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PERSPECTIVES ON NORTH AMERICAN FREE TRADE

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

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

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TABLE OF CONTENTS

PREFACE

Toward the mid-1980s, as international markets and production were becoming more global in scope and outlook, Canada was in danger of being pushed to the margin of the world economy. We were not equipped to expand our participation in global markets, and we were in danger of losing our own markets. Moreover, with over two-thirds of our exports destined for the United States and the share steadily climbing, we were highly exposed to rising U.S. protectionist sentiments. In essence, our past prosperity had made us complacent about the precarious position we faced as a trading nation.

It was in such a climate that the government undertook the steps necessary to renew and strengthen the economy, rather than resist the forces of global change. The government's approach was to make the private sector the driving force of this economic renewal. Policies were adopted to encourage and reward entrepreneurship and facilitate adaptation to the changing economic environment.

As a trading nation, getting our trade relations with the United States right was an obvious goal. It was decided that a free trade agreement was needed in order to forestall protectionist tendencies in the United States, enhance Canada's security of access to the American market and improve the predictability of trade relations with our neighbour to the south.

The Canada-United States Free Trade Agreement (FTA) was implemented in 1989. Five years later, in 1994, the North American Free Trade Agreement (NAFTA) came into effect and basically extended the FTA to the fast-growing Mexican market.

These free trade agreements were expected to increase prosperity in Canada by raising the efficiency and productivity of Canadian businesses. Such agreements are known to be mutually beneficial to the economies of the parties involved, and are particularly beneficial to the relatively small economies, such as that of Canada. They first expose domestically protected firms to international competition. Second, they reward innovative and productive firms by giving them access to larger markets. This increases trade flows between participating countries and improves the overall efficiency of their economies. The FTA and NAFTA were no exception; they were signed in the hope of obtaining those benefits for the Canadian economy after an initial adjustment period. Yet concomitantly, there were legitimate concerns about possible plant closures and job losses in Canada.

More than ten years have passed since the implementation of the FTA — enough time to reliably assess the implications of the agreement for the Canadian economy. In this context, the Micro-Economic Policy Analysis Branch has asked a group of experts to examine the Canadian economy in light of the FTA. The six papers coming out of this exercise are now being published under the general heading of *Perspectives on North American Free Trade*. These papers analyse a broad spectrum of issues ranging from the impact of the FTA on interprovincial trade flows to its impact on the productivity performance of the Canadian economy. In addition, the viability of the Canadian manufacturing sector is assessed, as is the relationship between outward foreign direct investment and trade flows. The papers also explore the implications of trade for the evolution of Canada's industrial structure and skill mix along with an assessment of Canada's migration patterns with the United States.

This monograph by Daniel Trefler is the last of the six papers in the Perspectives on North American Free Trade Series. It assesses the impact of tariff reductions under the Canada-U.S. Free Trade Agreement (FTA) on trade flows, productivity, output and employment in Canadian manufacturing over the 1989–96 period. The author finds that the FTA has caused a significant increase in exports and

imports throughout the 1990s. Trade growth outstripped growth in manufacturing output. This has been accompanied by other benefits such as increased product specialization which, in turn, lead to productivity improvements, reduced costs, and lower prices to consumers. Mr. Trefler also presents evidence that the tariff cuts raised labour productivity at a compounded rate of 0.6 percent in the manufacturing sector. The tariff cuts also increased annual earnings slightly, by raising production worker wages, though they did not affect earnings of non-production workers or weekly hours of production workers.

Of course, not all sectors have been affected in the same way by the FTA. Mr. Trefler finds that a handful of industries experienced certain adjustment costs early during the FTA implementation period. These adjustments were associated with reallocating resources out of protected and inefficient lines of manufacturing. However, according to the author, improvements in manufacturing employment and output since 1996 suggest that some and perhaps most of the reallocation has been to high-end manufacturing, further strengthening the economic outlook of Canada's manufacturing sector under free trade.

EXECUTIVE SUMMARY

This paper assesses the impact of the Canada-U.S. Free Trade Agreement (FTA) on Canadian manufacturing during the 1989–96 period. The estimated effects of the tariff concessions are calculated for manufacturing as a whole as well as for the most impacted industries (those industries faced with the largest tariff cuts).

(1) For the most impacted industries, the tariff cuts reduced employment by 18 percent, output by 12 percent, and the number of establishments by 12 percent. For manufacturing as a whole, the numbers are 4 percent, 2 percent, 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 at a compounded rate of 3.2 percent per year for the most impacted industries and at 0.6 percent per year for manufacturing as a whole. 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 increased annual earnings, primarily by raising production worker wages by 0.8 percent per year for the most impacted industries and by 0.2 percent per year for manufacturing as a whole. It thus minimally mitigated rising earnings inequality. The tariff cuts did not affect earnings of non-production workers or weekly hours of production workers.

(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. However, most of Canada's increased trade was in industries that had no tariffs in 1988.

The effects of the FTA tariff concessions are smaller than one would imagine from the heat generated by the debate. The controversy stems from the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed establishments) and those who are garnering the *long run efficiency gains* (stakeholders of efficient establishments).

INTRODUCTION

Ten years after its signing, the Canada-United States Free Trade Agreement remains one of the most contentious pieces of economic legislation ever enacted in Canada. Remarkably, the Free Trade Agreement (FTA) is far from being viewed as a success by either end of the political spectrum. The Canadian Labour Congress fingers the Agreement as the cause of job losses that tragically racked manufacturing in the early 1990s (Jackson, 1996). And even the business community complains about the ultimate FTA failure: lagging productivity growth (Rubin, 1997).

While the nay-sayers dominate public discussion, informed opinion in the research community points to varying degrees of benefits from the Agreement (e.g., Gaston and Trefler, 1994, 1997; Trefler, 1997; Head and Ries, 1997,1999; Feinberg, Keane and Bognanno, 1998*a*, 1998*b*). The problem with reconciling the public and research views is that each represents only one piece of a larger puzzle whose picture depicts the many impacts of the FTA. For example, Government of Canada (1997*b*) and U.S. Congress (1997) focus exclusively on trade, while Schwanen's (1997) excellent work focuses on trade and employment. In contrast, this paper will examine the impact of the FTA on a large number of performance indicators in the manufacturing sector. These include imports, value added, output, number of establishments, establishment size, labour productivity, employment, wages, hours of work, earnings, and income distribution. By assembling all, or at least most of the pieces of the FTA puzzle, we can ensure that our conclusions consistently explain a wide variety of FTA phenomena.

In the end, not all the pieces of the FTA puzzle fit together neatly, but most do. The picture that emerges will be unwelcome by those with extreme views on the subject. *It is a picture of long run gains from trade liberalization coupled with significant, short run adjustment costs borne by labour and uncompetitive enterprises.* This diversity of outcomes and experiences doubtless drives the diversity of views on the subject.

Before proceeding, an important caveat is in order. This paper deals with the impact of tariff reductions on the manufacturing sector. While this was the sector most obviously affected by the FTA, others sectors were also impacted. Some, such as insurance, were directly affected via non-tariff provisions of the FTA. Others were indirectly affected via induced changes in the terms of trade between services and manufactures. Further, non-tariff aspects of the FTA such as investment provisions and dispute resolution have also been important, but will not be examined. The unfortunate fact of the matter is that tariff cuts in manufacturing are one of the few aspects of the FTA that can be easily quantified.

This paper fits into the larger context of the Policy Research Committee work plan (Government of Canada, 1997*a*). The plan identifies research gaps in government-sponsored studies of economic growth. This paper overlaps two identified areas: (i) the determinants of productivity growth and (ii) trade, international investment and growth, and thus fills two research gaps that have been identified by the Policy Research Committee.

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 mainly at the 4-digit SIC level (213 manufacturing industries).[1] 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 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 establishments, employment, annual earnings, wages, and hours, from special tabulations by the Canadian Annual Survey of Manufactures (ASM) Section; (iii) the above ASM data by establishment 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.[2]

THE BROAD 'FACTS'

Productivity

Lagging productivity is the central economic policy issue engaging Canadians today. Productivity is commonly measured in one of two ways. Total factor productivity (TFP) measures the difference between output and the inputs of capital, labour, energy, materials and services. Labour productivity measures value added or output per hour of labour input. The top panel of Figure 1 displays movements in manufacturing TFP growth. The Canada–U.S. Free Trade Agreement was implemented on January 1, 1989 and the most recent data are for 1996. The figure looks at changes over the 8-year FTA period (1988–96), the 8-year pre-FTA period (1980–88), and the remaining period for which data are available (1961–80). 1980 and 1988 were chosen as base years for changes over the periods because each marks the end of a business expansion.[3] From Figure 1, productivity growth in the FTA period has been weak relative to past performance. The bottom panel displays the now famous observation about diverging Canadian and U.S. TFP growth. In the bottom panel, we have chosen 1980 as the base year since up until then Canadian labour productivity had tracked its U.S. counterpart very closely. (Indeed, the picture is identical if 1961 is chosen as the base year.) Whatever the productivity gap was in 1980, by 1988 it had widened by 11 percentage points, and by 1996 it had widened another 4 percentage points. Annualizing these numbers for the FTA period, Canadian productivity growth of 0.5 percent was overshadowed by U.S. productivity growth of 1 percent.[4]

Since the Agreement was expected to force Canadian firms into a more competitive position vis-a-vis U.S. firms, Figure 1 is often used to argue that the Agreement was a failure. In this view, the devaluation of the Canadian dollar is the only reason why Canada has stayed competitive (Rubin,1997). Figure 2 lends only partial support to this argument.[5]

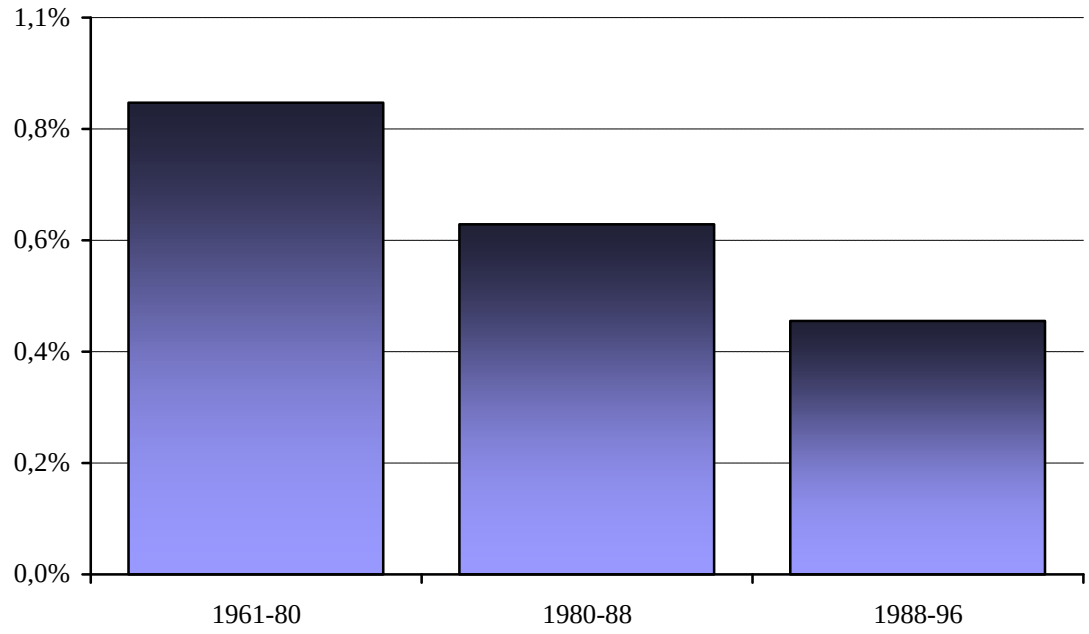
We have serious doubts about whether the FTA failed to live up to its productivity promise. This has to do with observations about four other data series. We will start with employment and gross domestic product (GDP). After that, we will turn to imports and exports.

Employment and GDP

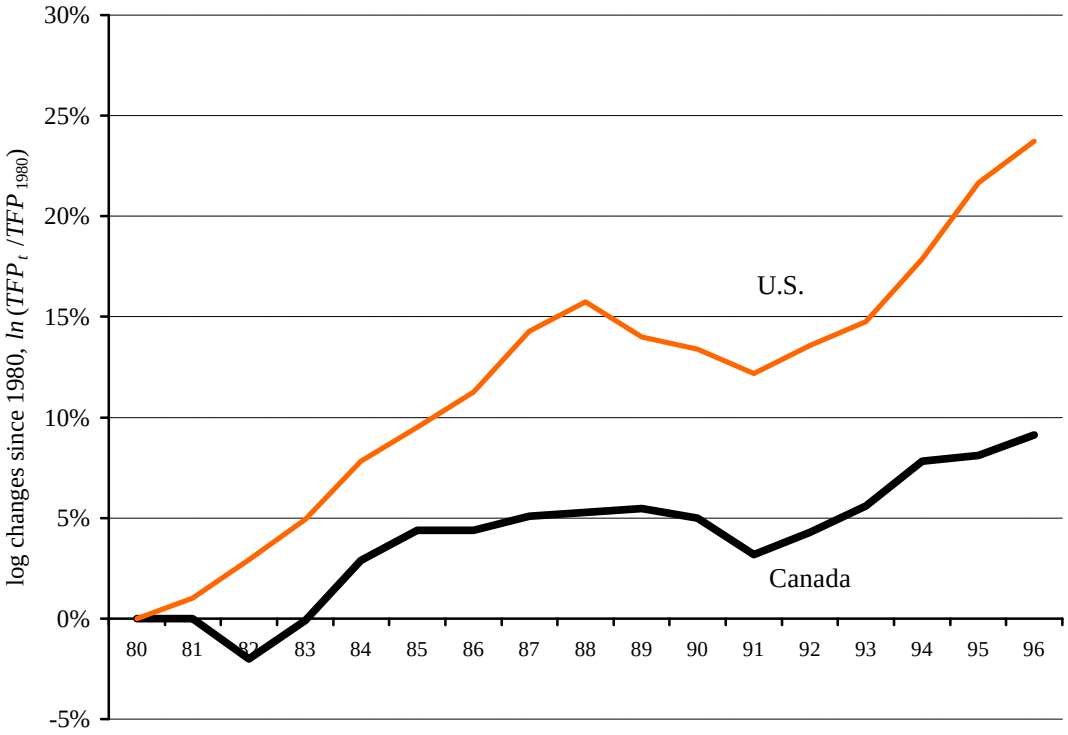
Early on in the debate about the merits of the FTA, interest was focused on the collapse of manufacturing employment. The top panel of Figure 3 shows the enormous employment losses experienced in manufacturing. The left-hand scale shows the cumulative reduction in manufacturing employment since 1988. The right-hand scale shows the same reduction as a percentage of 1988 employment. In 1993, there were almost 400,000 fewer employees in manufacturing than in 1988. This amounted to a staggering loss of 17 percent of the 1988 work force. Many have blamed the FTA for these lost jobs. From the current perspective these losses appear to be short-lived (which is not to minimize them). Manufacturing employment today is only 6 percent lower than it was in 1988.[6]

The bottom panel of Figure 3 plots real GDP for manufacturing. One can again see the large hit to manufacturing of the early 1990s followed by a strong recovery. At the trough in 1991, manufacturing GDP was down 10 percent from its 1988 level. By 1998 it was up 23 percent from its 1988 level. The information about employment and real GDP do not sit well with indicators of poor Canadian productivity growth. Figure 3 tells a story of rising GDP per worker.

Figure 1
Multifactor Productivity Growth in Manufacturing

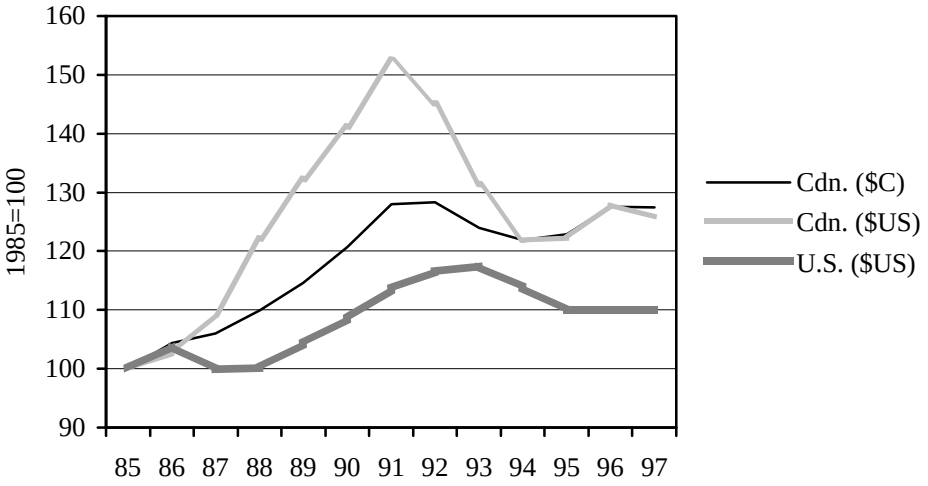


Canadian Total Factor Productivity Growth



Canadian and U.S. Total Factor Productivity Growth

Figure 2
Unit Labour Costs in Canada and the U.S.



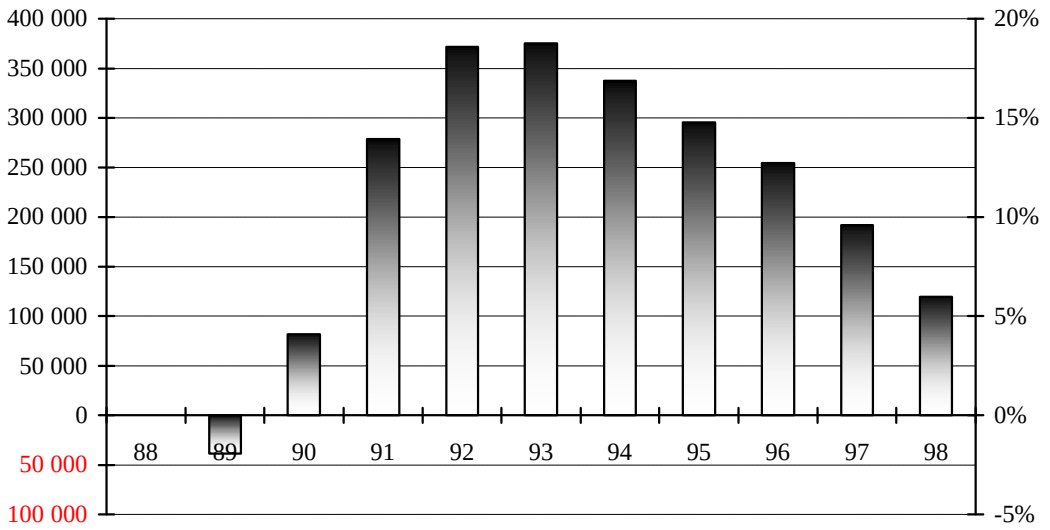
International Trade

Another piece of evidence that is hard to reconcile with employment losses and lagging productivity appears in Figure 4. 'Captain Canada,' as *Time Magazine* calls it (April 28, 1997), experienced unprecedented export and import expansion throughout the 1990s. See the top panel of Figure 4. This growth cannot be explained by exchange rate movements because imports should have declined as a result of the Canadian dollar devaluation. The second panel shows that trade growth outstripped growth in manufacturing output. The Canadian ratio of trade to output of close to 40 percent makes Canada one of the most open economies in world history. The bottom panel shows that since 1988 there has been a slow re-orientation of our trade flows towards the United States and away from the rest of our trading partners. This is indicative of a free trade effect. One would not expect lagging productivity to be associated with an export boom.[7]

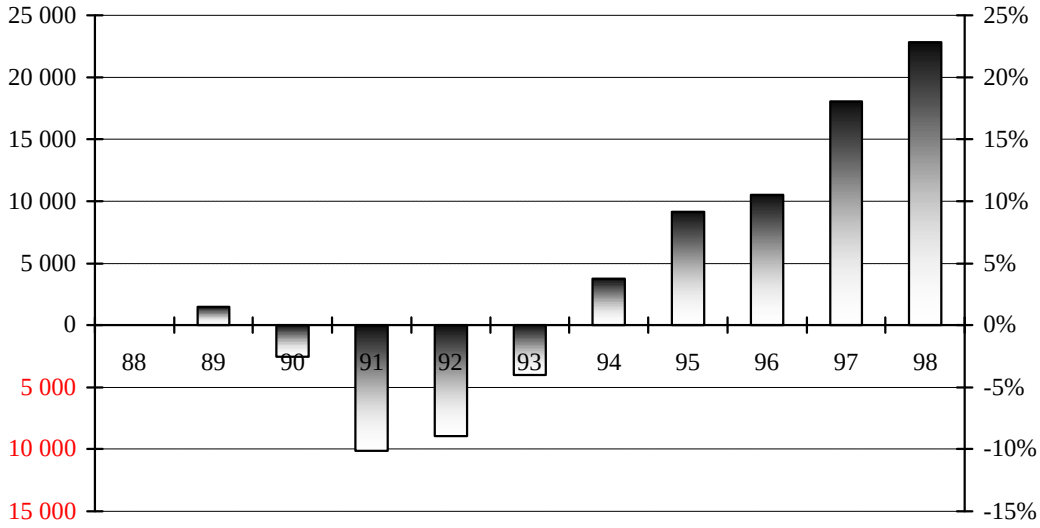
A Final Criticism of Myself and Other FTA Commentators

Employment losses and lagging Canadian productivity have caught the attention of many FTA commentators. This has led them to conclude that the FTA has had largely negative impacts. Yet the enormous manufacturing boom in GDP, GDP per worker, and exports to the United States all point to positive gains from the FTA. A fundamental problem with everything we have discussed in this section and with the methodology of most FTA commentators is that it relies exclusively on time series data. That is, if there is a structural break in any series between 1988 and 1989, we have been imputing the break to the FTA. This is crude for two reasons. First, the series of interest are so variable that identifying a structural break often reduces to guesswork. Second, the impacts of the FTA were very different across industries. The FTA likely had little impact on autos whereas it doubtless had a big impact on clothing. Thus, the obvious source of inferences is the sample variation across industries, not time. It is to this source of sample variation that we now turn.

Figure 3
Manufacturing Employment and Real GDP (1988–98)

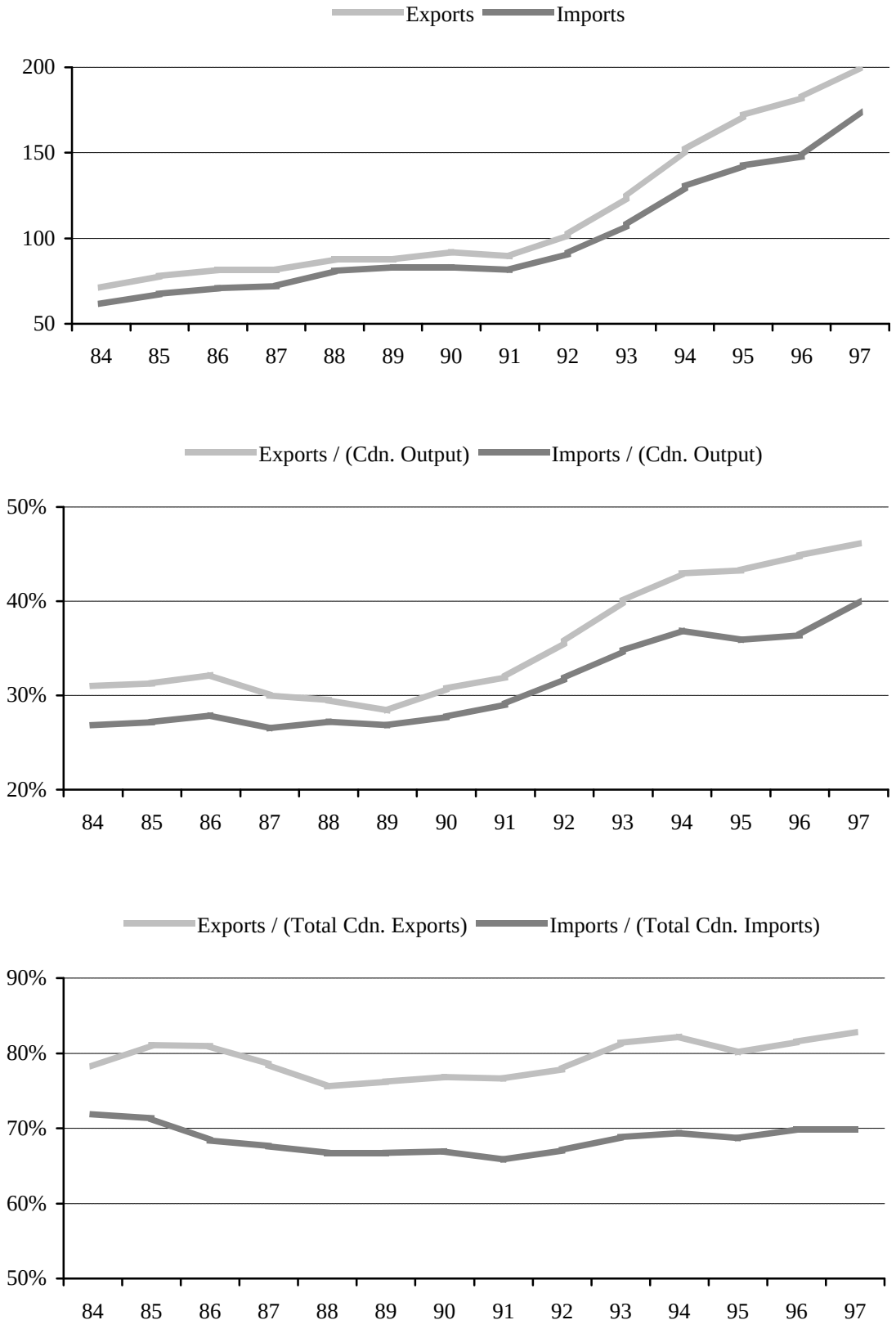


Employment Losses



Real GDP Gains ($Millions, 1992)

Figure 4
Canadian Imports from and Exports to the United States



THE FTA TARIFF CUTS: TOO SMALL TO MATTER?

This paper deals with the impact of the FTA tariff cuts on manufacturing. It is therefore natural to start by asking whether the FTA tariff cuts were deep enough to have mattered. The top panel of Figure 5 plots the average tariff rate against the United States in manufacturing.[8] In 1988 it was 4.5 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. For Canada this means that the tariff rate understates the effective rate of protection. Details of our (standard) formula for calculating the effective rate of protection are provided in the Appendix. The bottom panel of Figure 5 plots the effective rate of protection against the United States in manufacturing. Effective rates of protection are much higher and have fallen more dramatically than nominal tariff rates. Second, low average tariffs disguise enormous differences in tariffs across industries. Figure 6 plots a Lorenz curve for industry-level tariffs in 1988 and 1995. To derive this plot in any year, say 1988, industries were sorted by their tariff rates. Let t_{it}^{US} be the Canadian tariff against the United States in industry i in year t where $i < i + 1$ implies $t_{it}^{US} > t_{i+1,t}^{US}$. Let Q_{it} be Canadian output in industry i. The figure plots t_{it}^{US} against $q_{it} \equiv \sum_{j=1}^{i} Q_{jt} / \sum_{j=1}^{213} Q_{jt}$. For example, in 1988 almost 30 percent of Canadian production was sheltered behind a tariff in excess of 10 percent. By 1995 this number was down to about 1 percent.

It is important to emphasize that Figure 6 depends crucially on the level of aggregation. If one moves from the plotted 4-digit data (213 industries) to 3-digit data (about 85 industries) almost no industries had 1988 tariffs in excess of 10 percent. Thus the sample variation associated with 4-digit disaggregation is a key innovation of this study.

Another point to note is that the FTA called for reductions in U.S. tariffs against Canada. We 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 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 (NTBs). In a regression setting this means that the tariff regressor will be picking up the effects of U.S. tariffs, effective tariffs, and NTBs. This is precisely what we want.

Figure 5
Canadian Tariff and Effective Tariff Rates

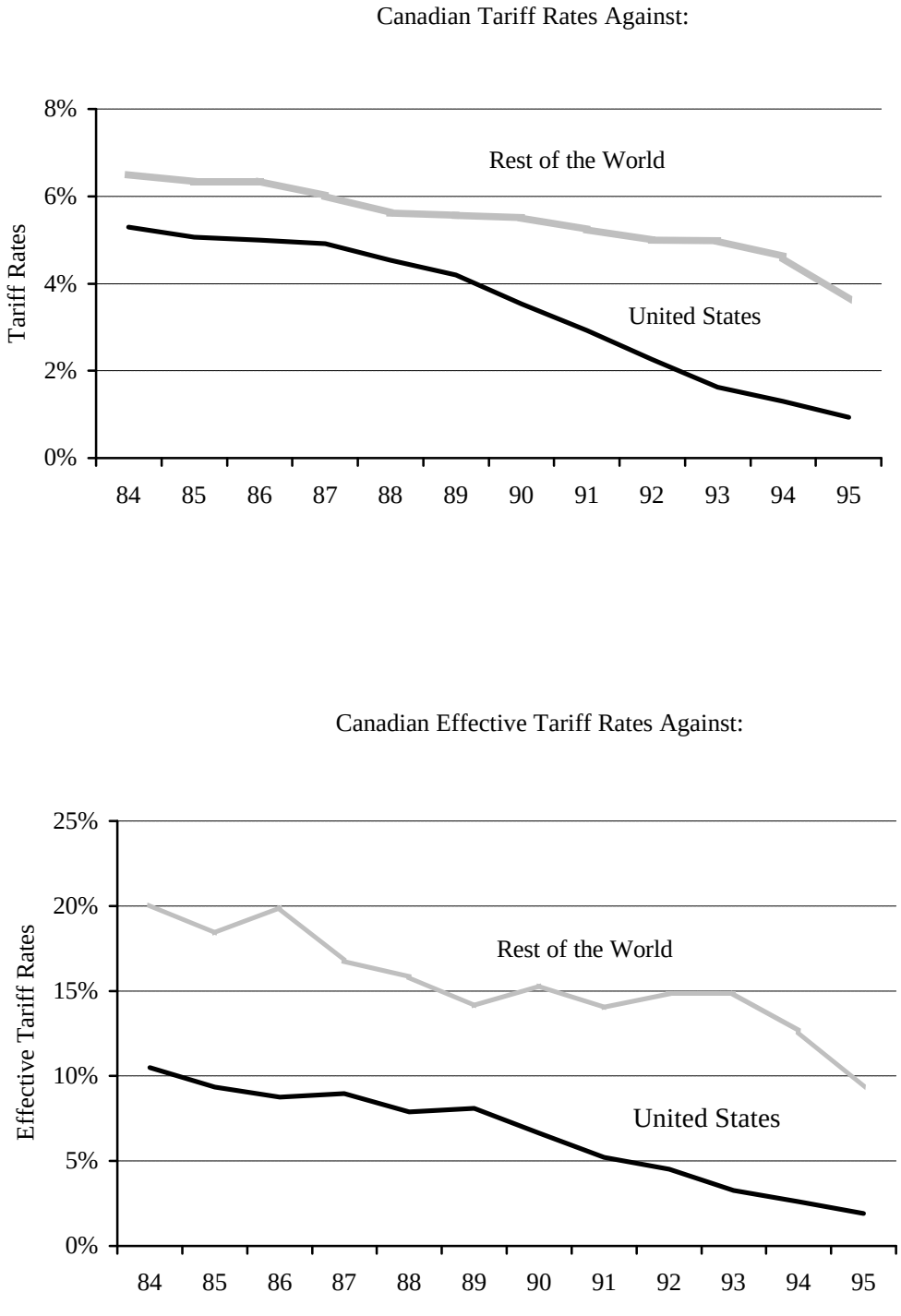
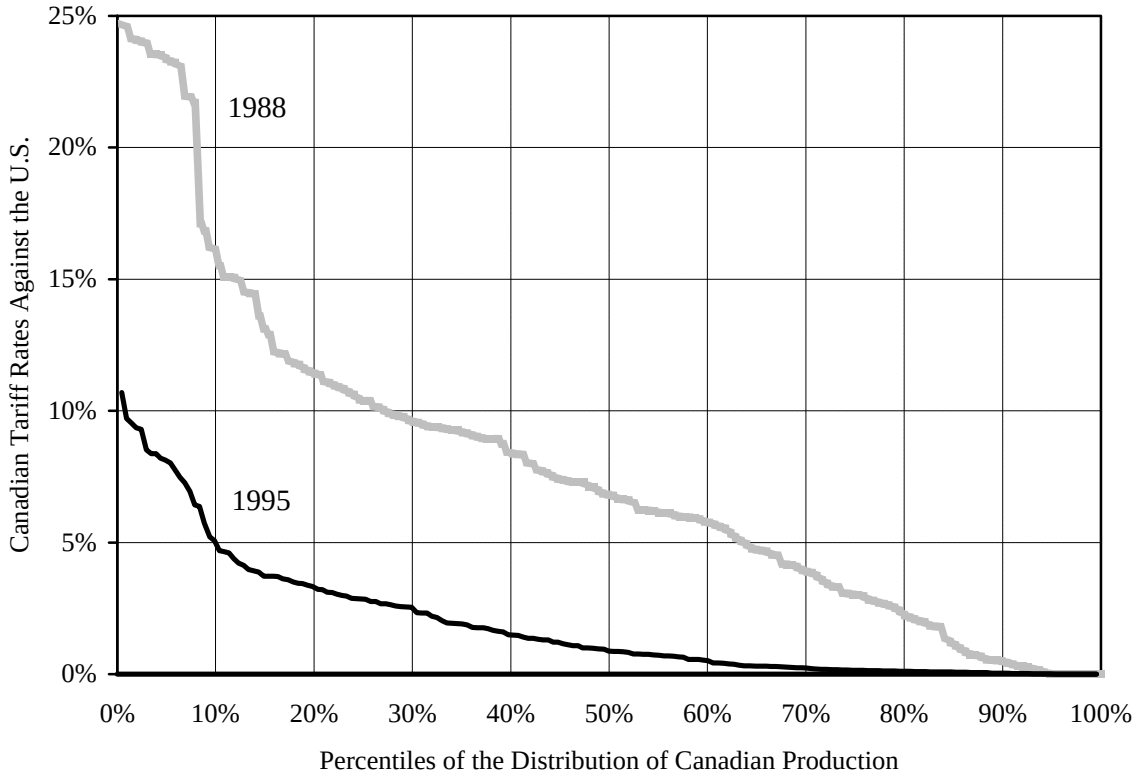


Figure 6
Distribution of Tariffs Across Industries



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. We 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 the choice of years t_0 and t_1 with $1980 < t_0 < 1989 < t_1$, we will define the FTA period as the years 1989 to t_1 and the pre-FTA period as the years up to t_0. Let Δy_{is} be the average annual log change in Y_{it} over period *s*. That is,

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

where *s* = 1 indexes the FTA period and s =0 indexes the pre-FTA period. Note that Δy_{is} approximates the annual compound growth rate of Y_{it} during period *s*. We are interested in a regression model explaining the impact of FTA tariff cuts on industry outcomes:

$$\Delta y_{is} = b\Delta t_{is}^{FTA} + g\Delta c_{is} + e_{is}, \qquad s = 0,1 \quad (2)$$

where Δt_{is}^{FTA} is a measure of the FTA-mandated tariff concessions and Δc_{is} collects all other determinants of $Dy_{is.}$ The remainder of this section is devoted to a discussion of the regression controls appropriate for equation (2).

The Cross-Section Conceptual Experiment

Interest in equation (2) focuses on the tariff term. It is tempting to measure the tariff Δt_{is}^{FTA} as the change in Canadian tariffs against the U.S. during period *s*. However, as Figure 5 above showed, such a term has a strong trend that coincides with larger globalization trends. It thus potentially picks up much more than just the FTA. 'Globalization' was coming with or without an 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 5 as the sharp drop in Canadian tariffs against the rest of the world beginning in 1994. Let t_{it}^{US} be the Canadian tariff against the U.S. in industry *i* in year *t* and let t_{it}^{ROW} be the Canadian tariff against the rest of the world (i.e., against non-U.S. trading partners). Then $t_{it}^{US} - t_{it}^{ROW}$ is the FTA-mandated preferential tariff concession extended to the United States. Its average annual change during the FTA period (*s* = 1) is

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

In terms of the top panel of Figure 5, Δt_{i1}^{FTA} measures how the distance between the two lines changed between 1988 and year $t_{1.}$ For the pre-FTA period, $\Delta t_{i0}^{FTA} = 0$ because tariff rates were extended on an MFN basis prior to 1988.[9]

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 identically zero in the pre-FTA period. Thus, much of the tariff data variability comes from the FTA-period cross-section. Implicitly, we are comparing the performance of industries that were subjected to large tariff cuts with the performance of industries that received small or zero tariff cuts. This is precisely the relevant comparison. While this is not entirely novel in the FTA literature, it has certainly not been considered at anywhere near the level of disaggregation used here. No previous paper on the FTA has worked beyond the 2-digit level of 20 industries, let alone with 213 industries.[10]

The Secular Growth Control

Sluggish growth or even decline is an important factor determining an industry's ability to lobby successfully for protection. This political economy effect is well documented (e.g., Trefler, 1993). It means that industries which experienced slow pre-FTA growth likely had high tariffs in 1988 and hence large FTA tariff cuts. But slow pre-FTA growth is correlated with slow FTA-period growth. Thus, the industries exposed to large FTA tariff cuts would likely have faced sluggish FTA-period growth even without the tariff cuts. There is thus a danger of incorrectly imputing sluggish growth to the tariff cuts.

The first column of numbers in Table 1 offers 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}. Confining attention to employment, value added, and output, the correlations are all positive. That is, sluggish FTA-period growth coincides with both sluggish pre-FTA growth and large FTA-period tariff cuts.

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

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

where $\Delta\chi'_{is}$ is all other controls except α_i. As a result, $\Delta\tau_{i1}^{FTA}$ can only pick up growth effects that are departures from trend growth.

The U.S. Control

The 1990s was a period of accelerating changes in technology and other determinants of supply and demand. Thus, the secular growth captured by α_i is not always a reliable indicator of current growth. Changes in the 1990s were probably not confined to Canadian industry – they likely effected U.S. industry as well. We thus control for underlying supply-demand changes by introducing a U.S. control Δy_{is}^{US} into the 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.

Table 1
Correlation of Dy_{i1} with Dy_{i0}, Dy_{i1}^{US}, and Dt_{i1}^{FTA}

Variable *(Dy_{i1})*	Dy_{i0}	Dy_{i1}^{US}	Dt_{i1}^{FTA}	*N*	*Form*
Employment					
All workers	0.29	0.35	0.24	213	log
Production workers	0.21	0.37	0.26	211	log
Non-production workers	-0.17	0.20	0.06	212	log
Proportion of non-production workers	-0.50	0.16	-0.15	212	ratio
Annual Earnings					
All workers	-0.06	0.17	0.06	213	log
Production workers	-0.03	0.07	0.09	211	log
Non-production workers	-0.39	0.09	0.15	212	log
Non-production relative to all workers	-0.52	-0.09	0.12	212	ratio
Wages and Hours					
Hourly wages of production workers	-0.13	0.14	0.07	211	log
Annual hours of production workers	-0.31	-0.05	0.05	211	log
Output, value added, and establishments					
Gross output from production activities	0.39	0.50	0.28	213	log
Value added from production activities	0.33	0.36	0.19	213	log
Number of establishments	0.22		0.34	213	log
Value added per establishment	0.01		-0.03	213	log
Canadian imports from the United States					
Level	-0.25		-0.23	211	log
As a share of total Canadian imports	-0.09		-0.36	211	ratio
As a share of Canadian output	-0.23		-0.36	211	log
Canada-U.S. intra-industry trade	-0.11		0.14	208	
Labour productivity (measure 1)	-0.03	0.26	-0.07	211	log
Output deflator	0.38	0.65	-0.04	213	log

Notes: *N* is the number of observations in the regressions of tables 2-7. *Form* indicates whether the variable is specified in log or ratio.

The second column of numbers in Table 1 reports the correlation of FTA-period Canadian growth (Δy_{i1}) with U.S. growth Δy_{i1}^{US}. All but two of the correlations are positive which indicates that FTA-period innovations in Canada and the United States shared a common component. Also, these correlations tend to be larger and more consistently positive than the correlations between Δy_{i1} and Δy_{i0}. This suggests that the U.S. control for period-specific growth is at least as important as the growth fixed effect control for secular growth (α_i).

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, Δy_{i1} and Δy_{i1}^{US} should be negatively correlated. Yet, we just showed in Table 1 that the bivariate correlations are positive. Further, Gaston and Trefler (1997) found a positive multivariate correlation, at least for employment growth using 2-digit data for the period 1980–93. Thus, endogeneity is not evident in bivariate or multivariate correlations of Δy_{i1} with Δy_{i1}^{US}. Second, endogeneity of Δy_{is}^{US} implies that Δy_{is}^{US} is correlated with the tariff cuts $\Delta\tau_{i1}^{FTA}$ and $\Delta\tau_{i1}^{US} = \tau_{i,t_1}^{US} - \tau_{i,1988}^{US}$. In fact, these correlations are virtually zero. The explanation for the zero correlations is simple: the U.S. market is so large that the effect of the FTA is swamped by more fundamental movements in industry demand and supply. It is exactly these movements that we wish to capture with Δy_{is}^{US}. We therefore amend equation (4) as follows:

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

where $\Delta\chi_{is}''$ is all other controls except α_i and Δy_{is}^{US}.

The Business Conditions Control

A key issue for examining the FTA is the treatment of the early 1990s recession. Figure 7 plots Canadian manufacturing GDP. The data are in logs relative to a 1980 base, ln (GDP_t / GDP_{1980}).[11] 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 with no industry subscript. This does not really solve the problem because industries vary in their sensitivity to general business conditions. That is, equation (5) needs a term Δz_s whose coefficient δ_i is industry subscripted. We 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 we have replaced $\delta\Delta\chi_{is}''$ with $\delta_i\Delta z_s$. $(\alpha_i, \Delta\tau_{is}^{FTA}, \Delta y_{is}^{US}, \delta_i\Delta z_s)$ is our full set of regression controls.

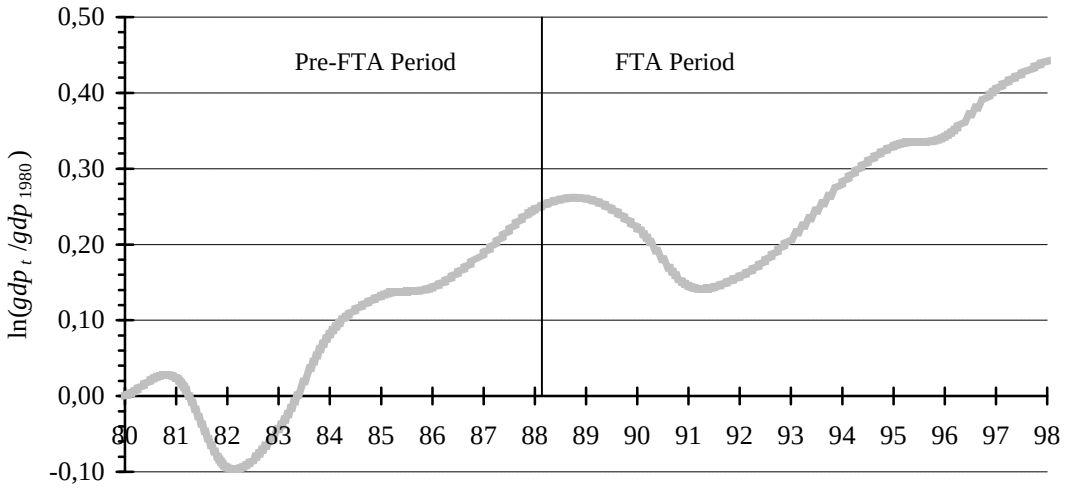
If all industries responded in the same way over the cycle ($\delta_i = \delta$ for all i), then the term $\delta_i\Delta z_s = \delta\Delta z_s$ would be equivalent to including a period dummy variable. Estimating both the δ_i and the α_i is a difficult problem, not least because it involves estimating these 2 x 213 parameters with only 2 x 213 observations. Fortunately, there is a simpler approach based on matching the FTA and pre-FTA business cycles.

From Figure 7, 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 cyclical sensitivity.

One 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 sensitive to this choice, a fact that will be shown at length below. We therefore differ further discussion.

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, we only had data back to 1984 because this 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.[12]

Figure 7
Real Canadian Manufacturing GDP



Estimation

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

$$(\Delta y_{i1} - \Delta y_{i0}) = b\,(\Delta t_{i1}^{FTA} - \Delta t_{i0}^{FTA}) + g\,(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) + v_i \qquad (7)$$

This exercise eliminates 2 x 213 parameters from equation (6). Not only do d_i fall out, but so do the a_i along lines related to the Heckman and Hotz (1989) random growth estimator.

Equation (7) with an intercept added is our primary regression specification:

$$(\Delta y_{i1} - \Delta y_{i0}) = a + b(\Delta t_{i1}^{FTA} - \Delta t_{i0}^{FTA}) + g(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) + v_i \tag{8}$$

We will also consider a simpler regression that eliminates the secular growth and business condition controls (a_i and $d\Delta z_s$) from equation (6):

$$\Delta y_{is} = a + b\Delta t_{is}^{FTA} + g\Delta y_{is}^{US} + e_{is}, \qquad s = 0,1 \tag{9}$$

This specification helps pinpoint the impact of these controls on the estimate of b. We emphasize that equation (9) is used only for regression diagnostic purposes. With this, we turn to the results.

EMPIRICAL RESULTS

Unlike most assessments of the impact of trade liberalization, this paper examines impacts on a large number of performance indicators. These include employment, earnings, trade, output, number of plants, and productivity. By assembling most of the pieces of the economic puzzle surrounding trade liberalization, we can ensure that our conclusions consistently explain a wide variety of FTA phenomena.

Employment

The employment results appear in Table 2. Since tables of this form will appear repeatedly, let us carefully review it. Consider the top block of lines which deal with employment of all workers. The 'specification' column states whether equation (8) or equation (9) is being estimated and how the pre-FTA and FTA periods are defined. For example, the first line (equation (8): 1980–86, 1988–96) presents estimates of equation (8) with pre-FTA period changes for 1980-86 and FTA-period changes for 1988–96. This is our preferred specification. The last line presents estimates of equation (9) which we emphasize is there strictly as a regression diagnostic.

Returning to the first line, the coefficient on the FTA tariff concessions is $\hat{b}$ =1.24 with a *t*-statistic of 2.28. The coefficient on the U.S. control is $\hat{g}$ = 0.21 with a *t*-statistic of 2.75. The intercept is not reported. There are 213 observations and the $\overline{R}^2$ is a modest 0.061. From the second line, the results are about the same when the pre-FTA changes are re-defined for 1980–88. It makes little difference if other years are chosen. Thus, the exact specification of business condition controls is not critical. The FTA cuts were to be fully implemented in 10 years (by 1998), but for some products full implementation occurred earlier. For industries producing these products, most of the adjustment may have occurred early on so that extending the analysis to 1996 may introduce noise. Accordingly, the third line shortens the definition of the FTA period to 1989–94. The results are similar to those of the first two lines. The last line gives estimates of the regression diagnostic equation (9). When the secular growth and business conditions controls are removed, the FTA effect $\hat{b}$ almost doubles in size. This shows that such controls tend to absorb some, but not all of the negative employment effects often attributed to the FTA.

$\hat{b}$ gives the impact on industry *i* of a tariff cut in industry *i.* A different question is the extent to which the FTA tariff concessions contributed to employment changes in highly protected industries and in manufacturing as a whole. Let *I* be the set of industries that are most protected. 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 or percentage change in the initial level times the initial level). The change in employment among industries in any set *I* is approximately $\sum_{ieI}(Dy_{i1})Y_{i,1988}$ .The percentage change in employment is approximately $\sum_{ieI}(Dy_{i1})Y_{i,1988} / \sum_{jeI}Y_{j,1988}$. This can be re-written as $\sum_{ieI}Dy_{i1}w_i$, where $w_i \equiv Y_{i,1988} / \sum_{jeI}Y_{j,1988}$. Using the fact that $\widehat{Dy_{i1}} = \hat{b}Dt_{i1}^{FTA}$ is the prediction of the impact of the tariff concessions, the predicted tariff-induced log change in employment is $\sum_{ieI}\hat{b}Dt_{i1}^{FTA}w_i$. We collect these observations in the following equations.

$$\omega_i \equiv Y_{i,1988} / \sum_{j \in I} Y_{j,1988}$$

$$Total\ Change \equiv 8 \sum_{i \in I} \Delta y_{i1} \omega_i \tag{10}$$

$$Due\ to\ FTA \equiv 8 \sum_{i \in I} \hat{\beta} \Delta \tau_{i1}^{FTA} \omega_i$$

Multiplying by 8 converts the average annual changes for the 8 FTA years through 1996 into a total FTA-period change.

The Table 2 column 'Change in Dependent Variable (1988–96)' reports *Total Change* and *Due to FTA* for three definitions of *I*. *All* is all 213 industries. $\Delta\tau_i > 4$ percent is the set of 51 industries that experienced tariff cuts averaging between 0.5 and 1 percentage point a year or between 4 and 8 percentage points over 1988–96. $\Delta\tau_i > 8$ percent is the set of 34 industries that experienced tariff cuts averaging in excess of 1 percentage point a year or 8 percentage points over 1988–96. In every case, the $\hat{\beta}$ used in *Due to FTA* is the estimate from the first-line specification (Equation (8): 1980–86, 1989–96). For all industries *Total Change* equals –0.16 log points and *Due to FTA* equals –0.04 log points. That is, manufacturing experienced substantial employment losses in the FTA period, about one quarter of which is due to the FTA. This is a large fraction when one considers that most industries had very low tariffs going into the FTA. For those experiencing at least 8 percent cuts, employment fell by a huge 0.36 log points, half of which (0.18 log points) is due to the FTA. *These numbers suggest very large transition costs of moving out of low-end, heavily protected industries.*

The data distinguish between workers employed in manufacturing activities and non-manufacturing activities. We will refer to these as production and non-production workers since the distinction broadly follows that used in the United States Annual Survey of Manufactures. In 1988, production workers earned 30 percent less annually than non-production workers. Judging from U.S. research, this earnings gap is likely explained by the higher educational attainment typical of non-production workers (e.g., Berman, Bound and Griliches, 1994). Of course, there is considerable noise since non-production workers can include janitors if those janitors are located in the head office. Table 2 reports results separately for production and non-production workers. The results for production workers are very similar to those of all workers. On the other hand, the FTA appears to have had almost no impact on non-production workers. Thus, the results for total employment are driven by production workers.

Let L_{it}^N denote employment of non-production workers in industry i in year t and let L_{it}^P denote employment of production workers so that $L_{it}^N / (L_{it}^N + L_{it}^P)$ is the proportion of non-production workers in industry i. $L_{it}^N / (L_{it}^N + L_{it}^P)$ is often taken as a measure of average industry skill. The *Total Change* numbers indicate that there has been no trend towards skill upgrading in Canadian manufacturing, except among industries with the largest FTA tariff concessions. All of the change is predicted by the tariff concessions, but the estimates are not statistically significant.

Table 2
Regression Results for Employment

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	ω	*t*	γ	*t*	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
Employment – All Workers								
Eqn (8): 1980-86, 1988-96	1.24	2.28	0.21	2.75	0.061	All	-0.16	-0.04
Eqn (8): 1980-88, 1988-96	1.00	2.04	0.17	2.53	0.052	$\Delta\tau_i > 4\%$	-0.20	-0.07
Eqn (8): 1980-86, 1988-94	1.08	2.06	0.27	3.31	0.068	$\Delta\tau_i > 8\%$	-0.36	-0.18
Eqn (9): 1980-86, 1988-96	2.10	5.63	0.21	3.94	0.096			
Employment – Production Workers								
Eqn (8): 1980-86, 1988-96	1.35	2.16	0.23	2.72	0.061	All	-0.17	-0.05
Eqn (8): 1980-88, 1988-96	1.13	2.06	0.19	2.55	0.053	$\Delta\tau_i > 4\%$	-0.21	-0.08
Eqn (8): 1980-86, 1988-94	1.41	2.33	0.32	3.52	0.083	$\Delta\tau_i > 8\%$	-0.39	-0.19
Eqn (9): 1980-86, 1988-96	2.54	6.25	0.18	3.29	0.100			
Employment – Non-Production Workers								
Eqn (8): 1980-86, 1988-96	0.20	0.24	0.13	1.09	-0.003	All	-0.17	-0.01
Eqn (8): 1980-88, 1988-96	0.44	0.54	0.11	1.04	-0.001	$\Delta\tau_i > 4\%$	-0.22	-0.01
Eqn (8): 1980-86, 1988-94	-0.53	0.66	0.04	0.34	-0.007	$\Delta\tau_i > 8\%$	-0.27	-0.03
Eqn (9): 1980-86, 1988-96	-0.08	0.18	0.25	3.64	0.026			
Proportion of Non-Production Workers								
Eqn (8): 1980-86, 1988-96	-0.16	1.01	0.21	1.08	0.003	All	0.00	0.01
Eqn (8): 1980-88, 1988-96	-0.13	0.89	0.25	1.25	0.002	$\Delta\tau_i > 4\%$	0.01	0.01
Eqn (8): 1980-86, 1988-94	-0.33	2.13	0.04	0.19	0.013	$\Delta\tau_i > 8\%$	0.02	0.02
Eqn (9): 1980-86, 1988-96	-0.35	4.32	0.15	1.51	0.040			

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Not all specifications have the same number of observations. The universe of industries is 213. From Table 1 above, one variable – intra-industry trade – has as few as 208 of these industries. Also, some variables are in logs whereas some – such as the proportion of non-production workers – are expressed in ratios. This is indicated in Table 1 in the '*Form*' column.

Earnings

Most commentators expected Canadian wages to suffer from competition from less-unionized, less educated workers in the Southern U.S. states. Table 3 works with annual earnings data from ASM payroll statistics.The *Total Change* column provides some evidence of downward earnings pressure: earnings growth in the $\Delta t_i > 4$ percent and $\Delta t_i > 8$ percent industries (0.01 and 0.04) was below the 0.05 log point growth for all industries. This makes it particularly interesting that in the presence of adequate controls, the FTA tariff concessions appear to have *raised* earnings. The tariff coefficient estimate is $\hat{b} = -0.50$ with a *t*-statistic of 2.67. From the *Due to FTA* column, 0.02 log points of the 0.05 log point rise in manufacturing earnings is attributable to the FTA. This is a tiny earnings change over 8 years, but it is not negative. For the most impacted industries ($\Delta t_i > 8$ percent), earnings rose by a more substantial 0.07 log points over 8 years. Inspection of Table 3 reveals that the FTA earnings gains are 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 earnings to all earnings, $E_{it}^N L_{it}^N / (E_{it}^N L_{it}^N + E_{it}^P L_{it}^P)$. This is confirmed by the regression results. For the most impacted industries, tariff concessions led to a 0.14 fall in this ratio. (See the *Due to FTA* column, $\Delta t_i > 8$ percent.)

The small positive effect of the FTA on production worker earnings reflects impacts on both hourly wages and annual hours. Table 4 shows that all of the earnings effect is due to FTA effects on wages, not hours.

Imports

While imports are the obvious starting point for a study of tariff impacts, the import results are unique in two ways. For one, the import regressions are the only ones not to include the U.S. controls. This is because more sensible controls can be introduced by scaling. In particular, we consider Canadian imports from the United States as a share of total Canadian imports and Canadian imports from the United States as a share of Canadian output. The former captures import substitution. The results are also unique in that the magnitudes (but not the signs) are sensitive to the definition of the pre-FTA period. This is not true for any other variable.

The results are presented in Table 5. From the *Total Change* and *Due to FTA* columns, the FTA tariff cuts explain most of the change in the FTA period for the most impacted industries, but not for the least-impacted industries. Further, the results suggest that if anything, the FTA has reduced intra-industry trade.

Table 3
Regression Results for Annual Earnings

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	β	*t*	γ	*t*	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
Earnings – All Workers								
Eqn (8): 1980-86, 1988-96	-0.50	2.67	0.18	1.76	0.037	All	0.05	0.02
Eqn (8): 1980-88, 1988-96	-0.34	2.13	0.22	2.14	0.029	$\Delta\tau_i > 4\%$	0.01	0.03
Eqn (8): 1980-86, 1988-94	-0.47	2.57	0.20	1.78	0.037	$\Delta\tau_i > 8\%$	0.04	0.07
Eqn (9): 1980-86, 1988-96	-0.20	1.52	-0.04	0.85	0.007			
Earnings – Production Workers								
Eqn (8): 1980-86, 1988-96	-0.41	2.07	0.11	1.09	0.017	All	0.03	0.01
Eqn (8): 1980-88, 1988-96	-0.29	1.59	0.04	0.43	0.003	$\Delta\tau_i > 4\%$	0.01	0.02
Eqn (8): 1980-86, 1988-94	-0.32	1.62	0.21	1.94	0.021	$\Delta\tau_i > 8\%$	0.00	0.06
Eqn (9): 1980-86, 1988-96	-0.08	0.59	0.01	0.12	-0.004			
Earnings – Non-Production Workers								
Eqn (8): 1980-86, 1988-96	0.01	0.02	0.11	1.29	-0.001	All	0.07	0.00
Eqn (8): 1980-88, 1988-96	0.16	0.59	0.14	1.43	0.002	$\Delta\tau_i > 4\%$	0.02	0.00
Eqn (8): 1980-86, 1988-94	0.26	1.01	0.13	1.45	0.006	$\Delta\tau_i > 8\%$	0.05	0.00
Eqn (9): 1980-86, 1988-96	0.18	1.15	0.03	0.79	0.002			
Earnings – Non-production Relative to All Workers								
Eqn (8): 1980-86, 1988-96	0.96	2.61	-0.02	0.20	0.023	All	0.01	-0.03
Eqn (8): 1980-88, 1988-96	0.79	2.14	-0.06	0.51	0.013	$\Delta\tau_i > 4\%$	-0.01	-0.05
Eqn (8): 1980-86, 1988-94	1.18	3.13	0.11	1.14	0.045	$\Delta\tau_i > 8\%$	-0.03	-0.14
Eqn (9): 1980-86, 1988-96	0.66	3.26	-0.04	0.87	0.024			

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Table 4
Regression Results for Wages and Hours

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	β	*t*	γ	*t*	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
Hourly Wages of Production Workers								
Eqn (8): 1980-86, 1988-96	-0.50	2.57	0.12	1.26	0.028	All	0.03	0.02
Eqn (8): 1980-88, 1988-96	-0.37	2.13	0.12	1.27	0.015	$\Delta\tau_i > 4\%$	0.00	0.03
Eqn (8): 1980-86, 1988-94	-0.45	2.29	0.18	1.79	0.030	$\Delta\tau_i > 8\%$	0.01	0.07
Eqn (9): 1980-86, 1988-96	-0.17	1.27	-0.04	1.07	0.007			
Annual Hours of Production Workers								
Eqn (8): 1980-86, 1988-96	0.07	0.57	0.12	1.47	0.002	All	0.00	0.00
Eqn (8): 1980-88, 1988-96	0.04	0.39	0.02	0.20	-0.009	$\Delta\tau_i > 4\%$	0.01	0.00
Eqn (8): 1980-86, 1988-94	0.10	0.80	-0.05	0.58	-0.005	$\Delta\tau_i > 8\%$	-0.01	-0.01
Eqn (9): 1980-86, 1988-96	0.16	2.07	0.06	0.99	0.007			

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Table 5
Regression Results for Imports

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	β	t	γ	t	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
Canadian Imports from the United States as a Share of Total Canadian Imports								
Eqn (8): 1980-86, 1988-96	-1.15	4.51	.	.	0.085	All	0.04	0.01
Eqn (8): 1980-88, 1988-96	-0.82	3.19	.	.	0.042	$\Delta\tau_i > 4\%$	0.10	0.07
Eqn (8): 1980-86, 1988-94	-1.29	4.77	.	.	0.094	$\Delta\tau_i > 8\%$	0.14	0.15
Eqn (9): 1980-86, 1988-96	-1.55	9.96	.	.	0.189			
Canadian Imports from the United States as a Share of Canadian Output								
Eqn (8): 1980-86, 1988-96	-7.64	6.26	.	.	0.154	All	0.33	0.15
Eqn (8): 1980-88, 1988-96	-4.55	2.78	.	.	0.031	$\Delta\tau_i > 4\%$	0.71	0.43
Eqn (8): 1980-86, 1988-94	-8.01	6.32	.	.	0.157	$\Delta\tau_i > 8\%$	0.83	1.14
Eqn (9): 1980-86, 1988-96	-8.60	10.83	.	.	0.217			
Canadian Imports from the United States								
Eqn (8): 1980-86, 1988-96	-6.22	5.52	.	.	0.124	All	0.39	0.02
Eqn (8): 1980-88, 1988-96	-3.14	1.99	.	.	0.014	$\Delta\tau_i > 4\%$	0.73	0.35
Eqn (8): 1980-86, 1988-94	-6.75	5.94	.	.	0.141	$\Delta\tau_i > 8\%$	0.53	0.74
Eqn (9): 1980-86, 1988-96	-6.55	8.69	.	.	0.151			
Canada-U.S. Intra-Industry Trade								
Eqn (8): 1980-86, 1988-96	0.88	1.33	.	.	0.004	All	-0.04	0.00
Eqn (8): 1980-88, 1988-96	1.07	3.38	.	.	0.025	$\Delta\tau_i > 4\%$	0.01	-0.04
Eqn (8): 1980-86, 1988-94	1.20	4.04	.	.	0.036	$\Delta\tau_i > 8\%$	-0.02	-0.13
Eqn (9): 1980-86, 1988-96	1.23	3.65	.	.	0.029			

Notes: *a) Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i >$ 8% is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Output, Value Added and Number of Establishments

Table 6 reports results for real output.[13] We will discuss deflation issues shortly. For now we note that there is little sensitivity to the choice of deflators. Also, we prefer to work with production activities since they exclude 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 *Total Change* column, there is a strong association between tariff concessions and reduced output. For the most impacted industries (Δt_i > 8 percent), output fell by a huge 0.20 log points over 1988–96, whereas for the manufacturing sector as a whole, output *rose* by 0.09 log points. This has been used as strong evidence of the harm caused by the FTA. Once controls for secular trends, business conditions, and U.S. movements are added, this relationship is weakened. A statistically insignificant relationship exists which is nevertheless economically large enough to have contributed negatively to output growth. (See the –0.02 log points result in the *Due to FTA* column.) The estimate is also large enough to account for half of the output decline in the most impacted industries (–0.12 of the –0.20 log point decline is due to the FTA). The same results obtain when using gross output in all activities.

Table 6 also reports results for real value added in manufacturing activities. Again, deflation is discussed below. The most impacted industries have experienced larger reductions in value added than all of manufacturing (–0.10 versus 0.06 log point changes, respectively). However, this relationship is not robust to inclusion of secular growth, business conditions, and U.S. controls.

Over 1988–96, the number of establishments declined by 0.12 log points. For the most impacted industries the number of establishments fell by 0.42 log points. This is indicative of an FTA effect and indeed much has been made of this fact in assessments of the FTA. This effect is diminished when full controls are included. The tariff coefficient $\hat{b}$ = 0.96 is not statistically significant and the FTA explains only a third of the decline in the number of establishments. Nevertheless, there is some evidence that the FTA led to plant rationalization by accelerating exit.

The last item in Table 6 is value added per establishment. In the FTA period, this measure of firm size increased by 0.23 log points for manufacturing and by even more for the most impacted industries (0.28 log points). The estimated coefficients are economically large, suggesting a role for the FTA in increasing plant size. However, the relationship is not statistically significant.

TFP and Labour Productivity

A key issue that has dominated the public debate is whether the FTA raised labour productivity in Canada. Up until the March 23, 1999 Statistics Canada productivity data release, a large number of commentators had argued that the FTA failed to raise Canadian productivity. It is an amazing and discouraging fact that the data used by these commentators were completely inappropriate for reasons that had nothing to do with the recent revisions.[14] Canada measures manufacturing labour productivity as real GDP per hour worked. The U.S. data used in the debate measures labour productivity as real 'net output' per hour worked. The difference between net output and GDP is purchases of energy, raw materials, and non-manufacturing intermediate inputs and services. Thus, the two measures are not comparable. Further, the growing importance of purchased inputs and services imparts an upward bias to U.S. labour productivity growth relative to Canadian labour productivity growth. Thus, an incorrect Canada-U.S. comparison made Canada look worse than it was.

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

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	β	*t*	γ	*t*	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
Gross Output in Manufacturing Activities								
Eqn (8): 1980-86, 1988-96	0.77	1.27	0.25	3.35	0.057	All	0.09	-0.02
Eqn (8): 1980-88, 1988-96	0.78	1.48	0.24	3.44	0.064	$\Delta\tau_i > 4\%$	-0.05	-0.04
Eqn (8): 1980-86, 1988-94	0.95	1.57	0.22	2.72	0.042	$\Delta\tau_i > 8\%$	-0.20	-0.12
Eqn (9): 1980-86, 1988-96	2.09	4.97	0.34	6.80	0.146			
Value Added in Manufacturing Activities								
Eqn (8): 1980-86, 1988-96	-0.08	0.12	0.24	3.32	0.042	All	0.06	0.00
Eqn (8): 1980-88, 1988-96	-0.11	0.19	0.20	2.95	0.031	$\Delta\tau_i > 4\%$	-0.04	0.00
Eqn (8): 1980-86, 1988-94	0.11	0.16	0.18	2.16	0.014	$\Delta\tau_i > 8\%$	-0.10	0.01
Eqn (9): 1980-86, 1988-96	1.59	3.43	0.29	5.46	0.092			
Number of Establishments								
Eqn (8): 1980-86, 1988-96	0.96	1.76	.	.	0.010	All	-0.12	-0.04
Eqn (8): 1980-88, 1988-96	0.91	1.98	.	.	0.014	$\Delta\tau_i > 4\%$	-0.11	-0.06
Eqn (8): 1980-86, 1988-94	1.29	2.28	.	.	0.019	$\Delta\tau_i > 8\%$	-0.42	-0.12
Eqn (9): 1980-86, 1988-96	1.60	5.24	.	.	0.111			
Value Added per Establishment								
Eqn (8): 1980-86, 1988-96	-0.69	0.90	.	.	0.004	All	0.23	0.03
Eqn (8): 1980-88, 1988-96	-0.73	1.11	.	.	0.001	$\Delta\tau_i > 4\%$	0.11	0.04
Eqn (8): 1980-86, 1988-94	-0.95	1.19	.	.	0.002	$\Delta\tau_i > 8\%$	0.28	0.09
Eqn (9): 1980-86, 1988-96	-0.82	1.70	.	.	0.004			

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Table 7
Regression Results for Labour Productivity

Regression Equation						Change in Dependent Variable (1988-96)		
	Tariffs		U.S. Control					
Specification	β	*t*	γ	*t*	Adj R^2	Industries	Total Change[a]	Due to FTA[b]
1. Labour Productivity – Production Activities – Hours Adjusted – Output Deflators								
Eqn.(8): 1980-86, 1988-96	-1.54	3.20	0.30	3.23	0.082	All	0.204	0.046
Eqn (8): 1980-88, 1988-96	-1.25	2.87	0.42	4.80	0.124	$\Delta\tau_i > 4\%$	0.156	0.087
Eqn (8): 1980-86, 1988-94	-1.57	2.92	0.13	1.11	0.033	$\Delta\tau_i > 8\%$	0.276	0.258
Eqn (9): 1980-86, 1988-96	-1.00	3.12	0.18	3.15	0.035			
2. Labour Productivity – Production Activities – Hours Adjusted – Value-Added Deflators								
Eqn (8): 1980-86, 1988-96	-1.50	2.88	0.16	1.68	0.040	All	0.200	0.048
Eqn (8): 1980-88, 1988-96	-1.30	2.69	0.17	1.80	0.040	$\Delta\tau_i > 4\%$	0.132	0.086
Eqn (8): 1980-86, 1988-94	-1.35	2.28	0.01	0.05	0.015	$\Delta\tau_i > 8\%$	0.247	0.253
Eqn (9): 1980-86, 1988-96	-1.32	3.18	0.23	3.81	0.045			
3. Labour Productivity – All Activities – Not Hours Adjusted – Output Deflators								
Eqn (8): 1980-86, 1988-96	-1.07	2.42	0.29	3.58	.072	All	0.230	0.031
Eqn (8): 1980-88, 1988-96	-0.84	1.91	0.30	3.37	.059	$\Delta\tau_i > 4\%$	0.174	0.060
Eqn (8): 1980-86, 1988-94	-0.93	2.03	0.16	1.62	.020	$\Delta\tau_i > 8\%$	0.270	0.177
Eqn (9): 1980-86, 1988-96	-0.47	1.60	0.23	4.39	.041			

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate in the first specification i.e., Eqn (8): 1980-86, 1988-96.

Since the new Statistics Canada release, much of the confusion surrounding productivity measures can now be easily removed. We begin with total factor productivity (TFP) and then move to labour productivity. Using some heroic assumptions about Canadian and U.S. data comparability, Statistics Canada published 1990–95 TFP growth by 2-digit SIC industry for both Canada and the United States.[15] These appear in Figure 8. The most impacted industries appear at the bottom while the least-impacted industries appear at the top. It is apparent that the industries which experienced the largest FTA tariff concessions were precisely those where TFP grew faster in Canada than in the United States. In short, Figure 8 suggests that the FTA raised TFP.

It would be ideal to get at this issue using detailed 4-digit SIC data. Unfortunately, the Canadian Annual Survey of Manufactures does not record capital stock or investment information. Further, the available 3-digit capital stock data are based on ownership rather than usage so that much of the capital stock used in manufacturing is attributed to the financial and leasing sectors.[16] This leaves us with no alternative but to use labour productivity i.e., value added per unit of labour.

In Table 7, we consider 3 different measures of labour productivity. As with any productivity study, there are a large number of data issues to be aware of. The first data issue 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. Measuring labour input by employment thus imparts an upward trend to Canadian labour input and a consequent downward trend to Canadian labour productivity. Hence, the downward bias in Canadian productivity will be spuriously correlated with tariff cuts and thus lead to a downward-biased estimate of the tariff effect. Fortunately, this bias is easily corrected. While both countries report hours worked by production workers, only Canada reports value added in production-related activities (i.e., in activities done by production workers). We can thus measure Canadian labour productivity as real value added in production-related activities per hour worked by production workers. Measure 1 uses this concept for Canada and uses real value added in all activities per employee for the United States. Measure 3 uses real value added in all activities per employee for both countries. As expected, $\hat{b}$ without the hours correction is closer to zero. As a result, we prefer measure 1.

The second data issue deals with deflators.[17] In Table 7, measures 1 and 3 use output deflators while measure 2 uses value-added deflators. Value-added deflators would be preferable, but our U.S. deflator is seriously flawed. It is at the 2-digit level (20 industries) and even at this highly aggregated level there are imputations for SIC 38 (instruments) and SIC 36 (electric and electronic equipment, which includes computers). The value-added deflated measure 2 thus has serious problems. This said, it makes little difference whether one uses value-added or output deflators. This can be seen by comparing measures 1 and 2 in Table 7 which yield very similar results and indeed identical *Due to FTA* results. There are also problems with the other deflators used in this study, but these turn out to be relatively minor. We thus relegate them to a footnote.[18]

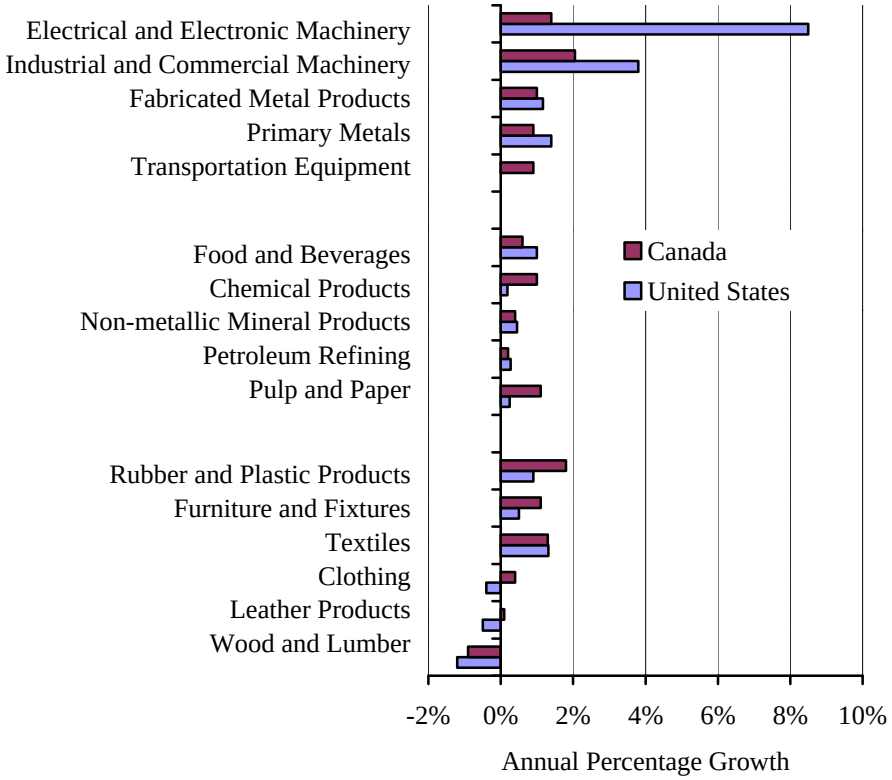
There is a data issue created by the benchmarking of purchased services and its inclusion in the definition of value added. This problem plagues all productivity research, not just the results of this paper, but we raise it in the Appendix in order to encourage more research into the problem.

We now turn to a detailed review of the results. Independent of the measure of labour productivity, FTA tariff concessions have raised labour productivity both statistically and economically. For our preferred specification (the first line of Table 7), the estimate of the FTA tariff effect is $\hat{b} = -1.54$ with a *t*-statistic of 3.20. This implies that the FTA raised labour productivity by 0.046 log points for manufacturing as a whole and by 0.258 log points for the most impacted industries. More generally, consider each of the equation (8) specifications (i.e., the first 3 lines for each measure). The estimates

range from −0.84 to −1.57. This implies that the FTA raised labour productivity by between 0.025 and 0.047 log points for manufacturing as a whole and by between 0.140 and 0.262 log points for the most impacted industries.[19]

These numbers leave a greater impression when put on a compound annual basis. To this end, we divide them by the number of annual changes in the FTA period (i.e., 8) and equate log points with percentages. For all of manufacturing, the FTA tariff concessions raised labour productivity by between 0.3 percent and 0.6 percent per year. For the most impacted industries ($\Delta t_i > 8$ percent), the tariff concessions raised labour productivity by between 1.7 and 3.3 percent per year. Further, our preferred measure 1 specification puts the gains at the upper end of these intervals. These are enormous numbers, large enough to wipe out differences between Canadian and U.S. productivity growth. The idea that a government policy could raise productivity so dramatically is in our opinion remarkable.

Figure 8
Annual Productivity Growth Rates by Industry, 1990-95



Specialization

The results of this study provide mixed support for the notion that the FTA would lead to increased specialization. It is worth gathering all the indirect evidence that we have on this point. On the one hand, there has been some exit and increased output per establishment in industries that experienced large tariff cuts. Also, there has been a significant decrease in intra-industry trade. On the other hand, there are indicators pointing to reduced specialization. First, let Q_{it} be the level of output in industry *i* in year *t*. The cross-industry correlation between Q_{i88} and Q_{i95} is very close to one, contrary to any notion of specialization. Second, let $H_t = \sum_i (Q_{it} / \sum_j Q_{jt})^2$ be the Herfindahl index. The Herfindahl index does not change to 3 decimal places over the period 1988–95. Again, this provides no evidence of increased specialization. This is consistent with the findings of Head and Ries (1997, 1999).

CONCLUSIONS

The FTA seems to live 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. Table 8 summarizes our results about the impact of the FTA-mandated tariff concessions. The following are the main points. The estimated effects of the tariff cuts are reported separately for manufacturing as a whole and for the most impacted industries, that is, those hit with tariff cuts in excess of 8 percent over the 1988–96 period.

(1) For the most impacted industries, the tariff cuts reduced employment by 18 percent, output by 12 percent, and the number of establishments by 12 percent. For manufacturing as a whole, the numbers are 4 percent, 2 percent, 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 at a compounded rate of 3.2 percent per year for the most impacted industries and at 0.6 percent per year for manufacturing as a whole.[20] 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 increased annual earnings slightly, primarily by raising production worker wages by 0.8 percent per year for the most impacted industries and by 0.2 percent per year for manufacturing as a whole. It thus minimally reduced inequality. The tariff cuts did not affect earnings of non-production workers or weekly hours of production workers.

(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. However, most of Canada's increased trade was in industries that had no tariffs in 1988.

(5) The FTA did not affect employment or earnings of non-production workers. It did not affect value added or value added per plant. It contributed only minimally to skill-upgrading and slightly reduced intra-industry trade.

The effects of the FTA tariff cuts are smaller than one would imagine from the heat generated by the debate. The controversy stems from the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed establishments) and those who are garnering the *long run efficiency gains* (stakeholders of efficient establishments).

Table 8
Summary of Results

Variable	All Industries		Most Impacted Industries ($\Delta\tau_i > 8\%$)		Quality of the Estimate
	Total Change	Due to FTA	Total Change	Due to FTA	
Employment					
All workers	-16%	-4%	-36%	-18%	H
Production workers	-17%	-5%	-39%	-19%	H
Non-production workers	-17%	-1%	-27%	-3%	L
Proportion of non-production workers	0%	1%	2%	2%	L
Annual Earnings					
All workers	5%	2%	4%	7%	M
Production workers	3%	1%	0%	6%	M
Non-production workers	7%	0%	5%	0%	L
Non-production relative to all workers	1%	-3%	-3%	-14%	M
Wages and Hours					
Hourly wages of production workers	3%	2%	1%	7%	M
Annual hours of production workers	0%	0%	-1%	-1%	L
Output, value added, and establishments					
Gross output from production activities	9%	-2%	-20%	-12%	M
Value added from production activities	6%	0%	-10%	1%	L
Number of establishments	-12%	-4%	-42%	-12%	L
Value added per establishment	23%	3%	28%	9%	L
Canadian imports from the United States					
Level	39%	2%	53%	74%	H
As a share of total Canadian imports	4%	1%	14%	15%	H
As a share of Canadian output	33%	15%	83%	114%	H
Canada-U.S. intra-industry trade	-4%	0%	-2%	-13%	L
Labour productivity (measure 1)	20%	5%	28%	26%	H

Notes: *a*) *Total Change* is the weighted average log change in the dependent variable for industries in the indicated group. *All* is all 213 industries. $\Delta\tau_i > 4\%$ is the 51 industries with tariff cuts of 4%-8% over 1988-96. $\Delta\tau_i > 8\%$ is the 34 industries with tariff cuts in excess of 8% over 1988-96. See equation (10).

b) *Due to FTA* is the weighted average log change in the dependent variable that is explained by the FTA. It is defined in equation (10) with β given by its estimate from the specification Eqn (8): 1980-86, 1988-96.

c) *Quality of the Estimate* is an informal measure based on *t*-statistics and adjusted R^2s.

APPENDIX

1. The Effective Rate of Protection: Let υ_j be the 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 $(\tau_1, \ldots, \tau_j, \ldots \tau_J)$ 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 at about the 3-digit SIC level and aggregated using production weights.

2. List of Industries in Each Tariff Group: See Table A.1.

3. Purchased Services: Firms do not report all purchased services in the ASM questionnaires of either country. Instead, the data are benchmarked using separate surveys. In Canada, the last survey is now 15 years old. Given that Canada invests more in timely input-output tables, we can only guess that the U.S. benchmark is even older. Benchmarking means that the measure of service inputs is $S_t = \sigma Q_t \varepsilon_t$ where Q_t is output, $\sigma = S_0 / Q_0$, is the ratio of services to output in the benchmark year, and ε_t is the benchmarking error. Using obvious notation and simplifying to avoid issues of chaining, deflation, and multiple inputs, define $TFP_t \equiv \ln Q_t - \alpha \ln X_t - \beta \ln S_t$ where X_t collects all non-service inputs. Then the change in TFP_t during period s is $\Delta TFP_s = \Delta \ln Q_s - \alpha \Delta \ln X_s - \beta \Delta \ln Q_s - \beta \ln \varepsilon_s$ and what researchers are reporting is not ΔTFP_s, but $\Delta TFP_s + \beta \ln \varepsilon_s$. Thus, sectoral TFP growth includes trends in the contracting out of services which benchmarking fails to pick up. Thus, the fact that value added includes purchased services raises a set of important issues that plague all sectoral productivity research.

For the purposes of this study, the concern is that if contracting out non-manufacturing activities is correlated with tariff cuts, then measured productivity might be spuriously correlated with the FTA tariff concessions. However, for this to be a problem the trend must be most pronounced in industries subject to large tariff concessions. We see no reasons for this to be the case.

Table A1
Groupings by Tariff Changes

SIC	INDUSTRY DESCRIPTION	Dt_{i1}^{FTA}	SIC	INDUSTRY DESCRIPTION	Dt_{i1}^{FTA}
1131	BREWERY PRODUCTS INDUSTRY	-0.041	1621	PLASTIC PIPE AND PIPE FITTINGS INDUSTRY	-0.007
3271	SHIPBUILDING AND REPAIR INDUSTRY	-0.030	3311	SMALL ELECTRICAL APPLIANCE INDUSTRY	-0.007
1931	CANVAS AND RELATED PRODUCTS IND.	-0.023	1051	CEREAL GRAIN FLOUR INDUSTRY	-0.007
2433	MEN'S AND BOYS' PANTS INDUSTRY	-0.021	3032	PREFABRICATED PORTABLE METAL BUILD.	-0.007
2443	WOMEN'S DRESS INDUSTRY	-0.020	2941	IRON FOUNDRIES	-0.007
2491	SWEATER INDUSTRY	-0.020	1093	POTATO CHIP, PRETZEL AND POPCORN IND.	-0.007
2451	CHILDREN'S CLOTHING INDUSTRY	-0.020	3991	BROOM, BRUSH AND MOP INDUSTRY	-0.007
2441	WOMEN'S COAT AND JACKET INDUSTRY	-0.020	2792	STATIONERY PAPER PRODUCTS INDUSTRY	-0.007
1993	HOUSEHOLD PRODUCTS OF TEXTILE MATER.	-0.020	1052	PREPARED FLOUR MIXES AND PREPARED CER.	-0.007
2442	WOMEN'S SPORTSWEAR INDUSTRY	-0.019	2819	OTHER COMMERCIAL PRINTING INDUSTRIES	-0.006
2494	HOSIERY INDUSTRY	-0.019	2799	OTHER CONVERTED PAPER PRODUCTS IND.	-0.006
1911	NATURAL FIBRES PROCESSING AND FELT PR.	-0.019	3031	METAL DOOR AND WINDOW INDUSTRY	-0.006
2434	MEN'S AND BOYS' SHIRT AND UNDERWEAR	-0.018	2821	PLATEMAKING TYPESETTING AND BINDERY	-0.006
2432	MEN'S AND BOYS' SUIT AND JACKET IND.	-0.018	1012	POUTRY PRODUCTS INDUSTRY	-0.006
2431	MEN'S AND BOYS' COAT INDUSTRY	-0.018	3594	NON-METALLIC MINER. INSULATING MATERIAL	-0.006
2493	GLOVE INDUSTRY	-0.017	3063	HAND TOOL AND IMPLEMENT INDUSTRY	-0.006
2496	FOUNDATION GARMENT INDUSTRY	-0.017	3332	ELECTRIC LAMP AND SHADE INDUSTRY	-0.006
1712	FOOTWEAR INDUSTRY	-0.016	3331	LIGHTING FIXTURE INDUSTRY	-0.006
2612	UPHOLSTERED HOUSEHOLD FURNITURE IND.	-0.014	2561	WOODEN BOX AND PALLET INDUSTRY	-0.006
1998	TIRE CORD FABRIC INDUSTRY & OTHER TE.	-0.014	2712	NEWSPRINT INDUSTRY	-0.006
2611	WOODEN HOUSEHOLD FURNITURE INDUSTRY	-0.013	1072	BREAD AND OTHER BAKERY PRODUCTS IND.	-0.006
2499	OTHER CLOTHING AND APPAREL INDUSTRIES	-0.013	3512	CLAY PRODUCTS INDUSTRY (FROM IMPORTED)	-0.005
2581	COFFIN AND CASKET INDUSTRY	-0.013	1811	MAN-MADE FIBRE & FILAMENT YARN IND.	-0.005
2495	FUR GOODS INDUSTRY	-0.012	3392	NON-CURRENT CARRYING WIRING DEVICES	-0.005
2444	WOMEN'S BLOUSE AND SHIRT INDUSTRY	-0.012	2714	BUILDING BOARD INDUSTRY	-0.005
2649	OTHER OFFICE FURNITURE INDUSTRIES	-0.011	3091	METAL PLUMBING FIXTURES AND FITTINGS	-0.005
1041	FLUID MILK INDUSTRY	-0.011	2691	BED SPRING AND MATTRESS INDUSTRY	-0.005
1991	NARROW FABRIC INDUSTRY	-0.011	1631	PLASTIC FILM AND SHEETING INDUSTRY	-0.005
2619	OTHER HOUSEHOLD FURNITURE INDUSTRIES	-0.011	3042	METAL CLOSURE AND CONTAINER INDUSTRY	-0.005
3761	SOAP AND CLEANING COMPOUNDS IND.	-0.011	1081	CANE AND BEET SUGAR INDUSTRY	-0.005
1829	OTHER SPUN YARN AND WOVEN CLOTH IND.	-0.011	1049	OTHER DAIRY PRODUCTS INDUSTRY	-0.005
3242	COMMERCIAL TRAILER INDUSTRY	-0.011	1699	OTHER PLASTIC PRODUCTS INDUSTRIES N.E.C.	-0.005
3792	ADHESIVES INDUSTRY	-0.010	1092	DRY PASTA PRODUCTS INDUSTRY	-0.005
1713	LUGGAGE, PURSE AND HANDBAG INDUSTRY	-0.010	3058	UPHOLSTERY & COIL SPRING - OTHER WIRE PR.	-0.005
2543	WOODEN DOOR AND WINDOW INDUSTRY	-0.010	3071	HEATING EQUIPMENT INDUSTRY	-0.005
1691	PLASTIC BAG INDUSTRY	-0.010	3039	OTHER ORNEMENTAL AND ARCHITECTURAL M.	-0.005
3612	LUBRICATING OIL AND GREASE INDUSTRY	-0.010	1611	FOAMED AND EXPANDED PLASTIC PRODUCTS	-0.005
2641	METAL OFFICE FURNITURE INDUSTRY	-0.010	3358	TELECOM. EQUIP. IND. - OTHER COMM. & ELEC.	-0.005
2811	BUSINESS FORMS PRINTING INDUSTRY	-0.010	3371	ELECTRICAL TRANSFORMER INDUSTRY	-0.005
1921	CARPET, MAT AND RUG INDUSTRY	-0.010	1111	SOFT DRINK INDUSTRY	-0.004
1083	SUGAR AND CHOCOLATE CONFECTIONERY	-0.010	3099	OTHER METAL FABRICATING INDUSTRIES	-0.004
3751	PAINT AND VARNISH INDUSTRY	-0.009	2719	OTHER PAPER INDUSTRIES	-0.004
2542	WOODEN KITCHEN CABINET AND BATHRM	-0.009	2522	SOFTWOOD VENEER AND PLYWOOD INDUSTRY	-0.004
1141	WINE INDUSTRY	-0.009	3913	CLOCK AND WATCH INDUSTRY	-0.004
3771	TOILET PREPARATIONS INDUSTRY	-0.009	3593	GYPSUM PRODUCTS INDUSTRY	-0.004
3993	FLOOR TILE, LINOLEUM AND COATED FABR.	-0.009	3971	SIGN AND DISPLAY INDUSTRY	-0.004
2721	ASPHALT ROOFING INDUSTRY	-0.009	3549	OTHER CONCRETE PRODUCTS INDUSTRIES	-0.004
3791	PRINTING INK INDUSTRY	-0.009	1719	OTHER LEATHER AND ALLIED PRODUCTS IND.	-0.004
2492	OCCUPATIONAL CLOTHING INDUSTRY	-0.008	2541	PREFABRICATED WOODEN BUILDINGS IND.	-0.004
3542	STRUCTURAL CONCRETE PRODUCTS IND.	-0.008	2692	HOTEL, RESTAURANT & INSTITUTIONAL FURN.	-0.004
3021	METAL TANKS (HEAVY GAUGE) INDUSTRY	-0.008	1071	BISCUIT INDUSTRY	-0.004
3029	OTHER FABRICATED STRUCTURAL METAL PR.	-0.008	1711	LEATHER TANNERIES	-0.004
3931	SPORTING GOODS INDUSTRY	-0.008	3321	MAJOR APPLIANCE INDUSTRY (ELECTRIC APP.)	-0.004

Table A1 (cont'd)

SIC	INDUSTRY DESCRIPTION	Dt_{i1}^{FTA}	SIC	INDUSTRY DESCRIPTION	Dt_{i1}^{FTA}
1821	WOOL YARN AND WOVEN CLOTH INDUSTRY	-0.008	1031	CANNED AND PRESERVED FRUIT AND VEGET	-0.004
2733	PAPER BAG INDUSTRY	-0.008	2599	OTHER WOOD INDUSTRIES N.E.C	-0.003
3243	NON-COMMERCIAL TRAILER INDUSTRY	-0.008	1053	FEED INDUSTRY	-0.003
3069	OTHER HARDWARE AND CUTLERY IND.	-0.003	2699	OTHER FURNITURE AND FIXTURE INDUSTRIES	0.000
3281	BOATBUILDING AND REPAIR INDUSTRY	-0.003	1091	TEA AND COFFEE INDUSTRY	0.000
3731	PLASTIC AND SYNTHETIC RESIN INDUSTRY	-0.003	2999	OTHER ROLLED, CAST AND EXTRUDED NON	0.000
1032	FROZEN FRUIT AND VEGETABLE INDUSTRY	-0.003	3111	AGRICULTURAL IMPLEMENT INDUSTRY	0.000
1098	MALT & MALT FLOUR – OTH. FOOD PR. N.E.C	-0.003	3729	OTHER AGRICULTURAL CHEMICAL IND.	0.000
3299	OTHER TRANSPORTATION EQUIPMENT IND.	-0.003	1598	TIRE & TUBE IND. - OTHER RUBBER PROD. IND.	0.000
3799	OTHER CHEMICAL PRODUCTS INDUSTRIES	-0.003	3254	MOTOR VEHICLE STEERING AND SUSPENSION	0.000
2791	COATED AND TREATED PAPER INDUSTRY	-0.003	2839	OTHER PUBLISHING INDUSTRIES	0.000
3049	OTHER STAMPED AND PRESSED METAL PR.	-0.003	2831	BOOK PUBLISHING INDUSTRY	0.000
3333	ELECTRIC LAMP (BULB AND TUBE) IND.	-0.003	2511	SHINGLE AND SHAKE INDUSTRY	0.000
3391	BATTERY INDUSTRY	-0.003	2512	SAWMILL & PLANING MILL PRODUCTS IND.	0.000
3379	OTHER ELECTRICAL EQUIPMENT INDUSTRIES	-0.002	3722	MIXED FERTILIZER INDUSTRY	0.000
3193	SAWMILL AND WOODWORKING MACHINERY	-0.002	2711	PULP INDUSTRY	0.000
2732	CORRUGATED BOX INDUSTRY	-0.002	3721	CHEMICAL FERTILIZER & FERTILIZER MAT.	0.000
2793	PAPER CONSUMER PRODUCTS INDUSTRY	-0.002	2841	NEWSPAPER, MAGAZINE & PERIODICAL IND.	0.000
3599	OTHER NON-METAL. MINEARL PRODS. N.E.C.	-0.002	2849	OTHER COMBINED PUBLISHING AND PRINTING	0.000
3062	METAL DIES, MOULDS AND PATTERNS IND.	-0.002	3081	MACHINE SHOP INDUSTRY	0.000
3711	INDUSTRIAL INORGANIC CHEMICAL IND.	-0.002	3581	LIME INDUSTRY	0.000
2918	FERRO - OTHER PRIMARY STEEL INDUSTRIES	-0.002	3211	AIRCRAFT AND AIRCRAFT PARTS INDUSTRY	0.000
2713	PAPERBOARD INDUSTRY	-0.002	3251	MOTOR VEHICLE ENGINE AND ENGINE PARTS	0.000
2592	PARTICLE BOARD INDUSTRY	-0.002	3591	REFRACTORIES INDUSTRY	0.000
2971	COPPER AND COPP. ALLOY ROLLING, CAST.	-0.002	3255	MOTOR VEHICLE WHEEL AND BRAKE IND.	0.000
3061	BASIC HARDWARE INDUSTRY	-0.002	3259	OTHER MOTOR VEHICLE ACCESSORIES, PARTS	0.000
3571	ABRASIVES INDUSTRY	-0.002	1521	RUBBER HOSE AND BELTING INDUSTRY	0.000
3191	COMPRESSOR, PUMP AND INDUSTRIAL FAN	-0.002	3912	OTHER INSTRUMENTS AND RELATED PROD.	0.000
1061	VEGETABLE OIL MILLS (EXCEPT CORN OIL)	-0.001	3352	ELECTRONIC PARTS AND COMPONENTS IND.	0.000
2731	FOLDING CARTON AND SET INDUSTRY	-0.001	3011	POWER BOILER AND HEAT EXCHANGER IND.	0.000
3192	CONSTRUCTION & MINING MACHIN. & MAT.	-0.001	3372	ELECTRICAL SWITCHGEAR AND PROTECTIVE	0.001
3092	METAL VALVE INDUSTRY	-0.001	1011	MEAT AND MEAT PRODUCTS INDUSTRY	0.001
3199	OTHER MACHINERY AND EQUIPMENT IND.	-0.001	3253	MOTOR VEHICLE STAMPING INDUSTRY	0.001
3361	ELECTRONIC COMPUTING AND PERIPHERAL	-0.001	3592	ASBESTOS PRODUCTS INDUSTRY	0.001
3921	JEWLERY	-0.001	3252	MOTOR VEHICLE WIRING ASSEMBLIES IND.	0.001
3999	OTHER MANUFACTURED PRODUCTS IND.	-0.001	3712	INDUSTRIAL ORGANIC CHEMICAL INDUSTRY	0.001
3992	BUTTON, BUCKLE AND CLOTHES FASTENER	-0.001	3256	PLASTIC PARTS AND ACCESSORIES FOR MOT.	0.001
3194	TURBINE & MECHANICAL POWER TRANSMIS.	-0.001	3257	MOTOR VEHICLE FABRIC ACCESSORIES IND.	0.001
2921	STEEL PIPE AND TUBE INDUSTRY	-0.001	3053	INDUSTRIAL FASTENER INDUSTRY	0.001
1994	HYGIENE PRODUCTS OF TEXTILE MATERIAL	-0.001	3521	HYDRAULIC CEMENT INDUSTRY	0.001
3052	WIRE AND WIRE ROPE INDUSTRY	-0.001	3562	GLASS PRODUCTS INDUSTRY (EXCEPT GLASS)	0.001
3911	INDICATING, RECORDING & CONTROLLING	-0.001	3341	RECORD PLAYER, RADIO AND TELEVISION	0.001
2521	HARDWOOD VENEER AND PLYWOOD IND.	-0.001	1211	LEAF TOBACCO INDUSTRY	0.002
2549	OTHER MILLWORK INDUSTRIES	-0.001	1831	BROAD KNITTED FABRIC INDUSTRY	0.002
2912	STEEL FOUNDRIES	-0.001	3994	MUSICAL INSTRUMENT AND SOUND RECORD.	0.002
3121	COMMERCIAL REFRIGERAT. AND AIR COND.	-0.001	3241	TRUCK AND BUS BODY INDUSTRY	0.002
2961	ALUMINUM ROLLING, CASTING AND EXTRUD.	-0.001	3914	OPHTHALMIC GOODS INDUSTRY	0.002
2958	PRIMARY PRODN OF NON-FERROUS METALS	-0.001	3399	OTHER ELECTRICAL PRODUCTS INDUSTRIES	0.003
3368	ELECTRONIC OFFICE, STORE AND BUSINESS - OTHER OFFICE, STORE AND BUSINESS MACH.	0.000	3741	PHARMACEUTICAL AND MEDICINE INDUSTRY	0.003
3611	REFINED PETROLEUM PRODUCTS INDUSTRY	0.000	1021	FISH PRODUCTS INDUSTRY	0.003
3561	PRIMARY GLASS AND GLASS CONTAINERS	0.000	3022	PLATE WORK INDUSTRY	0.004
3699	OTHER PETROLEUM AND COAL PROD. IND.	0.000	3231	MOTOR VEHICLE INDUSTRY	0.005
3932	TOYS AND GAMES INDUSTRY	0.000	3511	CLAY PRODUCTS INDUSTRY (FROM DOMEST.)	0.006
3261	RAILROAD ROLLING STOCK INDUSTRY	0.000			

NOTES

1 Twelve industries had such incomplete data that they were tossed out.

2 The U.S. data are at the 4-digit level of 450 U.S. SIC industries whereas the Canadian data are at the level of 225 Canadian SIC industries. We 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. Because some U.S. SIC industries do not go uniquely into a single Canadian SIC industry, we had to augment the Statistics Canada converter with more detailed U.S. data. Where there is no uniqueness, U.S. data were pro-rated 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* used year *t* shipments data. Data on 5-digit shipments are from the BEA website. With these data we were able to build a converter that "steps down" from over 1000 U.S. industry/products to 225 Canadian industries. We are indebted to our research assistant Susan Zhu for taking on this mind-numbing, lengthy task.

3 The FTA period is 1989–96. *Changes* over the FTA period are percentage changes using 1988 as the base year. Thus, even though the FTA period is 1989–96, we sometimes write 1988–96 as the FTA period in order to emphasize the use of 1988 as the base year.

4 The Canadian data are the Fisher value-added multifactor productivity measure from CANSIM as updated on March 23, 1999. The U.S. data are the MFP series from http://www.bls.gov/news.release/prod3.t01.htm as updated on February 11, 1999.

5 Data on unit labour costs are from the BLS foreign labour statistics home page as of June 23, 1999.

6 Given the rise of part-time employment in Canada, but not in the United States, many of those who worked full-time in 1988 may now be working part-time. This possibility is not backed by the data on average weekly hours in manufacturing. Weekly hours have risen slightly since 1988.

7 The data in Figure 5 are from the author's compilations based on data provided by Statistics Canada.

8 The rates were calculated at the 4-digit level as duties paid divided by imports. They were aggregated using Canadian production weights.

9 Aggregation bias (the use of imports as weights for aggregating tariffs to the 4-digit level) leads to violations of the MFN equality $t_{it}^{US} = t_{it}^{ROW}$ for $t \leq 1988$. Aggregation bias is only a problem in the present context if it *changes* over time. Imposing $t_{i,1988}^{US} = t_{i,1988}^{ROW}$ in equation (3) exacerbates the change over time because it implicitly uses 1988 aggregation weights that are unrelated to the import weights used for the year t_1 aggregation. 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, we do not impose $t_{i,1988}^{US} = t_{i,1988}^{ROW}$ in equation (3). To investigate further, we also considered specifications with $\Delta t_{i0}^{FTA} = 0$ replaced by

$\Delta t_{i0}^{FTA} \equiv \left((t_{i,t_0}^{US} - t_{i,t_0}^{ROW}) - (t_{i,1980}^{US} - t_{i,1980}^{ROW})\right)/(t_0 - 1980)$. However, this proved unimportant empirically.

10 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 between 1980 and 1996. This means that there were 16 tariff changes recorded for each industry. These annual-change results were similar to what will be repeated below. We 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.

11 Data are taken from the series 'gdp at factor cost, 1992 dollars' from Statistics Canada's CANSIM.

12 We are indebted to Paul Beaudry, Janet Currie, Paul Romer, Alwyn Young and other CIAR workshop participants for insisting that we control for business cycles. However, we hold them personally responsible for the considerable effort this has entailed.

13 Output includes adjustments for inventories, goods in process, and goods for resale from a special Statistics Canada run.

14 See "Faster, bigger, better: Canada has a productivity problem. And our standard of living is falling behind because of it" (*Globe & Mail*, November 14, 1998, pages D1-D2), "Drivers of the Canadian Dollar and Policy Implications" (*Current Analysis*, August 1998, volume 2, number 9, Department of Economics, Royal Bank of Canada), and Rubin (1997). At least the Royal Bank questions the numbers: "Canada's plummeting relative manufacturing productivity is a puzzle, especially when productivity was supposed to rise following free trade with the United States and when broader productivity measures have not shown a similar relative decline."

15 *The Daily*, March 23, 1999, as published on Statistics Canada's website.

16 See Statistics Canada (August, 1996). By the way, this is true of almost all capital stock data based on wealth surveys, including U.S. capital stock.

17 We are indebted to Alwyn Young for encouraging me to examine this issue carefully.

18 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 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 series plays little role. On a technical note, in converting 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 at the 3-digit Canadian SIC level (137) industries so that the deflator values were repeated to the 4-digit level (213 industries). It is difficult to evaluate the importance of this. Note though that the simple correlation of tariff cuts Δt_{i1}^{FTA} with the output deflator is –0.04. (See Table 1.) This suggests that cross-sectionally, the results are not being driven by a spurious correlation hidden here.

19 The numbers are calculated by adjusting the measure 3 '*Due to FTA*' column by the factor (–0.84)/(–1.07) and the measure 1 column by the factor (–1.57)/(–1.54). See equation (10).

20 Annual compound rates are calculated from Table 8 by dividing the entries by 8.

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