 1599 (1598); 1995 and 1999 (1998); 2911 and 2919 (2918); 2951 and 2959 (2958); 3051 and 3059 (3058); 3351 and 3359 (3358); 3362 and 3369 (3368).

4. Deflators:

U.S. Deflators: The value-added deflator is the gdp deflator reported on the BEA website as of May 1999. The output deflator is the usual value of shipments deflator. Through 1994, it is adjusted by Make tables as described in Bartelsman and Gray (1996). After 1994, it is unadjusted. To see the effect of this series break, in table 7 compare the first and third lines for the output-deflated productivity measures. The first line ends in 1996, the third in 1994. Since the estimates are similar, the splicing of the 1980-94 and 1995-96 deflator series plays little role. On a technical note, in converting deflators from U.S. SIC to Canadian SIC, Tornqvist indexes were used.

Canadian Deflators: The value-added (output) deflator is derived by dividing nominal value added (output) by real value added (output). The real and nominal series for value added and output are from the Canadian input-output tables. The tables are available through 1995. For 1996 both the value added and output deflators were spliced to the Canadian 'industry price indexes' from CANSIM. This series is almost identical to the input-output-derived output deflator, but not of course to the value added deflator. Again from table 7, comparison of the first line (ending in 1996) with the third line (ending in 1994) reveals that the splice plays little role. The input-output tables are roughly at the 3-digit Canadian SIC level (137 industries) so that the deflator values were repeated at the 4-digit level (213 industries). It is difficult to evaluate the importance of this. Note though that the simple correlation of tariff cuts $\Delta\tau_{i1}^{FTA}$ with the output deflator is -0.04. This suggests that cross-sectionally, the results are not being driven by a spurious correlation hidden here.

5. Defining 'Observed Change' and 'Due to FTA': Recall that $Y_{i,1988}$ is the level of, say employment, in industry i in 1988. The industry i change in employment over the FTA period is approximately $(\Delta y_{i1})\,Y_{i,1988}$ i.e., the log change times the initial level. The change in employment among industries in any set I is approximately $\sum_{i\epsilon I}(\Delta y_{i1})\,Y_{i,1988}$. As a proportion of total employment it is $\sum_{i\epsilon I}(\Delta y_{i1})\,Y_{i,1988}/\sum_{j\epsilon I}Y_{j,1988}$. This can be re-written as $\sum_{i\epsilon I}\Delta y_{i1}\omega_i$ where $\omega_i \equiv Y_{i,1988}/\sum_{j\epsilon I}Y_{j,1988}$.[18] Using the fact that $\widehat{\Delta y_{i1}} = \widehat{\beta}\Delta\tau_{i1}^{FTA}$ is the prediction of the impact of the tariff concessions, the predicted tariff-induced log change in employment is $\sum_{i\epsilon I}\widehat{\beta}\Delta\tau_{i1}^{FTA}\omega_i$. With this in mind, *Observed Change* is defined as $100\cdot 8\cdot\sum_{i\epsilon I}\Delta y_{i1}\omega_i$ and *Due to FTA* is defined as $100\cdot 8\cdot\sum_{i\epsilon I}\widehat{\beta}\Delta\tau_{i1}^{FTA}\omega_i$. Multiplying by 8 converts the average annual changes for the 8 FTA years into a total FTA period change. For the compounded annual rates reported in this paper, the '8' is removed. The $\widehat{\beta}$ used in *Due to FTA* is the estimate from the first-line specification (equation 8 with pre-FTA period changes over 1980-86 and FTA period changes over 1988-96).

[18] For the cases of production worker earnings and wages, ω_i is based on total hours worked by production workers. For the cases of skill upgrading and inequality ω_i is based on total employment. For cases where $Y_{i,1988}$ is a ratio, ω_i is based on the numerator of the ratio i.e., if $Y_{i,1988} = a_{i,1988}/b_{i,1988}$ then $\omega_i \equiv a_{i,1988}/\sum_{j\epsilon I}a_{j,1988}$.

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Table 1. Correlates of FTA-Period Growth

	Correlation of Δy_{i1} with		
	Δy_{i0}	$\Delta \tau_{i1}^{FTA}$	Δy_{i1}^{US}
Variable (y)	(1)	(2)	(3)
Employment	.21	.24	.35
Output	.30	.28	.50
Value Added	.28	.19	.36
Number of Plants	.13	.34	

Notes: For concreteness in describing this table let y be the log of employment. Then Δy_{i1} is the 1988-96 FTA period log change in employment, Δy_{i0} is the 1980-88 pre-FTA period log change in employment, Δy_{i1}^{US} is the 1988-96 log change in U.S. employment, and $\Delta \tau_{i1}^{FTA}$ is the 1988-96 FTA-mandated tariff cut. The table reports the correlation of Δy_{i1} with Δy_{i0} (column 1), Δy_{i1} with $\Delta \tau_{i1}^{FTA}$ (column 2), and Δy_{i1} with Δy_{i1}^{US} (column 3). These are cross-industry correlations using 213 industries (observations).

Table 2. Regression Results for Employment

Regression Specification[a]								
	Period		Tariffs		U.S. Control			
Eqn.	Pre-FTA	FTA	β	*t*	γ	*t*	Adj R^2	Wu's T2[b]
Employment - All Workers								
8	1980-86	1988-96	1.51	2.73	0.20	2.62	.071	
8	1980-88	1988-96	1.16	2.33	0.16	2.44	.057	
8	1980-86	1988-94	1.30	2.42	0.26	3.23	.075	
8	1980-86	1988-96	2.70	2.90	0.17	2.06	.076	.106
9	1980-86	1988-96	2.29	6.31	0.21	3.91	.112	
Observed Change = (-16% , -25%), *Due to FTA* = (-5% , -15%)[c]								
Employment - Production Workers								
8	1980-86	1988-96	1.62	2.55	0.22	2.58	.069	
8	1980-88	1988-96	1.28	2.29	0.18	2.45	.058	
8	1980-86	1988-94	1.62	2.61	0.31	3.44	.089	
8	1980-86	1988-96	3.63	3.30	0.15	1.66	.091	.020
9	1980-86	1988-96	2.74	6.93	0.18	3.26	.117	
Observed Change = (-17% , -29%), *Due to FTA* = (-6% , -16%)[c]								
Employment - Non-Production Workers								
8	1980-86	1988-96	0.48	0.55	0.12	1.03	-.002	
8	1980-88	1988-96	0.66	0.78	0.10	0.97	.000	
8	1980-86	1988-94	-0.27	-0.33	0.04	0.29	-.009	
8	1980-86	1988-96	-3.04	-2.03	0.21	1.60	.018	.002 *
9	1980-86	1988-96	0.08	0.18	0.25	3.61	.026	
Observed Change = (-17% , -17%), *Due to FTA* = (-1% , -5%)[c]								
Skill Upgrading[d]								
8	1980-86	1988-96	-1.35	-1.35	0.21	0.90	.005	
8	1980-88	1988-96	-0.79	-0.86	0.14	0.66	-.004	
8	1980-86	1988-94	-2.23	-2.20	0.03	0.11	.014	
8	1980-86	1988-96	-5.76	-3.40	0.08	0.32	.058	.000 *
9	1980-86	1988-96	-2.60	-5.27	0.07	0.60	.059	
Observed Change = (7% , 20%), *Due to FTA* = (5% , 13%)[c]								

Notes: a) The regression specification is given by the estimating equation (equations 8 or 9), the definition of the pre-FTA period changes (1980-86 or 1980-88), and the definition of the FTA period changes (1988-96 or 1988-94).

b) The *Wu's T2* column is blank when the OLS estimator is reported and is filled when the IV estimator is reported. The column reports the *p*-value for a Hausman test (specifically, Wu's T2 test). Rejection of exogeneity is indicated by a *p*-value of less than 0.01 (and an asterisk).

c) *Observed Change* is the FTA-period change in the dependent variable. *Due to FTA* is the FTA-period change estimated to be caused by the FTA tariff cuts. The first number in parentheses reports the change for all 213 industries. The second number reports the change for the 71 industries that experienced the largest tariff cuts. Estimates are based on the estimated β that appear in the variable's first line e.g., β=1.51 for All Workers and β=1.62 for Production Workers.

d) Skill upgrading is the log of the ratio of non-production workers to production workers.

e) The dependent variable is indicated in bold font at the start of each block of results e.g., 'Employment - All Workers.' All dependent variables are in logs. For equation (8) there are 213 observations for all workers, 211 observations for production workers, 212 observations for non-production workers, and 211 observations for skill upgrading. For equation (9) there are twice as many observations.

Table 3. Regression Results for Annual Earnings

Regression Specification[a]

	Period		Tariffs		U.S. Control			
Eqn.	Pre-FTA	FTA	β	*t*	γ	*t*	Adj R^2	Wu's T2[a]
Earnings - All Workers								
8	1980-86	1988-96	-0.50	-2.61	0.19	1.82	.036	
8	1980-88	1988-96	-0.37	-2.22	0.22	2.20	.031	
8	1980-86	1988-94	-0.48	-2.57	0.21	1.82	.037	
8	1980-86	1988-96	-1.02	-3.29	0.20	1.87	.056	.028
9	1980-86	1988-96	-0.28	-2.21	0.07	1.20	.007	
Observed Change = (5% , 2%), *Due to FTA* = (2% , 5%)[a]								
Earnings - Production Workers								
8	1980-86	1988-96	-0.42	-2.06	0.11	1.14	.017	
8	1980-88	1988-96	-0.32	-1.74	0.05	0.49	.005	
8	1980-86	1988-94	-0.34	-1.68	0.21	1.97	.022	
8	1980-86	1988-96	-0.57	-1.72	0.11	1.13	.011	.570
9	1980-86	1988-96	-0.11	-0.82	0.08	1.46	.001	
Observed Change = (3% , 0%), *Due to FTA* = (1% , 4%)[a]								
Earnings - Non-Production Workers								
8	1980-86	1988-96	-0.01	-0.04	0.11	1.30	-.001	
8	1980-88	1988-96	0.13	0.48	0.14	1.43	.002	
8	1980-86	1988-94	0.24	0.93	0.13	1.45	.005	
8	1980-86	1988-96	0.61	1.42	0.08	0.95	.009	.063
9	1980-86	1988-96	0.17	1.15	0.08	1.61	.006	
Observed Change = (7% , 2%), *Due to FTA* = (0% , 0%)[a]								
Earnings Inequality[b]								
8	1980-86	1988-96	0.39	1.23	0.06	0.63	.001	
8	1980-88	1988-96	0.44	1.35	0.04	0.38	.000	
8	1980-86	1988-94	0.56	1.75	0.13	1.42	.016	
8	1980-86	1988-96	1.15	2.20	0.03	0.31	.018	.062
9	1980-86	1988-96	0.27	1.58	0.00	-0.06	.001	
Observed Change = (2% , 0%), *Due to FTA* = (-1% , -4%)[a]								

Notes: a) See notes *a*, *b*, *c*, and *e* of table 2.

b) *Earnings Inequality* is the log of the ratio of non-production worker earnings to production worker earnings.

c) All variables are in logs. There are 213 observations for all workers, 211 observations for production workers, 212 observations for non-production workers, and 211 observations for earnings inequality.

Table 4. Regression Results for Wages and Hours

Regression Specification[a]								
	Period		Tariffs		U.S. Control			
Eqn.	Pre-FTA	FTA	β	*t*	γ	*t*	Adj R^2	Wu's T2[a]
Hourly Wages of Production Workers								
8	1980-86	1988-96	-0.59	-2.96	0.13	1.30	.038	
8	1980-88	1988-96	-0.46	-2.56	0.13	1.39	.025	
8	1980-86	1988-94	-0.51	-2.53	0.18	1.80	.036	
8	1980-86	1988-96	-0.73	-2.30	0.13	1.33	.021	.559
9	1980-86	1988-96	-0.28	-2.16	0.04	0.74	.006	
Observed Change = (3% , 0%), *Due to FTA* = (2% , 6%)[a]								
Annual Hours of Production Workers								
8	1980-86	1988-96	0.14	1.13	0.12	1.50	.006	
8	1980-88	1988-96	0.08	0.77	0.02	0.26	-.007	
8	1980-86	1988-94	0.14	1.12	-0.05	-0.60	-.002	
8	1980-86	1988-96	0.13	0.64	0.12	1.49	.002	.953
9	1980-86	1988-96	0.19	2.62	0.06	0.96	.013	
Observed Change = (0% , 0%), *Due to FTA* = (0% , -1%)[a]								

Notes: a) See notes *a* , *b* , *c* , and *e* of table 2.

b) All variables are in logs. There are 211 observations for both wages and hours.

Table 5. Regression Results for Imports

Regression Specification[a]								
	Period		Tariffs		U.S. Control[b]			
Eqn.	Pre-FTA	FTA	β	*t*	γ	*t*	Adj R^2	Wu's T2[a]
Canadian Imports from the U.S. as a Share of Canadian Output								
8	1980-86	1988-96	-7.98	-6.33	.	.	.157	
8	1980-88	1988-96	-4.68	-2.81	.	.	.032	
8	1980-86	1988-94	-8.32	-6.26	.	.	.155	
8	1980-86	1988-96	-15.37	-7.02	.	.	.228	.000 *
9	1980-86	1988-96	-7.70	-10.21	.	.	.197	
Observed Change = (13% , 72%), *Due to FTA* = (2% , 67%)[a]								
Canadian Imports from the U.S. as a Share of Total Canadian Imports								
8	1980-86	1988-96	-7.80	-7.85	.	.	.225	
8	1980-88	1988-96	-5.80	-6.27	.	.	.155	
8	1980-86	1988-94	-6.89	-7.01	.	.	.187	
8	1980-86	1988-96	-15.43	-8.52	.	.	.342	.000 *
9	1980-86	1988-96	-5.59	-10.73	.	.	.214	
Observed Change = (4% , 24%), *Due to FTA* = (2% , 65%)[a]								
Canadian Imports from the U.S.								
8	1980-86	1988-96	-6.21	-5.36	.	.	.117	
8	1980-88	1988-96	-3.09	-1.93	.	.	.013	
8	1980-86	1988-94	-6.81	-5.79	.	.	.135	
8	1980-86	1988-96	-11.99	-6.08	.	.	.171	.000 *
9	1980-86	1988-96	-5.31	-7.37	.	.	.113	
Observed Change = (44% , 70%), *Due to FTA* = (2% , 52%)[a]								
Canada-U.S. Intra-Industry Trade								
8	1980-86	1988-96	0.76	1.45	.	.	.005	
8	1980-88	1988-96	1.34	2.48	.	.	.025	
8	1980-86	1988-94	0.72	1.39	.	.	.005	
8	1980-86	1988-96	0.79	0.95	.	.	-.001	.962
9	1980-86	1988-96	1.20	3.62	.	.	.029	
Observed Change = (3% , 8%), *Due to FTA* = (0% , -6%)[a]								

Notes: a) See notes *a* , *b* , *c* , and *e* of table 2.

b) The U.S. control is not included because it is meaningless here. Instead, controls are implicitly introduced via scaling.

c) All variables are in logs except intra-industry trade. There are 211 observations for the three import variables and 208 observations for the intra-industry trade variable.

Table 6. Regression Results for Output, Value Added, and Number of Plants

Regression Specification[a]

Eqn.	Period: Pre-FTA	Period: FTA	Tariffs: β	Tariffs: *t*	U.S. Control: γ	U.S. Control: *t*	Adj R^2	Wu's T2[a]
Gross Output in Production Activities								
8	1980-86	1988-96	1.08	1.76	0.24	3.23	.064	
8	1980-88	1988-96	0.93	1.73	0.23	3.36	.068	
8	1980-86	1988-94	1.16	1.89	0.22	2.65	.047	
8	1980-86	1988-96	2.54	2.43	0.20	2.62	.077	.079
9	1980-86	1988-96	2.40	5.86	0.33	6.73	.164	
Observed Change = (9% , -10%), *Due to FTA* = (-3% , -11%)[a]								
Value Added in Production Activities								
8	1980-86	1988-96	0.25	0.37	0.23	3.23	.042	
8	1980-88	1988-96	0.01	0.02	0.20	2.91	.031	
8	1980-86	1988-94	0.36	0.52	0.18	2.09	.015	
8	1980-86	1988-96	1.59	1.42	0.21	2.78	.051	.132
9	1980-86	1988-96	1.95	4.32	0.28	5.37	.106	
Observed Change = (6% , -5%), *Due to FTA* = (-1% , -3%)[a]								
Number of Plants[b]								
8	1980-86	1988-96	0.97	1.74	.	.	.009	
8	1980-88	1988-96	0.90	1.93	.	.	.013	
8	1980-86	1988-94	1.32	2.28	.	.	.019	
8	1980-86	1988-96	2.05	2.21	.	.	.019	.140
9	1980-86	1988-96	2.62	7.28	.	.	.109	
Observed Change = (-12% , -23%), *Due to FTA* = (-4% , -8%)[a]								

Notes: a) See notes *a* , *b* , *c* , and *e* of table 2.

b) The U.S. control for number of plants is omitted because the published data are only available at 5-year intervals.

c) All variables are in logs. There are 213 observations for each variable.

Table 7. Regression Results for Labour Productivity

Regression Specification[a]

Eqn.	Period: Pre-FTA	Period: FTA	Tariffs: β	Tariffs: t	U.S. Control: γ	U.S. Control: t	Adj R^2	Wu's T2[a]
1. Labour Productivity - Production Activities - Hours Adjusted - Output Deflators								
8	1980-86	1988-96	-1.56	-3.17	0.30	3.32	.081	
8	1980-88	1988-96	-1.31	-2.95	0.42	4.79	.126	
8	1980-86	1988-94	-1.59	-2.87	0.13	1.10	.032	
8	1980-86	1988-96	-2.17	-2.68	0.30	3.33	.069	.344
9	1980-86	1988-96	-0.87	-2.75	0.18	3.11	.030	
8[b]	1980-86	1988-96	-1.52	-3.03	.	.	.037	
8[b]	1980-86	1988-96	-1.56	-3.16	0.32	3.51	.090	
8[b]	1980-86	1988-96	-1.38	-2.45	0.03	3.33	.069	
8[b]	1980-86	1988-96	-1.95	-2.53	-0.07	-0.40	.059	
Observed Change = (20.4% , 21.4%), *Due to FTA* = (4.7% , 16.6%)[a]								
2. Labour Productivity - Production Activities - Hours Adjusted - Value-Added Deflators								
8	1980-86	1988-96	-1.51	-2.84	0.16	1.70	.039	
8	1980-88	1988-96	-1.35	-2.73	0.17	1.82	.041	
8	1980-86	1988-94	-1.34	-2.20	0.01	0.06	.013	
8	1980-86	1988-96	-2.17	-2.49	0.17	1.75	.031	.335
9	1980-86	1988-96	-1.16	-2.84	0.23	3.77	.040	
Observed Change = (20.0% , 18.6%), *Due to FTA* = (4.9% , 16.1%)[a]								
3. Labour Productivity - All Activities - Not Hours Adjusted - Output Deflators								
8	1980-86	1988-96	-1.03	-2.29	0.29	3.57	.069	
8	1980-88	1988-96	-0.88	-1.95	0.30	3.36	.060	
8	1980-86	1988-94	-0.92	-1.96	0.16	1.60	.018	
8	1980-86	1988-96	-0.73	-0.98	0.29	3.55	.050	.603
9	1980-86	1988-96	-0.32	-1.12	0.22	4.33	.039	
Observed Change = (23.0% , 21.1%), *Due to FTA* = (3.0% , 10.9%)[a]								

Notes: a) See notes *a* , *b* , *c* , and *e* of table 2.

b) These rows report some alternative specifications. The first row (β = -1.52) omits the U.S. controls. The second row (β = -1.56) deletes the 9 automotive-related industries (observations). The third row (β = -1.38) deletes the 2 observations with the largest FTA mandated tariff cuts. The fourth row (β = -1.95) deletes all but the 71 most impacted industries.

c) All variables are in logs. There are 211 observations for measures 1 and 2 (unless indicated otherwise in note *c*) and 213 observations for measure 3.

Table 8. Investigating Labour Productivity

Regression Specification[a]								
	Period		Tariffs		U.S. Control			
Eqn.	Pre-FTA	FTA	β	*t*	γ	*t*	Adj R^2	Wu's T2[a]
Capital-Labour Ratio - All Capital - 3-digit SIC								
8	1984-86	1988-95	-0.02	-0.20	-0.09	0.95	-.010	
8	1984-88	1988-95	0.00	0.10	-0.13	1.35	-.002	
Observed Change = (2.4% , 1.2%), *Due to FTA* = (0.0% , 0.0%)[a]								
Capital-Labour Ratio - Machinery & Equipment - Hours Adjusted - 3-digit SIC								
8	1984-86	1988-95	0.01	0.25	-0.11	2.64	.047	
8	1984-88	1988-95	0.01	0.39	-0.10	2.41	.036	
Observed Change = (0.8% , 0.8%), *Due to FTA* = (0.0% , 0.0%)[a]								
Output per Plant - Production Activities - Output Deflators[b]								
8	1980-86	1988-96	0.51	0.69	.	.	-.002	
8	1980-88	1988-96	0.40	0.63	.	.	-.003	
8	1980-86	1988-94	0.10	0.14	.	.	-.005	
8	1980-86	1988-96	0.95	0.79	.	.	-.002	.646
9	1980-86	1988-96	-0.03	-0.06	.	.	-.002	
Observed Change = (15% , 8%), *Due to FTA* = (-1% , -5%)[a]								
Value Added per Plant - Production Activities - Output Deflators[b]								
8	1980-86	1988-96	-0.35	-0.45	.	.	-.004	
8	1980-88	1988-96	-0.58	-0.87	.	.	-.001	
8	1980-86	1988-94	-0.71	-0.88	.	.	-.001	
8	1980-86	1988-96	-0.02	-0.02	.	.	-.005	.750
9	1980-86	1988-96	-0.44	-0.92	.	.	.000	
Observed Change = (11% , 12%), *Due to FTA* = (1% , 4%)[a]								
Shipments Deflators - 3-digit SIC								
8	1980-86	1988-96	0.19	0.73	0.54	7.41	.347	
8	1980-88	1988-96	0.19	0.79	0.56	6.78	.302	
8	1980-86	1988-94	0.10	0.37	0.64	7.48	.355	
9	1980-86	1988-96	0.91	3.81	0.75	12.79	.464	
Observed Change = (18% , 20%), *Due to FTA* = (0% , -2%)[a]								

Notes: a) See notes *a* , *b* , *c* , and *e* of table 2.

b) The U.S. controls for output and value added per plant are omitted because the data on the number of U.S. plants are only published at 5-year intervals.

c) All variables are in logs. The number of observations, listed in the same order as the 5 variables that appear in this table, are 104, 103, 213, 213, and 104, respectively.

Table 9. The FTA Impact on TFP

	All Industries	Most Impacted Industries
TFP		
1. $da/d\tau$	.019	.077
Labour Productivity		
2. $d(v - l)/d\tau$	.047	.166
Other		
3. α_m	.541	.520
4. $v - l$	.204	.214
5. $k - l$	.008	.008
6. $d\alpha_m/d\tau$	.016	.031
7. $d\alpha_k/d\tau$	-.040	-.040

Notes: a) Row 1 is the log point change in TFP that is due to the FTA. Row 2 is the log point change in labour productivity that is due to the FTA. See measure 1 of table 7. Row 3 is the materials share in 1996. Row 4 is the log point change (1988-96) in labour productivity. Row 5 is the log point change (1988-96) in machinery and equipment per hour worked. Row 6 (7) is the change in α_m (α_k) over the 1988-96 period (times -1). This change is entirely attributed to the FTA because the exact attribution makes little difference. Row 1 is calculated using equation (13) with $\mu = 1.05$.

b) *All Industries* is all 213 manufacturing industries. *Most Impacted Industries* is the one-third of all industries that experienced the deepest FTA-mandated tariff cuts.

Table 10. Decomposition of Growth into Within and Between Components

	Decompositions			
	Within	Between	Total	Within/Total
Labour Productivity				
Labour Productivity	0.164	0.047	0.212	78%
Value Added	-0.004	0.211	0.207	-2%
Hours	-0.192	0.159	-0.034	572%
Output per Plant				
Output per Plant	0.108	0.293	0.401	27%
Output	0.024	0.330	0.354	7%
Plants	-0.266	0.023	-0.243	110%

Notes: 'Within' refers to within each of the 1,026 industry-plant size cells. There are 213 industries and the median industry has 6 plant sizes. Labour productivity is defined as in measure 1 of table 7 (production activities, hours adjusted, output deflators). Output per plant is defined as in table 8 (production activities, output deflators).

Table A1. The 71 Most Impacted Industries

SIC	INDUSTRY DESCRIPTION	$\Delta\tau_{i1}^{FTA}$	SIC	INDUSTRY DESCRIPTION	$\Delta\tau_{i1}^{FTA}$
1131	Brewery Products Industry	-.331	3612	Lubricating Oil And Grease Industry	-.079
3271	Shipbuilding And Repair Industry	-.241	2641	Metal Office Furniture Industry	-.079
1931	Canvas And Related Products Industry	-.183	2811	Business Forms Printing Industry	-.078
2433	Men's and Boy's Pants Industry	-.170	1921	Carpet, Mat And Rug Industry	-.078
2443	Women's Dress Industry	-.162	1083	Sugar And Chocolate Confectionery Industry	-.077
2491	Sweater Industry	-.159	3751	Paint And Varnish Industry	-.073
2451	Children's Clothing Industry	-.159	2542	Wooden Kitchen Cabinet And Bathroom Vanity Ind.	-.073
2441	Women's Coat and Jacket Industry	-.157	1141	Wine Industry	-.071
1993	Household Products Of Textile Materials	-.156	3771	Toilet Preparations Industry	-.070
2442	Women's Sportswear Industry	-.154	3993	Floor Tile, Linoleum And Coated Fabrics Inds.	-.070
2494	Hosiery Industry	-.152	2721	Asphalt Roofing Industry	-.069
1911	Natural Fibres Processing And Felt Processing	-.150	3791	Printing Ink Industry	-.069
2434	Men's and Boy's Shirt and Underwear Industry	-.147	2492	Occupational Clothing Industry	-.066
2432	Men's and Boy's Suit and Jacket Industry	-.147	3542	Structural Concrete Products Industry	-.066
2431	Men's and Boy's Coat Industry	-.143	3021	Metal Tanks (Heavy Gauge) Industry	-.066
2493	Glove Industry	-.140	3029	Other Fabricated Structural Metal Products Inds.	-.065
2496	Foundation Garment Industry	-.137	3931	Sporting Goods Industry	-.065
1712	Footwear Industry	-.127	1821	Wool Yarn And Woven Cloth Industry	-.061
2612	Upholstered Household Furniture Industry	-.112	2733	Paper Bag Industry	-.061
1998	Tire Cord Fabric Industry & Other Textiles Products	-.108	3243	Non-Commercial Trailer Industry	-.060
2611	Wooden Household Furniture Industry	-.106	1621	Plastic Pipe And Pipe Fittings Industry	-.058
2499	Other Clothing And Apparel Industries	-.103	3311	Small Electrical Appliance Industry	-.058
2581	Coffin And Casket Industry	-.101	1051	Cereal Grain Flour Industry	-.057
2495	Fur Goods Industry	-.097	3032	Prefabricated Portable Metal Buildings Industry	-.057
2444	Women's Blouse and Shirt Industry	-.094	2941	Iron Foundries	-.057
2649	Other Office Furniture Industries	-.090	1093	Potato Chip, Pretzel And Popcorn Industry	-.056
1041	Fluid Milk Industry	-.089	3991	Broom, Brush And Mop Industry	-.055
1991	Narrow Fabric Industry	-.089	2792	Stationery Paper Products Industry	-.054
2619	Other Household Furniture Industries	-.089	1052	Prepared Flour Mixes And Prepared Cereal Foods	-.054
3761	Soap And Cleaning Compounds Industry	-.088	2819	Other Commercial Printing Industries	-.052
1829	Other Spun Yarn And Woven Cloth Industries	-.088	2799	Other Converted Paper Products Industries	-.051
3242	Commercial Trailer Industry	-.087	3031	Metal Door And Window Industry	-.051
3792	Adhesives Industry	-.084	2821	Platemaking Typesetting And Bindery Industry	-.051
1713	Luggage, Purse And Handbag Industry	-.082	1012	Poutry Products Industry	-.051
2543	Wooden Door And Window Industry	-.079	3594	Non-Metallic Mineral Insulating Materials Inds.	-.049
1691	Plastic Bag Industry	-.079			

Notes: $\Delta\tau_{i1}^{FTA}$ is the FTA mandated tariff concessions. It is defined in equation (3) with t_1 = 1996.