The Long and Short of the Canada-U.S. Free Trade Agreement

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Abstract

The Canada-U.S. Free Trade Agreement (FTA) provides a unique window onto the effects of a reciprocal trade agreement on an industrialized economy (Canada). For industries that experienced the deepest Canadian tariff cuts, employment fell by 12 percent and labour productivity rose by 15 percent as low-productivity plants contracted. For industries that received the largest U.S. tariff cuts, there were no employment gains, but plant-level labour productivity soared by 14 percent. Finally, the tariff reductions translated one-for-one into lower import prices for both U.S. and Canadian consumers. These results highlight the conflict between those who bore the *short-run adjustment costs* (displaced workers and struggling plants) and those who are garnering the *long-run gains* (consumers and efficient plants).

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The central tenet of international economics is that free trade is welfare improving. We express our conviction about free trade in our textbooks and we sell it to our politicians. Yet the fact of the matter is that we have one heck of a time explaining these benefits to the larger public, a public gripped by Free Trade Fatigue.

Why is the message of professional economists not more persuasive? To my mind there are two reasons. First, in examining trade liberalization we treat short-run transition costs and long-run efficiency gains as entirely separate areas of inquiry. On the one hand are those who study the long-run productivity benefits of free trade policies e.g., Tybout et al. (1991), Levinsohn (1993), Harrison (1994), Tybout and Westbrook (1995), Krishna and Mitra (1998), Head and Ries (1999b), and Pavcnik (2002). On the other hand are those who study the impacts of freer trade on short-run worker displacement and earnings e.g., Gaston and Trefler (1994, 1995), Revenga (1997), Levinsohn (1999), Beaulieu (2000), and Krishna et al. (2001). Only Currie and Harrison's (1997) study of Morocco examines both labour market outcomes and productivity. In assessing free trade policies there is clearly a bias introduced when looking only at the long-run benefits or only at the short-run costs. Nowhere is this more apparent than for the Canadian experience with the Canada-U.S. Free Trade Agreement (FTA) and its extension to Mexico. The FTA triggered on-going and heated debates about freer trade. This heat was generated by the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed plants) and those who garnered the *long run efficiency gains* (stakeholders of competitive plants and users of final and intermediate goods).

There is another reason why the free trade message is not more persuasive. While case-study evidence abounds about efficiency gains from liberalization (e.g., Krueger 1997), solid econometric evidence for industrialized countries remains scarce. When I teach my students about the effects of free trade on productivity I turn to high-quality studies for Chile (Tybout et al. 1991; Pavcnik 2002), Turkey (Levinsohn 1993), Cote d'Ivoire (Harrison 1994), Mexico (Tybout and Westbrook 1995), and India (Krishna and Mitra 1998) among others. Even though I find these studies compelling, I wonder whether they can be expected to persuade policy makers and voters in *industrialized* countries such as Canada and the United States. What is needed is at least some research focussing on industrialized countries.

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

Third, the FTA is not just about import-liberalizing policies. It is a reciprocal agreement that includes export-liberalizing policies as well. It should therefore be expected to induce a pronounced general equilibrium relocation of resources out of import-competing sectors and into export-oriented sectors. I will examine these general equilibrium FTA effects on a large number of Canadian plant and industry outcomes. At the plant and industry levels the outcomes include employment and earnings of both production and non-production workers, skill upgrading, earnings inequality, hours of work, plant size, and labour productivity. At the industry level the outcomes include the number of plants, investment in human capital, imports, exports, trade diversion, and intra-industry trade.

Fourth, product price changes play a central role in welfare theorems about the gains from trade. Thus, any assessment of the FTA requires a statement about import and export prices. Unfortunately, price studies are rare e.g., Huber (1971). To examine price effects, I take the novel tack of correlating changes in bilateral tariffs with changes in import prices at the product level i.e., at the 10-digit Harmonized System (HS) level of about 10,000 products.

The backdrop of the FTA – an industrialized country, a clean policy experiment, the direct policy lever of tariffs, general equilibrium reciprocity effects, and the long list of outcomes including employment, productivity and prices – will be my basis for a rigourous and detailed examination of the short-run costs and long-run benefits of trade liberalization.

The FTA has been the subject of several studies since its implementation on January 1, 1989. Gaston and Trefler (1997) found that the FTA had no effect on earnings and only a modest effect on employment. Beaulieu (2000) found that the employment effect was primarily driven by modest non-production worker employment losses. Claussing (2001) found evidence that the FTA raised U.S. imports from Canada (trade creation), but did not divert U.S. imports away from other U.S. trading partners. The most intriguing FTA study is by Head and Ries (1999b). They found that the FTA had little net effect on industry-level average output per plant (which they take as a proxy for scale) and a puzzling effect on Canadian plant exit (exit was induced by falling Canadian tariffs *and* by falling U.S. tariffs). Unfortunately, none of these papers use plant-level data. Further, I will argue below that at least some of these papers (including my own), suffer specification issues that substantively mar the inferences drawn about the effects of the Canada-U.S. Free Trade Agreement.

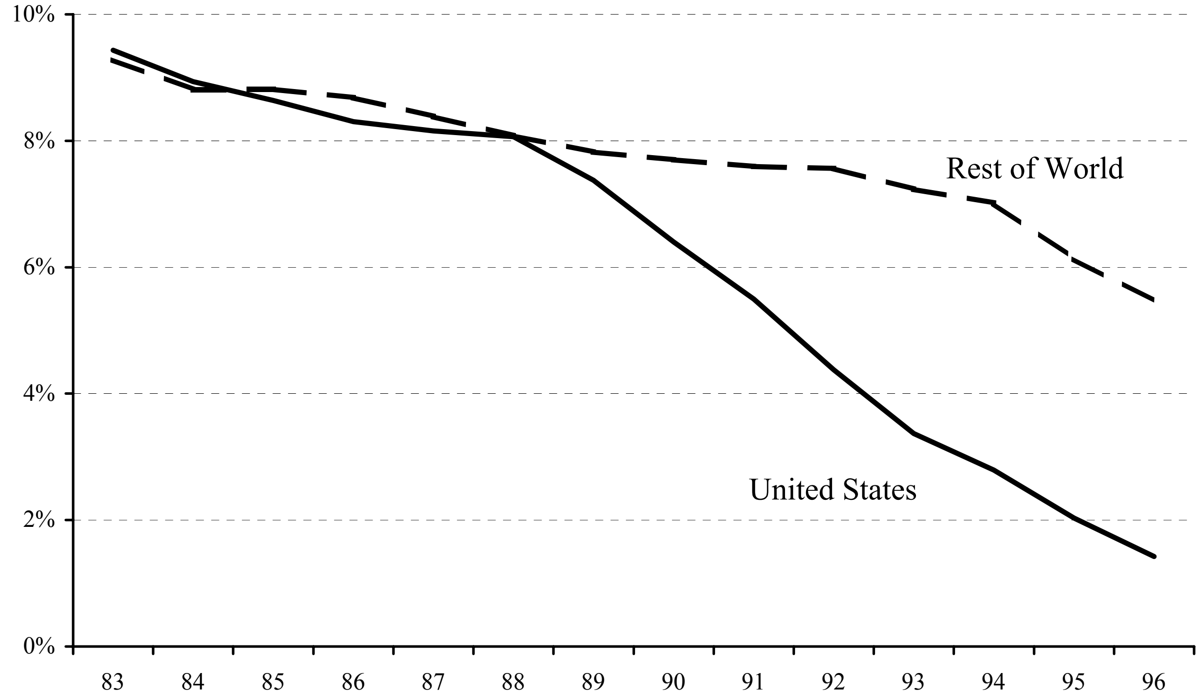
1. The FTA Tariff Cuts: Too Small to Matter?

This paper deals with the impact of FTA-mandated tariff cuts. The top panel of figure 1 plots Canada's average manufacturing tariff against the United States (solid line) and Canada's average manufacturing tariff against the rest of the world (dashed line). The bottom panel plots the corresponding U.S. tariffs against Canada (solid line) and the rest of the world (dashed line). In 1988, the average Canadian tariff rate against the United States was 8.1 percent. The corresponding effective tariff rate was 16 percent.[1] Perhaps most importantly, *tariffs in excess of 10 percent sheltered one in four Canadian industries.* Given that these industries were almost all characterized by low wages, low capital-labour ratios, and low profit margins, the 1988 tariff wall was indeed high. Similar comments apply

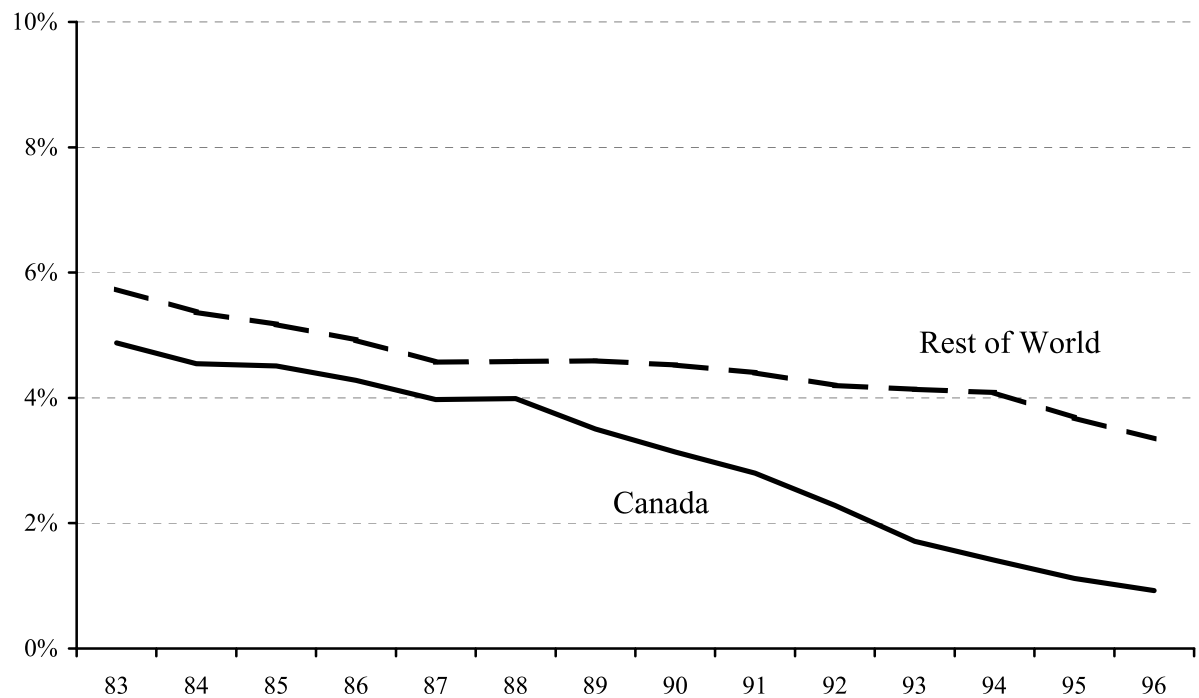
[1]Both the nominal and effective tariff rates were calculated at the 4-digit level as duties paid divided by imports. They were aggregated up to all of manufacturing using Canadian production weights. The standard formula used to calculate the effective rate of protection appears in Trefler (2001, page 39).

Figure 1. Canadian and U.S. Bilateral Tariffs in Manufacturing

The Average Canadian Tariff Rate Against:



The Average U.S. Tariff Rate Against:



to the U.S. tariff against Canada, albeit with less force since the average 1988 U.S. tariff was 4 percent.

That one in four Canadian industries had tariffs in excess of 10 percent depends crucially on the level of aggregation. I am working with 4-digit Canadian SIC data (213 industries). If one aggregates up even to 3-digit data (105 industries), almost no industries had 1988 tariffs in excess of 10 percent. This is important because studies of trade liberalization typically do not work with comparably disaggregated tariff data. For example, papers by Tybout et al. (1991), Levinsohn (1993), Harrison (1994), Tybout and Westbrook (1995), Gaston and Trefler (1997), Krishna and Mitra (1998), and Beaulieu (2000) are never at a finer level of aggregation than 3-digit ISIC with its 28 manufacturing sectors.

The core feature of the FTA is that it reduced tariffs between Canada and the United States without reducing tariffs against the rest of the world. Graphically, the FTA placed a gap between the dashed and solid lines of figure 1. Letting i index industries and t index years, my measures of the FTA policy levers will be

τ_{it}^{CA}: the FTA-mandated Canadian tariff concessions granted to the United States. In terms of the top panel of figure 1, this is the solid line minus the dashed line.

τ_{it}^{US}: the FTA-mandated U.S. tariff concessions granted to Canada. In terms of the bottom panel of figure 1, this is the solid line minus the dashed line.

τ_{it}^{CA} and τ_{it}^{US} capture the core textual aspects of the FTA.[2]

[2] Given that tariffs are positively correlated with effective tariffs and nontariff barriers to trade (NTBs), the coefficients on τ_{it}^{CA} and τ_{it}^{US} will capture the effects of FTA-mandated reductions in tariffs, effective tariffs, and nontariff barriers. This is exactly what I want: When analysing tariff concessions I am actually capturing a broader set of FTA trade-liberalizing policies.

2. Econometric Strategy

In this section, I lay out econometric strategies for analysing the plant- and industry-level data. I begin with the latter. Let i index industries, let t index years, and let Y_{it} be a Canadian outcome of interest such as employment or productivity. The FTA was implemented on January 1, 1989. I have data for the FTA period 1989-96. In what follows I will define the pre-FTA period as the years 1980-86. As will be shown in detail, this choice is useful for dealing with business fluctuations. Let Δy_{is} be the average annual log change in Y_{it} over period s where $s = 1$ indexes the FTA period and $s = 0$ indexes the pre-FTA period. That is,

$$\Delta y_{is} \equiv \begin{cases} (\ln Y_{i,1996} - \ln Y_{i,1988})/(1996 - 1988) & \text{for } s = 1 \\ (\ln Y_{i,1986} - \ln Y_{i,1980})/(1986 - 1980) & \text{for } s = 0 \end{cases} . \tag{1}$$

For $k = CA$ and $k = US$, define

$$\Delta \tau_{i1}^{k} \equiv (\tau_{i,1996}^{k} - \tau_{i,1988}^{k})/(1996 - 1988). \tag{2}$$

$\Delta \tau_{i1}^{CA}$ measures the change in the FTA-mandated tariff concessions extended by Canada to the United States. Likewise, $\Delta \tau_{i1}^{US}$ measures the change in the FTA-mandated tariff concessions extended by the United States to Canada.

What of pre-FTA period tariff concessions, which I denote by $\Delta \tau_{i0}^{k}$? Except for the 1965 Canada-U.S. Auto Pact, all tariff rates were extended on a Most Favoured Nation (MFN) basis prior to 1988. Thus, define $\Delta \tau_{i0}^{k} \equiv (\tau_{i,1986}^{k} - \tau_{i,1980}^{k})/(1986 - 1980)$ when industry i is in the automotive sector and $\Delta \tau_{i0}^{k} = 0$ otherwise. As will be shown, setting $\Delta \tau_{i0}^{k} = 0$

for all i or omitting the automotive sector entirely from the analysis makes no difference to the results. Additional details about $\Delta\tau_{i1}^{k}$, including a list of industries with large absolute values of $\Delta\tau_{i1}^{CA}$ and $\Delta\tau_{i1}^{US}$, appear in appendix A.

I am interested in a regression model explaining the impact of the FTA-mandated tariff concessions on a variety of industry outcomes:

$$\Delta y_{is} = \theta_s + \beta^{CA}\Delta\tau_{is}^{CA} + \beta^{US}\Delta\tau_{is}^{US} + \varepsilon_{is}, \qquad s = 0, 1 \tag{3}$$

where θ_s is a period fixed effect. There is an obvious problem with estimating equation (3). I have no deeply satisfying way of controlling for the lack of randomization in the tariff concessions. I must thus take particular care to control both for the endogeneity of tariffs and for sources of industry-level heterogeneity that might contaminate the estimates of β^{CA} and β^{US}. I turn to this task now.

2.1. The Secular Growth Control

For political economy reasons, one might expect declining industries to have high tariffs and hence deep FTA tariff concessions e.g., Trefler (1993). To prevent mistakenly attributing secular growth trends to the FTA tariff concessions, I introduce a growth fixed effect α_i into equation (3):

$$\Delta y_{is} = \alpha_i + \theta_s + \beta^{CA}\Delta\tau_{is}^{CA} + \beta^{US}\Delta\tau_{is}^{US} + \varepsilon_{is}, \qquad s = 0, 1. \tag{4}$$

As a result, β^{CA} and β^{US} only pick up FTA impacts on industry growth that are departures from industry trend growth.

2.2. The U.S. Control

A surprising feature of the data is that secular change is not pervasive. 45 percent of Canadian industries experienced reversals of fortune in the sense that employment growth in the pre-FTA and FTA periods had opposite signs. This is indicative of industry-specific demand and supply shocks. If these reversals of fortune are a characteristic of highly protected industries, then there is a danger of overstating the magnitudes of β^{CA} and β^{US}. Controlling for reversals of fortune is not easy. It is thus relevant that these reversals are mirrored in the U.S. data. I exploit this as follows. Let Δy_{is}^{US} be the U.S. counterpart to Δy_{is} e.g., if Δy_{is} is Canadian employment growth then Δy_{is}^{US} is U.S. employment growth. For employment, the sign patterns of $(\Delta y_{i0}, \Delta y_{i1})$ and $(\Delta y_{i0}^{US}, \Delta y_{i1}^{US})$ are the same in almost half of all industries. This suggests that Δy_{is}^{US} is a useful control for reversals of fortune and should be introduced as a regressor into equation (4). Unfortunately, there is a tension here. On the one hand, the Canadian tariff concessions increased the level of U.S. exports to Canada and hence raised Δy_{i1}^{US} i.e., Δy_{i1}^{US} is endogenous. On the other hand, it is not the case that increased U.S. employment came at the expense of Canadian employment i.e., Δy_{i1} and Δy_{i1}^{US} have a very strong *positive* correlation of 0.50. I interpret this correlation to mean that FTA-induced movements in Δy_{i1}^{US} were swamped by exogenous supply and demand shocks that affected Δy_{i1} and Δy_{i1}^{US} in the same direction. It is exactly these shocks that I am attempting to control for by introducing Δy_{is}^{US}. Of course, since this interpretation is open to question, I will focus only on those conclusions that hold when Δy_{is}^{US} is instrumented or even excluded.

2.3. The Business Conditions Control

A key issue for examining the FTA is the treatment of the early 1990's recession. Figure 2 plots GDP in year t (gdp_t) for Canadian manufacturing. The data are in logs relative to a 1980 base i.e., $\ln(gdp_t/gdp_{1980})$. The FTA period recession stands out. This is a problem if the industries that experienced the deepest tariff concessions share a common sensitivity to changes in business conditions. General business conditions can be introduced into equation (4) by including a regressor Δb_{is} that captures how movements in GDP and the real exchange rate affect industry i. I will explain how Δb_{is} is constructed shortly. Introducing Δb_{is} and Δy_{is}^{US} into equation (4) yields

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

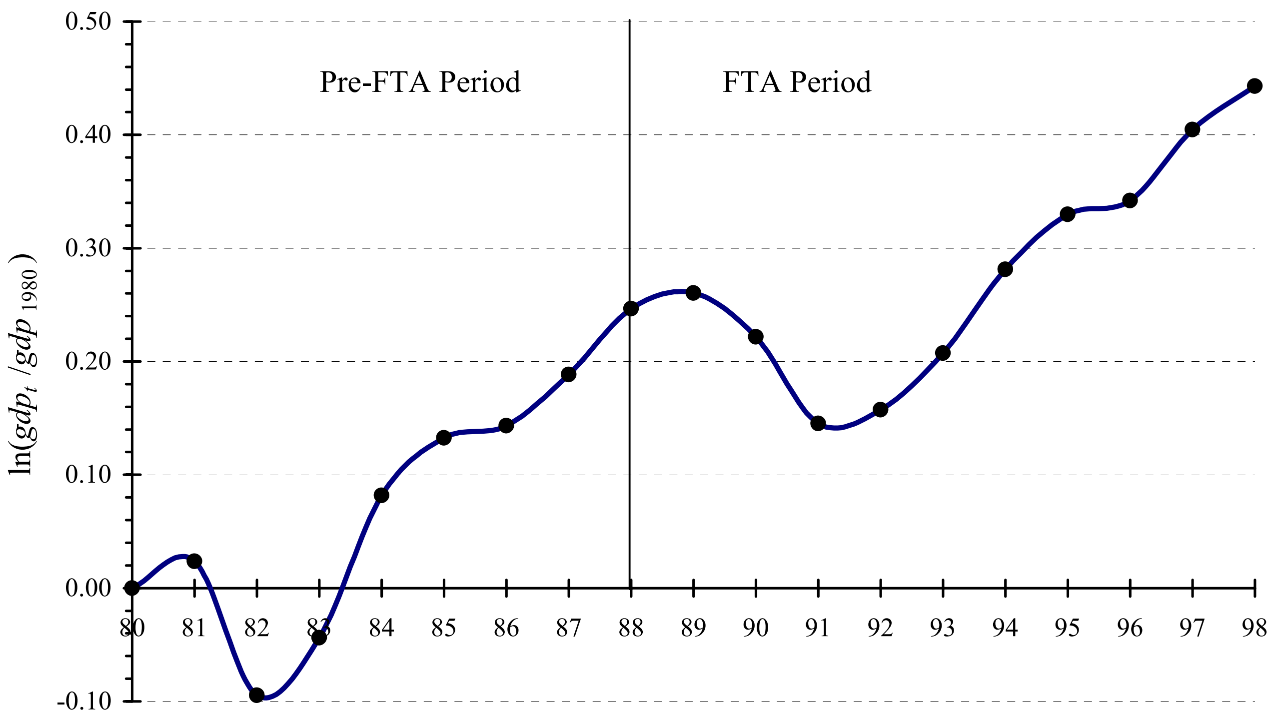
2.4. Estimation

Differencing (5) across periods yields my difference-of-differences baseline specification:

$$\begin{aligned}(\Delta y_{i1} - \Delta y_{i0}) \;&=\; \theta + \beta^{CA}(\Delta\tau_{i1}^{CA} - \Delta\tau_{i0}^{CA}) + \beta^{US}(\Delta\tau_{i1}^{US} - \Delta\tau_{i0}^{US}) \\ &\quad + \;\gamma(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) \;+\; \delta(\Delta b_{i1} - \Delta b_{i0}) \;+\; \upsilon_i \end{aligned} \tag{6}$$

where $\theta \equiv \theta_1 - \theta_0$. This specification controls for secular industry trends (by differencing out the α_i), idiosyncratic industry demand and supply shocks (the Δy_{is}^{US}), and industry-specific business condition effects (the Δb_{is}). Clearly, I will have to use an IV estimator to deal with the endogeneity of the tariff concessions as well as the endogeneity of $\Delta y_{i1}^{US} - \Delta y_{i0}^{US}$. Less

Figure 2. Real Canadian Manufacturing GDP



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

obviously, the use of long double-differencing means that I need not worry about dynamic panel estimation problems (Arellano and Honoré, 2001). This is important because all previous FTA studies have used annual data without any correction for autocorrelation i.e., Gaston and Trefler (1997), Head and Ries (1999a,b), Beaulieu (2000), and Claussing (2001). Yet the fact is that employment and output display strong autocorrelation at lags of up to 3 years. For example, Canadian employment displays significant 3-year autocorrelation in 31 percent of all industries and 1-year autocorrelation in an overwhelming 77 percent of all industries. Thus, the estimators used in all previous studies of the FTA (including my own) are inconsistent and yield standard errors that are too small.

2.5. Plant-Level Data

Letting k index plants, my baseline plant-level specification is

$$\begin{aligned}(\Delta y_{ik1} - \Delta y_{ik0}) &= \theta + \beta^{CA}(\Delta\tau_{i1}^{CA} - \Delta\tau_{i0}^{CA}) + \beta^{US}(\Delta\tau_{i1}^{US} - \Delta\tau_{i0}^{US}) + \phi x_{ik,1980} \\ &+ \gamma(\Delta y_{i1}^{US} - \Delta y_{i0}^{US}) + \delta(\Delta b_{i1} - \Delta b_{i0}) + \upsilon_{ik} \qquad (7)\end{aligned}$$

where Δy_{iks} is the change in the outcome of interest for plant k in industry i in period s and $x_{ik,1980}$ is a vector of plant characteristics that includes the log of 1980 employment, the log of 1980 earnings per worker, the log of 1980 labour productivity, and the log of plant age. Since the plant data only go back to 1973, I also include a dummy for whether the plant was older than 7 years of age in 1980. There are 3,801 plants in the sample.[3]

[3] I am indebted to Alla Lileeva for running these regressions and for sharing her experience as to which plant-level controls to use. Without her, the plant-level analysis would not have been possible.

There are two selection issues that require attention. First, equation (7) only makes use of plants that were in existence in 1980, 1986, 1988, and 1996. Obviously these 'continuing' plants are not representative of all plants. Second, I will be working with what are known as 'long-form' plants, that is, plants that fill out a detailed survey. In 1988, long-form plants were 2.2 times larger than 'short-form' plants. Thus, my plant-level results must be understood as dealing with larger plants. This said, appendix F provides some evidence that my results apply to small plants as well.

2.6. A General Equilibrium Aside

This paper is unabashedly a reduced-form exercise that allows the inferences to be driven more by the data than by a highly structured model. This has obvious advantages, but it also has a cost. A more structured approach, as in Head and Ries (2001) or Lai and Trefler (2002), muzzles the data, but allows for a clearer interpretation of the coefficients and for a richer treatment of general equilibrium feedbacks. This said, my approach does capture at least a few general equilibrium effects. One of these deals with the fact that because cost advantages vary across industries, so will the coefficients β^{CA} and β^{US}. This cross-industry variation is explored in appendix E. (Appendix E is best read after section 8 on labour productivity has been read.)

3. The Data

Canadian data are from the Canadian *Annual Survey of Manufactures* (ASM), the *Canadian Labour Force Survey*, the International Trade Division, the Input-Output Division, the Prices

Division, and the Standards Division (for commodity and industry concordances). Almost all the data used involved special tabulations by Statistics Canada. Most of the U.S. data through 1994 are from the NBER Manufacturing Productivity Database (Bartelsman and Gray, 1996) and Feenstra (1996). I updated these sources to 1996. As discussed in Trefler (2001, page 11), I have been especially careful to build a Canada-U.S. converter that steps down from over 1,000 U.S. products to 213 Canadian industries. I work with both plant- and industry-level data from the Canadian ASM. I will present extensive sensitivity analysis for the industry-level results. Unfortunately, the shortage of resources at Statistics Canada's Micro-Economic Analysis Division, which maintains the longitudinal ASM file, made it impossible to do much more than run a limited set of plant-level specifications.

4. Empirical Results: Employment

Table 1 reports estimates of equations (6) and (7) for the case where the dependent variable is employment growth. The table includes a large number of specifications in order to show that the estimates of β^{CA} and β^{US} are not particularly sensitive to the choice of specification. Row 1 is my industry-level baseline specification. It uses ordinary least squares (OLS) and includes all 4 regressors. I will explain coefficient magnitudes shortly, but for now treat $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ as the log-point changes in employment associated with the FTA. For example, the Canadian tariff concessions led to a $-.12$ log-point change in employment ($t = -2.35$).

The first specification issue handled by table 1 deals with the sensitivity of $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ to the way in which the business conditions variable Δb_{is} is constructed. In order to explain how Δb_{is} is constructed, define $z_t \equiv (\ln gdp_t, \ln rer_t)$ where rer_t is the real exchange rate and let Δ_1 be the annual difference operator so that $\Delta_1 z_t = z_t - z_{t-1}$ and $\Delta_1 y_{it} = y_{it} - y_{i,t-1}$. To construct Δb_{is}, I first regressed $\Delta_1 y_{it}$ on $(\Delta_1 z_t, \ldots, \Delta_1 z_{t-J})$ for some lag length J. This is a time-series regression that was estimated separately for each i. The regression generates an industry-specific prediction $\widehat{\Delta_1 y}_{it}$ of the effect of current and past business conditions on current annual employment growth. Second, note from equation (1) that Δy_{i1} can be written as $\Sigma_{t=1989}^{1996} \Delta_1 y_{it}/8$. This motivates the definition of Δb_{i1} as $\Delta b_{i1} \equiv \Sigma_{t=1989}^{1996} \widehat{\Delta_1 y}_{it}/8$. Δb_{i1} is just an industry-specific prediction of the effect of business conditions on FTA-period employment growth. For the pre-FTA period I use $\Delta b_{i0} \equiv \Sigma_{t=1981}^{1986} \widehat{\Delta_1 y}_{it}/6$. Note that there is a different Δb_{is} for each outcome. For example, when Δy_{is} is earnings growth then Δb_{is} is the portion of industry i earnings growth driven by movements in GDP and the real exchange rate. See appendix C for further details.

Row 1 of table 1 uses my baseline specification of Δb_{is} in which the lag length is $J = 2$. I chose $J = 2$ because the industry-specific autocorrelation functions only vanish at longer lags. Rows 2 and 3 of table 1, which use $J = 1$ and $J = 0$ respectively, illustrate that $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ are not sensitive to the choice of lag length. Row 4 uses $J = 2$, but drops rer_t from z_t. This does not dramatically alter the estimates either. In fact, as row 5 shows, the estimates rise only slightly when $\Delta b_{i1} - \Delta b_{i0}$ is omitted from the baseline specification. This requires some explanation as it might be misinterpreted to mean that business conditions are playing only a minor role.

Returning to figure 2, the 1980-86 and 1988-96 periods are very similar in terms of business conditions. Each began a year before the peak, each entered a deep recession in the third year, and each ended in the midst of a prolonged expansion. Further, my decision to end the pre-FTA period in 1986 ensures that the two periods are similar as judged by GDP growth over the period and by the number of years into the expansion. That is, I have purposely chosen the pre-FTA period so that, after double-differencing, my estimating equations have a built-in, implicit control for business conditions. This explains why omitting $\Delta b_{i1} - \Delta b_{i0}$ does not dramatically alter the results.[4]

Consider now the U.S. control variable $(\Delta y_{i1}^{US} - \Delta y_{i0}^{US})$. Its coefficient is positive for all results reported in this paper. This is to be expected if it is picking up demand and supply shocks that are common to both U.S. and Canadian industries. Row 6 shows that the omission of the U.S. control has no effect on $\widehat{\beta}^{US}$ and only a minor effect on $\widehat{\beta}^{CA}$. Row 7 shows that omission of both the U.S. control and the business conditions control has no effect on $\widehat{\beta}^{US}$, but does raise $\widehat{\beta}^{CA}$ from -0.12 to -0.17. I conclude from rows 1-7 that my row 1 baseline estimates are not sensitive to the exact treatment of the U.S. control and the business conditions control provided that at least one of them is included in the specification. This conclusion holds true for all the statistically significant estimates reported in this paper.

Rows 8 and 9 examine the role of particular observations. As appendix table A1 shows, the Brewery and Shipbuilding industries have unusually large Canadian tariff concessions and are thus potentially influential observations. In row 8, I delete these observations. This slightly raises $\widehat{\beta}^{CA}$. In row 9, I delete the 9 industries in the automotive sector. This raises $\widehat{\beta}^{US}$, but not significantly.

Row 10 is my baseline plant-level specification. It includes the plant-level controls i.e.,

[4] It is no coincidence that there were sufficient data for lining up the pre-FTA and FTA business fluctuations. The first draft of this paper only used data back to 1983 because that was the year that Statistics Canada changed its industrial classification from SIC(1970) to SIC(1980). Obtaining data back to 1980 in order to match business fluctuations involved custom runs by Statistics Canada and a lot of additional data cleaning.

plant age and the 1980 values of the log of employment, the log of earnings, and the log of labour productivity. Notice that the plant-level estimate of β^{CA} and β^{US} are almost identical to the industry-level estimates of row 1. This suggests that, at least for employment, the industry-level regressions are capturing within-plant effects rather than between-plant effects. Row 11 shows that $\widehat{\beta}^{CA}$ or $\widehat{\beta}^{US}$ are unaffected by the exclusion of the plant-level controls.

Rows 12-15 report the IV results. A key issue is the identification of variables that satisfy the two requirements of an instrument. The most likely candidates for valid instruments are variables measuring the level of industry characteristics in 1988. For one, these level characteristics are unlikely to be correlated with the residuals because the latter are twice-differenced. Such change in changes are far removed from levels. For another, the 1988 characteristics determine the 1988 levels of protection which in turn are highly correlated with the tariff changes. I therefore use an instrument set that consists of 1988 log values for: (1) Canadian hourly wages, which captures protection for low-wage industries as in Corden's (1974) conservative social welfare function, (2) the level of employment, which captures protection for large industries as in Finger et al.'s (1982) high-track protection for large industries, (3) Canadian imports from the United States, and (4) U.S. imports from Canada. I also include cross–products as well as any exogenous regressors. The first-stage R^2s are between 0.30 and 0.40 for almost all the results in this paper.

Row 12 repeats the specification of row 1, but with the two tariff regressors instrumented. $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ are now larger. This increase in magnitude is typical of most of the IV estimates reported in this paper, though the labour results are particularly extreme. The Hausman test rejects endogeneity. The p-value for the Hausman test appears in the column labelled 'Hausman.' Given the poor small-sample properties of IV estimators (Nelson and Startz, 1990), I will only reject exogeneity at the 1 percent level i.e., when the p-value falls below 0.010. Row 13 reports the IV estimates for the case where the U.S. control is instrumented along with the two tariff concessions. Comparing row 13 with row 12, it is clear that endogenizing the U.S. control has no impact on the estimates of $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$. Further, endogeneity continues to be rejected.[5]

Rows 14 and 15 repeat the IV exercises of rows 12 and 13, respectively, but starting with the plant-level baseline specification of row 10. As with the industry-level results, the $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ are much larger, but endogeneity is rejected. Indeed, endogeneity is easily rejected for every plant-level specification reported in this paper. This likely reflects the fact that tariffs, even if endogenous to the industry, are exogenous to the plant.

5. Coefficient Magnitudes

I have not yet properly explained the magnitudes of $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$. Since the distribution of tariff concessions is skewed, it is of interest to know the effect of the Canadian tariff concessions on the *most-impacted, import-competing* group of industries i.e., on the one-third of industries with the most negative values of $\Delta\tau_{i1}^{CA}$. This group has 71 (=213/3) industries, tariff concessions ranging from -5 to -33 percent, and an average tariff concession of -10

[5] As someone who has tried to build a career on the endogeneity of protection (Trefler, 1993), I am surprised by the rejection of endogeneity. To investigate further, I have experimented with a much larger set of instruments drawn from 1988 characteristics of Canadian and U.S. industries. I have also considered reducing the instrument set by omitting cross-products, the exogenous second-stage regressors, and/or several of the instruments. None of this makes any difference to the conclusion that endogeneity is rejected. As a result, I will report the industry-level IV results, but downplay them.

percent. The industries are listed in appendix table A1. For any industry i, the Canadian tariff concessions are estimated to change employment by $\widehat{\beta}^{CA}\Delta\tau_{i1}^{CA}$ log points. For the most-impacted, import-competing group as a whole this change is given by $\widehat{\beta}^{CA}\overline{\Delta\tau}_{\cdot 1}^{CA}$ where $\overline{\Delta\tau}_{\cdot 1}^{CA}$ is a weighted average of the $\Delta\tau_{i1}^{CA}$ with weights that depend on industry size. (See appendix B for details about the weights.) It is $\widehat{\beta}^{CA}\overline{\Delta\tau}_{\cdot 1}^{CA}$ that is reported in the β^{CA} column of all the tables in this paper. From row 1 of table 1, the most-impacted, import-competing group as a whole experienced a 12 percent employment loss.

A similar discussion of coefficient magnitudes applies to the *most-impacted, export-oriented* group of industries i.e., the one-third of industries (71 industries) with the most negative values of $\Delta\tau_{i1}^{US}$. For this group the estimated impact of the U.S. tariff concessions on employment is given by $\widehat{\beta}^{US}\overline{\Delta\tau}_{\cdot 1}^{US}$ where $\overline{\Delta\tau}_{\cdot 1}^{US}$ is the weighted average of the $\Delta\tau_{i1}^{US}$. $\widehat{\beta}^{US}\overline{\Delta\tau}_{\cdot 1}^{US}$ is reported in the β^{US} column of all the tables in this paper. From row 1 of table 1, this group experienced a statistically insignificant 3 percent employment loss. I had expected employment gains, a point to which I will return shortly.

The 'Total FTA Impact' columns in this paper present the joint effect of the tariff concessions on manufacturing employment as a whole. This effect is just

$$TFI \equiv \widehat{\beta}^{CA}\overline{\Delta\tau}_{\cdot 1}^{CA} + \widehat{\beta}^{US}\overline{\Delta\tau}_{\cdot 1}^{US}. \tag{8}$$

From the 'TFI' column of row 1 in table 1, the FTA reduced manufacturing employment by 5 percent. This impact is statistically significant and quite similar across all the OLS specifications. It stands in sharp contrast to Gaston and Trefler (1997) who found economically small and statistically insignificant effects of the FTA.

Employment losses of 5 percent translate into 100,000 lost jobs and strike me as large, not least because only a relatively small number of industries experienced deep tariff concessions. Indeed, most of these lost jobs were concentrated in the most-impacted, import-competing industries. For this group, with its 12 percent job losses, one in eight jobs disappeared. *This number points to the very large transition costs of moving out of low-end, heavily protected industries. It reflects the most obvious of the costs associated with trade liberalization.*

It is difficult to be sure whether these transition costs were short-run in nature. However, two facts drawn from the most recent seasonally adjusted data suggest that they probably were short run costs. First, the FTA had no long-run effect on the Canadian employment rate which was 62 percent both in April 1988 and April 2002. Second, Canadian manufacturing employment has been more robust than in most OECD countries. For example, between April 1988 and April 2002, manufacturing employment rose by 9.1 percent in Canada, but fell by 12.9 percent in the United States and by 9.7 percent in Japan. This suggests, albeit not conclusively, that the transition costs were short run in the sense that within 10 years the lost employment was made up for by employment gains in other parts of manufacturing.

6. Employment of Production and Non-Production Workers

We are now in a position to quickly review the results for other outcomes. The data distinguish between workers employed in manufacturing activities and non-manufacturing activities. I will refer to these as production and non-production workers since the distinction broadly follows that used in the U.S. ASM. In particular, non-production workers are more educated and better paid. The top block of results in table 2 reports a limited number of specifications for the employment of production workers. My baseline industry- and plant-level specifications appear in rows 1 and 10, respectively. (Row numbers match those of table 1 so that the reader can always remind herself of the specification details of any row by referring back to the detailed discussion surrounding table 1.) The results indicate that the Canadian tariff concessions reduced employment by a large amount, 14 percent using industry-level estimates ($t = -2.44$) and 9 percent using plant-level estimates ($t = -2.58$). The effects of the U.S. tariff concessions are less clear. They reduced employment by 7 percent using industry-level estimates, but this is not statistically significant and virtually disappears in the plant-level estimates. The total FTA impact of 8 percent (industry-level) and 4 percent (plant level) are both economically large and statistically significant.

Rows 5, 6, and 12 present alternative specifications. In rows 5 and 6 the business conditions control and the U.S. control are excluded, respectively. This does not affect the $\widehat{\beta}^{CA}$ or $\widehat{\beta}^{US}$. In row 12, the industry-level IV results are reported. Endogeneity is rejected ($p = 0.280$). I do not report the plant-level IV results because endogeneity is always strongly rejected at the plant level.

The negative estimates of β^{US} come as a surprise to me, even though they are statistically insignificant. It is thus reassuring that $\widehat{\beta}^{US}$ is positive for non-production workers. See table 1. Interestingly, the Hausman p-value of 0.013 for non-production workers is the smallest of the paper, suggesting that the IV result should be taken more seriously than elsewhere in the paper. The IV estimate of β^{US} is a statistically insignificant, but an economically large +35 percent.

Finally, the 'Skill Upgrading' block of results in table 1 show that there has been FTA-induced skill upgrading i.e., an increase in the ratio of non-production workers to production workers. This happened at the industry level much more than at the plant level which means that market shares have shifted in favour of non-production-worker-intensive plants. Possibly these workers are a fixed cost that is needed to penetrate U.S. markets.

7. Earnings

Most commentators expected Canadian wages to fall in response to competition from less-unionized, less-educated workers in the southern United States. Table 3 revisits this question using payroll statistics. Since the industry-level results are robust and since endogeneity is strongly rejected, I do not report the specifications that appeared as rows 5, 6, and 12 of tables 1-2. For all workers, the tariff concessions raised annual earnings. For example, the total FTA impact is a rise of 3 percent at both the industry level ($t = 3.80$) and the plant level ($t = 5.64$). At the plant level, earnings rose for both production and non-production workers. At the industry level, earnings gains were concentrated among production workers.[6] I have refined this observation by looking at hourly wages and hours worked by production workers. As shown in table 3, there are strong wage effects and no hours effects. These earnings and wage effects are large in a statistical sense, but small in an economic sense. For example, a 3 percent rise in earnings spread over 8 years will buy you more than a cup of coffee, but not at Starbucks. The important finding is not that earnings went up, but that earnings did not go down in response to competitive pressures from the U.S. South.

[6] My earnings results contrast sharply with those of Gaston and Trefler (1997) and Beaulieu (2000). Gaston and Trefler found no statistically significant effect of the tariff concessions on earnings. The only effect Beaulieu finds is the positive effect of U.S. tariff concessions on non-production worker earnings (an effect I find only in the plant-level data, *not* the industry-level data).

It is not obvious to me why earnings rose at a time when employment was falling. One explanation is that hiring and attrition policies favoured more educated workers. While Canadian data on education by industry is limited, the *Labour Force Survey* reports these data for a classification in which manufacturing is divided up into 16 industries.[7] Figure 3 plots the Canadian tariff concessions against the 1988-96 log changes in average years of schooling. The correlation is -0.28 which would support the view that the tariff cuts were associated with educational upgrading. However, this correlation is almost completely driven by the Clothing industry. The correlation falls to -0.06 when Clothing is omitted. Thus, while there is some evidence that the earnings effect is driven in part by educational upgrading, this conclusion must be tentative.

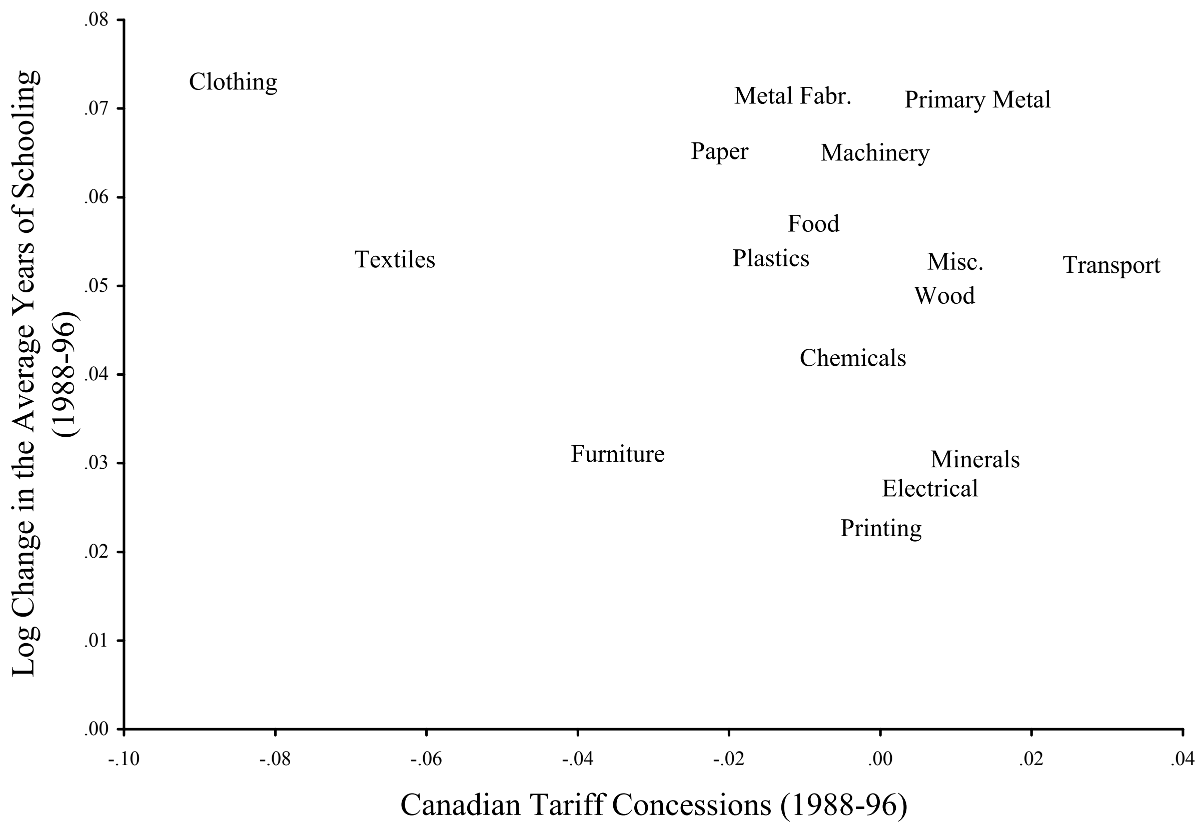
There is a presumption in the popular press that anything to do with globalization will worsen income inequality. It is thus reassuring that there is absolutely no evidence that the FTA worsened income inequality. In the last block of results in table 3, where inequality is measured as the earnings of non-production workers relative to production workers, $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ are effectively 0.

8. Labour Productivity

It would be best to examine productivity using a total factor productivity (TFP) measure. Unfortunately, the Canadian ASM does not record capital stock or investment data. There is thus little alternative but to work with labour productivity. I define labour productivity

[7] These data were compiled from the confidential *LFS* microfiles. I am indebted to Laine Ruus, data librarian at the University of Toronto, for facilitating access.

Figure 3. Human Capital



as value added in production activities per hour worked by production workers.[8] I deflate using 3-digit SIC output deflators.[9] Table 4 reports the labour productivity results. The table has the exact same format as the table 1 employment results so that I can review it quickly. As in the table 1, endogeneity is always rejected and all the industry-level OLS results are similar so that I can focus on the baseline row 1 specification.

From the industry-level OLS results, the Canadian tariff concessions raised labour productivity by 15 percent in the most-impacted, import-competing group of industries ($t = 3.11$). *This translates into an enormous compound annual growth rate of 1.9 percent.* The fact that the effect is smaller and statistically insignificant at the plant level (row 10) suggests that much of the productivity gain is coming from market share shifts favouring high productivity plants. Such share shifting would come about from the growth of high-productivity plants and the demise and/or exit of low-productivity plants.

From the plant-level OLS results (row 10), the U.S. tariff concessions raised labour productivity by 14 percent or 1.9 percent annually in the most-impacted, export-oriented group of industries ($t = 3.97$). This labour productivity gain does not appear at the industry level ($\widehat{\beta}^{US} = 0.04$, $t = 1.14$) which is likely due to the fact that the U.S. tariff concessions encouraged entry of plants that are less productive by virtue of being young. (On the low productivity of young plants see Baldwin 1995 for Canada and Bernard and Jensen 1995 for

[8] Trefler (2001) extensively examined the sensitivity of results to alternative definitions of labour productivity. Appendix D of the current draft shows that the results are not sensitive to redefining labour productivity as total value added (in both production and non-production activities) per worker (both production and non-production workers). This definition does not correct for hours; however, it is useful in that it is directly comparable to the way in which I am forced to define U.S. labour productivity in Δy_{is}^{US}. (The U.S. ASM does not report value added in production activities.)

[9] Appendix D also shows that the results do not change when labour productivity is deflated by the available 2-digit SIC value-added deflators. I am indebted to Alwyn Young for encouraging me to carefully examine the issue of deflators.

the United States.) The importance of controlling for plant age can be seen by comparing rows 10 and 11 since the latter excludes the plant age control and has a lower $\widehat{\beta}^{US}$.[10]

The last column of table 4 looks at the total FTA impact on all of manufacturing. The plant-level numbers of row 10 indicate that *the FTA raised labour productivity in manufacturing by 7.4 percent or by an annual compound growth rate of 0.93 percent* ($t = 4.92$). The industry-level numbers are about the same. These numbers, along with the 14-15 percent effects for the most-impacted importers and exporters, are enormous. *The idea that an international trade policy could raise labour productivity so dramatically is to my mind remarkable.*

9. Prices

Tariffs create an inefficiency by driving a wedge between the producer price charged by exporters and the consumer price paid by importers of final goods and intermediate inputs. The most obvious first-order benefits from trade liberalization come from driving the consumer price down by the amount of the tariff.[11] Surprisingly, there exists very little econometric work on the effects of trade liberalization on import prices. Huber (1971) is a rare exception.

To investigate, I examine the relationship between tariff cuts and changes in import unit

[10]Another contributing factor to the difference between the $\widehat{\beta}^{US}$ at the industry and plant levels is that the U.S. tariff concessions encouraged Canadian plants to enter the U.S. market. This must reduce average productivity because new Canadian exporters are less productive than old Canadian exporters (Baldwin and Gu 2001). (This is not true of U.S. exporters. See Bernard and Jensen 1999.) Expansion into the U.S. market therefore increases the market share of lower productivity new exporters, thus reducing the industry-level productivity effect. This explanation resonates with my previous observation about the role of non-production workers as a fixed cost that must be incurred in order to enter U.S. markets.

[11]There are, of course, many subtleties and exceptions associated with both imperfect competition (e.g., Brander 1995) and even perfect competition (e.g., Krishna and Panagariya 2000).

values. Both these variables are available at the 10-digit Harmonized System (HS10) level. While unit values are difficult to interpret as prices, the hope is that at this detailed level of disaggregation, *changes* in unit values over the FTA period reflect *changes* in prices. Note that I am looking only at unit-value changes *within* an HS10 item. This is very different from and less problematic than the typical use made of unit values. Typically, researchers draw conclusions from the fact that one HS10 item has a higher unit value *level* than another e.g., Schott (2001). Since unit values are based on actual payments net of import duties, freight, insurance, and other charges, I will interpret changes in unit values as changes in producer prices.

The first full year of trade data in the HS system is 1988 for Canada and 1989 for the United States. In matching these years with 1996 data I loose 33 percent of the 1988-89 HS10 items. There is some evidence of a selection issue in that the average tariff on these unmatched commodities is 0.5 percentage points lower than on the matched commodities. This reflects the fact that many of the unmatched commodities are in high-tech industries. For example, Intel's introduction of the 486 CPU in 1989 quickly led to the demise of the 386 CPU. (Don't date yourself by admitting you remember this!)

Let $\Delta\tau^o_{ijk}$ be the change in country j's tariff against country k for HS10 product i. In this section, time differences are for 1988-96 when Canada is the importer and 1989-96 when the United States is the importer. Note that $\Delta\tau^o_{ijk}$ is a bilateral tariff rate change as opposed to an FTA tariff concessions: The latter is $\Delta\tau^o_{ijk}$ minus the tariff change against the rest of the world. Let Δm_{ijk} be the log change in country j's imports from country k and let Δp_{ijk} be the log change in the producer price of country j's imports from country k.

The top panel of table 5 reports the rank correlations between $\Delta\tau_{ijk}$ and Δm_{ijk}. If tariff cuts lead to increased imports then these correlations should be negative. From the column 'Without Controls,' the correlations are indeed negative: -0.21 for Canadian imports from the United States and -0.20 for U.S. imports from Canada. These are statistically significant at the 1 percent level (indicated by an asterisk). With 9,121 Canadian observations and 6,212 U.S. observations it would be surprising if these correlations were not significant.

The bottom panel of table 5 reports the rank correlations between $\Delta\tau^{o}_{ijk}$ and Δp_{ijk}. Despite the large number of observations, the correlations are statistically insignificant. The small row 1 correlation of 0.03 means that the Canadian tariff concessions had no effect on U.S. producer prices of goods shipped to Canada. Likewise, the small row 2 correlation of 0.01 means that the U.S. tariff concessions had no effect on Canadian producer prices of goods shipped to the United States. Re-stated, *all of the fall in tariffs was passed on to domestic users of intermediate inputs and final goods*.

The fact that tariff concessions were allocated non-randomly potentially sheds doubt on this conclusion. For example, an alternative interpretation of the zero correlations is that the tariff cuts were deepest for those commodities that had stable prices. A natural control for how prices would have evolved in the absence of the FTA is the producer price changes of third-party exporters e.g., the change in the producer price of U.K. goods shipped to Canada and the United States. I thus correlate $(\Delta\tau^{o}_{ijk} - \Delta\tau^{o}_{ijk'})$ with $(\Delta p_{ijk} - \Delta p_{ijk'})$ where k' is a third-party exporter. These correlations can be viewed as a product-level variant of my equation (6) difference-of-differences regressions. The correlations appear in table 5. Results are reported separately for each k' i.e., for the United Kingdom, Germany, France, and Japan. The correlations are virtually zero for all choices of control k'. This increases my confidence in the conclusion that all of the tariff concessions were passed on to consumers.

10. Trade Creation, Trade Diversion, and Intra-Industry Trade

Table 5 also reports the comparable correlations between tariff cuts and log changes in imports i.e., the correlations between $(\Delta\tau^o_{ijk} - \Delta\tau^o_{ijk'})$ and $(\Delta m_{ijk} - \Delta m_{ijk'})$. From table 5, the FTA tariff concessions increased trade significantly for all choices of control k'. Was this effect due to trade creation, trade diversion, or both? Table 6, which returns to my regression setting, shows that the U.S. tariff concessions raised Canada's share of U.S. imports by 16 log points in the most-impacted, export-oriented industries. Claussing (2001) finds a similar result, albeit with a very different methodology. However, she does not examine the Canadian tariff concessions. These dramatically raised the U.S. share of Canadian imports by 46 percentage points for the most-impacted, import-competing industries. That is, trade diversion is a part of the FTA story. Finally, table 6 shows that the FTA had no statistically significant effect on intra-industry trade. If anything, the FTA reduced such trade. This is indicative of the sort of lack of comparative advantage specialization documented in Head and Ries (1999a).

11. What Underlies Rising Labour Productivity?

To the extent that the labour productivity benefits of the FTA reflect gains in technical efficiency (as opposed to allocative efficiency), it is of interest to know how this came about. In this section I examine a number of possibilities.

11.1. Down the Average Cost Curve

One explanation of rising labour productivity is that plants have been moving along their steep average cost curves. To examine this I estimated my industry-level equation (6) for average output per plant and my plant-level equation (7) for plant output. The results appear in table 7. The industry-level $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ are comparable in magnitude to those estimated by Head and Ries (1999b) though my significance level is much lower.[12] Their finding of statistical significance may reflect their decision to work with annual changes without correcting for serial correlation. The more interesting results are at the plant level since these are more readily interpretable as moving along an average cost curve. The results indicate that the Canadian tariff concessions led the most-impacted, import-competing plants to contract by 5 percent ($t = 1.36$) while the U.S. tariff concessions led the most-impacted, export-oriented plants to expand by 6 percent ($t = 2.01$). These are not statistically significant results. Whether they are economically significant is difficult to know because I cannot directly relate these output changes to productivity changes.

The lack of any clear-cut conclusions about scale effects as a result of the FTA is surprising and counter to much of the theoretical literature and computable general equilibrium empirics. This lack of scale effects has been emphasized by Head and Ries (1999b) and Tybout and Westbrook (1995). However, it is not the only form of scale that has been discussed. An important form that is not captured by a plant's output is the possibility that multi-product plants have rationalized their product lines without altering the value of their output. This possibility received a lot of attention in the theoretical literature prior to

[12] Head and Ries find $\widehat{\beta}^{CA} = -0.11$ with $t = 3.08$ and $\widehat{\beta}^{US} = .06$ with $t = 2.74$. (For comparability, I have scaled their estimates.)

implementation of the FTA (e.g., Baldwin and Gorecki 1983). It has since received a lot of press as prominent U.S.-owned multinationals reorganized their Canadian plants in order to produce fewer product lines, each with a global mandate. The only systematic evidence on this point appears in Baldwin and Beckstead (2001) who find that, for foreign-owned plants, increases in exports are associated with reductions in the number of commodities produced. This plant rationalization view also makes sense of my finding that labour productivity rose without a corresponding fall in price. Product lines that were produced efficiently and exported were maintained (with no change in price) while product lines that were produced inefficiently were eliminated. To my mind, this is an area that needs more scrutiny.

11.2. A Shifting Average Cost Curve

The fact that the FTA induced a plant-level fall in employment without a large change in output suggests that the FTA induced TFP gains. Of course, such a conclusion ignores the possibility that more intensive use was made of non-labour inputs. The appropriate lens for examining TFP gains is Hall's (1988) TFP measure a:

$$a = q - \mu(\theta_l l + \theta_k k + \theta_m m) \tag{9}$$

where θ_j is factor j's share of revenues, μ is the mark-up of price over marginal cost, and q, l, k, and m are log changes in output, labour, capital, and purchased materials (including energy), respectively. Using the available 3-digit SIC capital stock data (105 industries), table 7 shows that the U.S. tariff concessions did not lead to more intensive use of machinery and equipment ($\widehat{\beta}^{US} = -0.01$, $t = -0.20$). The Canadian tariff concessions did lead to capital deepening, but not in a statistically significant sense ($\widehat{\beta}^{CA} = 0.04$, $t = 0.45$).[13] Table 7 also reports that at both the plant and industry levels, the share of purchased inputs (materials plus energy) in total costs actually fell. That is, purchased inputs were also used less intensively. Thus, non-labour inputs were not used much more intensively.

More formally, I can plug in the estimated plant-level, FTA-induced components of q, l, k, and m into equation (9) in order to calculate the FTA-induced change in TFP. The result appears in table 8. For θ_j in equation (9) I use the actual 1988 factor shares data. I do not take a stand on the value of the mark-up μ. Instead I report results for several values common in the literature. The Canadian tariff concessions operating in the most-impacted, import-competing industries raised labour productivity at the plant level by a statistically insignificant 8 percent of which as little as 2.2 percentage points is a TFP increase. This reinforces the conclusion I have already drawn that the Canadian tariff concessions may not have raised productivity at the plant level. *The U.S. tariff concessions operating in the most-impacted, export-oriented industries raised labour productivity at the plant level by 14 percent of which between 6.0 and 6.2 percentage points is a TFP increase.* This is a large and important effect. For manufacturing as a whole, the FTA tariff concessions raised labour productivity by 7 percent of which between 2.8 and 3.7 percentage points is a TFP increase. In short, almost half of my estimated FTA-induced plant-level labour productivity gains are likely to be TFP gains. Note that these are only the plant-level effects on technical efficiency. They do not capture the large allocative efficiency gains I documented earlier.

[13] There are a large number of caveats associated with the capital stock data. These are described in detail in Trefler (2001, section 10.1).

12. Conclusions

There are many ways in which the Canada-U.S. Free Trade Agreement provides a unique window onto the effects of freer trade. The FTA was a relatively clean policy experiment, untainted by macro shocks or financial crises. It was an agreement between two industrialized countries. It was a reciprocal agreement, which means it effected exporters, not just importers. In contrast, most previous studies of trade liberalization have dealt with the unilateral trade actions of a developing country.

Several strong conclusions emerged from the analysis.

- The FTA was associated with substantial employment losses: 12 percent for the most-impacted, import competing group of industries and 5 percent for manufacturing as a whole. These effects appear in both the industry- and plant-level analyses.

- The FTA led to large labour productivity gains. For the most-impacted, export-oriented group of industries, labour productivity rose by 14 percent at the plant level. For the most-impacted, import-competing group of industries, labour productivity rose by 15 percent with at least half of this coming from the exit and/or contraction of low-productivity plants. For manufacturing as a whole, labour productivity rose by about 6 percent which is remarkable given that much of manufacturing was duty free before implementation of the FTA.

- The FTA had no impact on producer prices. This means that purchasers of imported final goods and intermediate inputs benefited by the full amount of the tariff concessions. This represents one of the very few econometric results in the literature that bears directly on a key theoretical issue, namely, the impact of trade liberalization, via prices, on welfare.

A number of additional findings were also reported. First, the employment losses were particularly concentrated among production workers in the most-impacted, import-competing group of industries. Second, the FTA was associated with significant skill upgrading with most of it occurring at the industry level, not the plant level. Third, the FTA did *not* lead to lower wages or rising inequality. Indeed, the point estimates are that the FTA raised wages modestly and reduced inequality. Fourth, the FTA both created trade between Canada and the United States and diverted trade away from other trade partners. Finally, there is little evidence of a role for economies of scale: plants in the most-impacted, import-competing industries contracted only modestly while those in the most-impacted, export-oriented industries expanded only modestly. This together with the observation that rising productivity did not translate into lower producer prices suggests that the productivity gains may have come about from plant rationalization i.e., from reductions in the number of products produced in each plant. This is an area that requires more attention.

The FTA is the well spring of one of the most heated political debates in Canada. This heat is generated by the conflict between those who bore the *short run adjustment costs* (displaced workers and stakeholders of closed plants) and those who are garnering the *long run gains* (stakeholders of efficient plants, consumers, and purchasers of intermediate inputs). One cannot understand current debates about freer trade without understanding this conflict. Unfortunately, much of the academic debate has been fragmented: one set of researchers has focussed on the short-run adjustment costs of worker displacement while another has focussed on the long-run productivity gains. While this paper does not provide the silver bullet that makes the case either for or against free trade, I believe that it has considerably refined the question. My hope is that the results here take us one step closer to understanding how freer trade can be implemented in an industrialized economy in a way that recognizes both the long-run gains and the short-run adjustment costs borne by workers and others.

Appendix

A. Tariff Details

The Canadian tariff data were supplied by Statistics Canada at the 4-digit SIC level. The U.S. tariff data were constructed as follows. The 1980-88 data were converted from the TSUSA classification system (approximately 10,000 products) to SITC(revision 2) (approximately 800 products) using Feenstra's (1996) converter. It was then converted to Canadian SIC (213 industries) using a converter supplied by Statistics Canada. This converter was largely unique, but where not, weights for pro-rating data across SIC industries were supplied by Statistics Canada. For 1989-94 tariff rates, the same procedure was followed, but starting from HS10 rather than TSUSA. For 1996 data, I converted the Census Bureau's 'U.S. Imports of Merchandise: December 1996' (CD-96-12) data from HS10 to SITC(revision 3) using the supplied converter. I then converted the data to SITC(revision 2) using an almost 1:1 converter supplied by Feenstra (1996) and proceeded as with the 1980-88 data.

Of Canada's 225 4-digit SIC industries, 4 were excluded from the analysis because of incomplete data and another 16 were aggregated into 8 categories in order to ensure consistency of the trade and tariff data over time. The aggregated industries are: 1094 and 1099; 1511 and 1599; 1995 and 1999; 2911 and 2919; 2951 and 2959; 3051 and 3059; 3351 and 3359; 3362 and 3369.

Trefler (2001, appendix 2) discusses aggregation bias and, in particular, its implication for $\Delta\tau^{CA}_{i,1988}$ and $\Delta\tau^{US}_{i,1988}$.

Table A1 reports $\Delta\tau^{CA}_{i1}$ and $\Delta\tau^{US}_{i1}$ for the most-impacted, import-competing industries.

B. Scaling β^{CA} and β^{US} and Defining 'Total FTA Impact'

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 $8\left(\Delta y_{i1}\right)Y_{i,1988}$ i.e., the log change times the initial level. Multiplying by 8 converts the average annual changes for the 8 FTA years into a total FTA period change. The change in employment among industries in any set I is approximately $8\sum_{i\epsilon I}\left(\Delta y_{i1}\right)Y_{i,1988}$. As a proportion of total employment it is $8\sum_{i\in I}\Delta y_{i1}\omega_i$ where $\omega_i \equiv Y_{i,1988}/\sum_{j\in I}Y_{j,1988}$.[14] Using the fact that $8\widehat{\Delta y_{i1}} = 8\widehat{\beta}^k\Delta\tau^k_{i1}$ ($k = CA, US$) is the predicted impact of country k's tariff concessions in industry i, the predicted tariff-induced log change in employment is $8\sum_{i\in I}\widehat{\beta}^k\Delta\tau^k_{i1}\omega_i$ where I is the set of industries in the most-impacted, import-competing industries ($k = CA$) or export-oriented industries ($k = US$). Defining $\overline{\Delta\tau}^k_{\cdot 1} \equiv 8\Sigma_{i\in I}\Delta\tau^k_{i1}\omega_i$, the predicted impact reduces to $\widehat{\beta}^k\overline{\Delta\tau}^k_{\cdot 1}$ which is what is reported in the tables.

[14] There are some exceptions to this definition of ω_i. For the cases of production worker earnings and wages, ω_i is based on total hours worked by production workers. For the cases of skill upgrading and inequality ω_i is based on total employment. For intra-industry trade, ω_i is based on Canadian imports from the United States. Otherwise, if $Y_{i,1988}$ is a ratio then ω_i is based on the numerator of the ratio i.e., if $Y_{i,1988} = a_{i,1988}/b_{i,1988}$ then $\omega_i \equiv a_{i,1988}/\sum_{j\in I}a_{j,1988}$.

C. Estimation of Δb_{is}

As noted in section 4, construction of Δb_{is} requires the preliminary step of estimating

$$\Delta_1 y_{it} = \theta_i + \Sigma_{j=0}^{J} \theta_{ij} \Delta_1 z_{t-j} + \eta_{it}.$$

I use OLS since my only criterion is to minimize in-sample prediction error. This regression was estimated separately for each industry using 1983-96 data. (As discussed in footnote 4, I do not have data for 1981 and 1982.) This leaves only 13 observations for estimating 7 parameters. (θ_{i0}, θ_{i1}, and θ_{i2} are each tuples.) To modestly increase the degrees of freedom, I estimated the regression at the 3-digit SIC industry level rather than at the 4-digit SIC industry level. There is not much difference between the 3- and 4-digit Δb_{is} as can be seen from the fact that on average there are only 2.03 4-digit industries per 3-digit industry. Finally, since Δb_{is} is imperfectly measured, I re-estimated all my results for the case where $\Delta b_{i1} - \Delta b_{i0}$ is an endogenous regressor in equations (6) and (7). This had no impact on the results.

D. Measuring Labour Productivity

Table A2 reports the results for labour productivity using 3 alternative measures of labour productivity. The most commonly used measure of labour productivity at the industry level is value added per worker deflated by an output deflator. This is the third measure reported in table A2. There are several defects with this measure, two of which are easily addressed.

The first deals with the measurement of labour input. In Canada, but not in the United States, there has been a strong trend towards part-time employment. By not correcting for Canadian hours, measure 3 has a downward trend. Since this trend will be spuriously correlated with the downward trend in tariffs, the estimated effect of the FTA on productivity ($\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$) will be downward biased. The Canadian data allow for an hours correction. Unlike the U.S. data, value added is reported for production activities alone and thus can be directly compared with the data reported for hours worked. Measure 1 of table A2 reports the estimates using Canadian real value added in production activities per hour worked and U.S. real value added in all activities per employee. This is the same measure used in table 4. As expected, the estimates tend to be larger for measure 1 than for measure 3 (though both are large). Clearly, measure 1 is preferred.

The second data issue deals with deflators. In table A2, measures 1 and 3 use output deflators while measure 2 uses value-added deflators. Value-added deflators would have been preferable had the U.S. deflator not been seriously flawed for present purposes. It is at the 2-digit level (20 industries) and even at this highly aggregated level there are imputations for instruments (SIC 38) and electric and electronic equipment (SIC 36). Measure 2 of table A2, the value added-deflated measure, thus has serious problems. This said, the $(\widehat{\beta}^{CA}, \widehat{\beta}^{US})$ based on value-added deflators are very similar to the $(\widehat{\beta}^{CA}, \widehat{\beta}^{US})$ based on output deflators. This can be seen by comparing measures 1 and 2 in table A2. See Trefler (2001, appendix 4) for a detailed discussion of deflators.

E. General Equilibrium Effects

In general equilibrium, workers relocate from protected to unprotected industries. This means that in the industry-level employment regressions, $\widehat{\beta}^{CA}$ and $\widehat{\beta}^{US}$ may be too large. If so then one would expect $\widehat{\beta}^{CA}$ to shrink when estimated using only data for the most-impacted, import-competing industries. Further, one would expect $\widehat{\beta}^{US}$ to shrink when estimated using only data for the most-impacted, export-oriented industries. The first 3 rows of table A3 investigate. $\widehat{\beta}^{CA}$ indeed falls from $-.12$ to $-.07$ and $\widehat{\beta}^{US}$ falls from $-.03$ to $-.09$. Thus, there is some evidence that we are finding general equilibrium effects. Note however that the fall in the coefficients is not statistically significant (possibly due to the small sample size of 71). Further note that one does not see the expected differences at the plant level.

Table A3 also includes results for labour productivity on the grounds that there should be no general equilibrium effects of the type described because productivity does not 'relocate' to other sectors. It is thus reassuring that the two key productivity results of this paper are unaltered. First, the industry-level $\widehat{\beta}^{CA}$ is .15 for all industries and .15 for import-competing industries. Second, the plant-level $\widehat{\beta}^{US}$ is .14 for all industries and .13 for export-oriented industries.

F. Plant Selection Issues

As noted in section 2.5, my results apply to long-form plants that were in existence in 1980, 1986, 1988, and 1996. These tend to be large plants. For example, in 1988 the average long-form plant was 2.2 times larger than the all-plant average. Note that the average long-form continuing plant was only 2.1 times larger than the all-continuing-plant average so that the large size of my plants is due to the fact that they are long-form rather than continuing per se.

The available evidence suggests that long-form selection issues are of secondary importance in the current context. To see this, I begin by noting that almost every plant in Canada receives either a long-form or short-form survey so that almost the entire universe of Canadian plants are surveyed. Next, for the few industry outcomes available in the short-form survey (employment, earnings, output, and a measure of labour productivity), the estimates of β^{CA} and β^{US} based on long-form and on long-form plus short-form plants are very similar. The exception is the estimate of β^{US} for employment. It implies employment losses of -4 percent using the long-form plants and -6.7 percent using long–form plus short-form plants. Thus, the conclusions from the long-form continuing plants appear to be broadly representative of all continuing plants.

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Table 1. Detailed Results for Employment

Construction of Δb	Canadian Tariffs $\Delta\tau^{CA}$ β^{CA}	t	U.S. Tariffs $\Delta\tau^{US}$ β^{US}	t	Business Conditions Δb δ	t	U.S. Control Δy^{US} γ	t	Adj. R^2	Haus-man	Total FTA Impact TFI	t
Industry Level, OLS												
1 *gdp, rer* (2)	-.12	-2.35	-.03	-0.67	.29	6.96	.15	2.21	.24		-.05	-2.66
2 *gdp, rer* (1)	-.11	-1.93	-.03	-0.79	.30	4.92	.19	2.66	.16		-.05	-2.39
3 *gdp, rer* (0)	-.11	-2.03	-.04	-0.91	.30	3.66	.21	2.75	.12		-.06	-2.58
4 *gdp* (2)	-.11	-2.08	-.03	-0.66	.37	6.60	.15	2.16	.23		-.05	-2.41
5[e] --	-.14	-2.40	-.02	-0.52			.20	2.58	.07		-.06	-2.58
6 *gdp, rer* (2)	-.14	-2.75	-.03	-0.80	.30	7.12			.23		-.06	-3.16
7[e] --	-.17	-2.88	-.03	-0.66					.04		-.07	-3.15
8[e] *gdp, rer* (2)	-.14	-2.24	-.02	-0.53	.29	6.89	.15	2.11	.24		-.06	-2.65
9[e] *gdp, rer* (2)	-.12	-2.30	-.06	-1.45	.30	7.23	.14	2.04	.27		-.06	-3.24
Plant Level, OLS												
10 *gdp, rer* (2)	-.12	-3.76	.00	0.15	.13	4.59	.25	5.29	.04		-.04	-3.26
11[e] *gdp, rer* (2)	-.12	-3.60	-.01	-0.26	.16	5.63	.25	5.21	.02		-.04	-3.51
Industry Level, IV												
12[e] *gdp, rer* (2)	-.39	-2.60	.20	1.69	.28	6.10	.13	1.62	.08	.070	-.05	-1.53
13[e] *gdp, rer* (2)	-.36	-2.37	.21	1.71	.27	5.56	.32	1.20	.06	.112	-.04	-1.13
Plant Level, IV												
14[e] *gdp, rer* (2)	-.25	-2.89	.10	1.44	.12	4.16	.23	4.62	.03	.989	-.04	-2.29
15[e] *gdp, rer* (2)	-.28	-3.13	.12	1.65	.14	4.42	.00	0.02	.02	.890	-.05	-2.41

Notes :

a) The dependent variable is the log of employment. The estimating equation is equation (6) for the industry-level regressions and equation (7) for the plant-level regressions.

b) β^{CA} is scaled so that it gives the log-point impact of the Canadian tariff concessions on employment in the most-impacted, import-competing industries. β^{US} is scaled so that it gives the log-point impact of the U.S. tariff concessions on employment in the most-impacted, export-oriented industries. The 'Total FTA Impact' column gives the joint impact of the tariff concessions on employment in all 213 industries

c) The 'Hausman' column reports the *p* -value for a Hausman test. Rejection of exogeneity is indicated by a *p* -value of less than 0.010.

d) The number of observations is 213 for the industry-level regressions and 3,801 for the plant-level regressions.

e) In rows 5 and 7, the business conditions variable is omitted so that business conditions are controlled for implicitly by double-differencing ([1996-1988] less [1986-1980]). In row 8, the 2 'outlier' observations with the largest Canadian tariff cuts are omitted. In row 9, all 9 observations associated with the automotive sector are omitted. In row 11, the plant controls are omitted. In rows 12 and 14, only the Canadian and U.S. tariff variables are endogenized. In rows 13 and 15, the two tariff variables and the U.S. control are endogenized.

Table 2. Employment and Skill Upgrading

	Canadian Tariffs		U.S. Tariffs		Total FTA Impact		Business Conditions	U.S. Control	Adj.	Haus-
	β^{CA}	t	β^{US}	t	*TFI*	t	δ	γ	R^2	man[e]
Employment - Production Workers										
1 Industry	-.14	-2.44	-.07	-1.56	-.08	-3.44	.37 *[d]	.16	.33	
5 Industry	-.13	-1.99	-.07	-1.36	-.08	-2.89		.21	.07	
6 Industry	-.16	-2.93	-.08	-1.71	-.09	-4.08	.37 *		.32	
12 Industry	-.34	-2.31	.09	.71	-.08	-2.37	.37 *	.13	.32	.280
10 Plant	-.09	-2.58	-.03	-.87	-.04	-3.01	.17 *	.29 *[d]	.04	
Employment - Non-Production Workers										
1 Industry	-.06	-.71	.05	.79	.00	.02	.36 *	.07	.26	
5 Industry	-.07	-.77	.05	.73	.00	-.09		.14	.00	
6 Industry	-.06	-.79	.04	.71	.00	-.12	.36 *		.26	
12 Industry	-.15	-.67	.35	1.85	.08	1.94	.36 *	.14	.28	.013
10 Plant	-.14	-3.02	.04	1.19	-.03	-1.72	.02	.15	.01	
Skill Upgrading[f]										
1 Industry	.11	1.41	.10	1.67	.08	2.72	.47 *	.24	.48	
5 Industry	.08	.79	.11	1.26	.07	1.81		.24	.01	
6 Industry	.12	1.63	.10	1.56	.08	2.82	.47 *		.48	
12 Industry	.11	.53	.26	1.43	.15	3.36	.47 *	.26	.49	.096
10 Plant	-.01	-.30	.04	1.48	.01	.96	.05 *	.17	.01	

Notes:

a) The estimating equation is equation (6) for the industry-level regressions and equation (7) for the plant-level regressions. Row numbers correspond to those in table 1 so that the reader can refer to table 1 for details of the specification. Rows 1 and 10 are my baseline specifications.

b) The dependent variable is indicated in bold font at the start of each block of results e.g., 'Employment - Production Workers.'

c) β^{CA} is scaled so that it gives the log-point impact of the Canadian tariff concessions on, say, employment in the most-impacted, import-competing industries. β^{US} is scaled so that it gives the log-point impact of the U.S. tariff concessions on, say, employment in the most-impacted, export-oriented industries. The 'Total FTA Impact' column gives the impact of both tariff concessions on, say, employment of all manufacturing.

d) An asterisk indicates statistical significance at the 1 percent level.

e) The 'Hausman' column is blank when the OLS estimator is reported and is filled when the IV estimator is reported. The column reports the *p*-value for a Hausman test. Rejection of exogeneity is indicated by a *p*-value of less than 0.01.

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

g) All dependent variables are in logs. The number of observations in the industry-level (plant-level) regressions is 211 (3,742) for production workers, 212 (3,539) for non-production workers, and 211 (3,489) for skill upgrading.

Table 3. Earnings, Wages, Hours, and Inequality

	Canadian Tariffs		U.S. Tariffs		Total FTA Impact		Business Conditions	U.S. Control	Adj.	Haus-
	β^{CA}	*t*	β^{US}	*t*	*TFI*	*t*	δ	γ	R^2	man
Earnings - All Workers										
1 Industry	.05	2.43	.03	1.92	.03	3.80	.34 *	.25 *	.20	
10 Plant	.04	2.92	.04	3.60	.03	5.64	.17 *	.19 *	.03	
Earnings - Production Workers										
1 Industry	.04	2.12	.00	-.02	.02	3.61	.16 *	.11	.07	
10 Plant	.05	3.25	.03	2.57	.03	4.74	.12	.21	.02	
Earnings - Non-Production Workers										
1 Industry	.01	.30	-.01	-.29	.00	.02	.18 *	.12	.08	
10 Plant	.04	1.48	.06	2.87	.03	3.67	.11	.11	.01	
Hourly Wages of Production Workers										
1 Industry	.05	3.15	.03	1.84	.03	4.37	.60 *	.13	.33	
10 Plant	.06	3.23	.02	1.40	.03	4.04	.20	.16 *	.01	
Annual Hours of Production Workers										
1 Industry	-.01	-.48	-.02	-1.75	-.01	-1.94	.02	.14	.01	
10 Plant	-.02	-.90	.01	.80	.00	-.12	.03	.07	.00	
Earnings Inequality[b]										
1 Industry	-.04	-1.32	-.01	-.55	-.02	-1.66	.42 *	.05	.21	
10 Plant	-.01	-.46	.02	.97	.00	.41	.13 *	.08	.00	

Notes:

a) See notes (*a*)-(*d*) of table 2.

b) Earnings inequality is the ratio of non-production-worker earnings to production-workers earnings.

c) All dependent variables are in logs. The number of observations in the industry-level (plant-level) regressions is 213 (3,801) for the earnings of all workers, 211 (3,742) for the earnings of production workers, 212 (3,526) for the earnings of non-production workers, 211 (3,489) for earnings inequality, 211 (3,738) for wages, and 211 (3,738) for hours.

Table 4. Detailed Results for Labour Productivity

Construction of Δb	Canadian Tariffs $\Delta\tau^{CA}$ β^{CA}	Canadian Tariffs $\Delta\tau^{CA}$ t	U.S. Tariffs $\Delta\tau^{US}$ β^{US}	U.S. Tariffs $\Delta\tau^{US}$ t	Business Conditions Δb δ	Business Conditions Δb t	U.S. Control Δy^{US} γ	U.S. Control Δy^{US} t	Adj. R^2	Haus-man	Total FTA Impact *TFI*	Total FTA Impact t
Industry Level, OLS												
1 *gdp, rer* (3)	.15	3.11	.04	1.14	.25	8.30	.16	1.99	.31		.058	3.79
2 *gdp, rer* (2)	.15	2.76	.01	0.37	.25	4.89	.23	2.69	.17		.047	2.83
3 *gdp, rer* (1)	.15	2.77	.02	0.40	.13	1.79	.28	3.05	.09		.050	2.87
4 *gdp* (3)	.17	3.21	.04	1.17	.25	5.19	.21	2.43	.18		.065	3.87
5[e] --	.16	2.85	.01	0.34			.29	3.23	.08		.051	2.89
6 *gdp, rer* (3)	.14	2.96	.05	1.44	.27	8.82			.30		.059	3.89
7[e] --	.15	2.58	.03	0.76					.04		.053	2.98
8[e] *gdp, rer* (3)	.17	2.97	.04	0.98	.26	8.34	.16	1.95	.30		.061	3.76
9[e] *gdp, rer* (3)	.16	3.27	.02	0.49	.26	8.61	.18	2.24	.33		.051	3.36
Plant Level, OLS												
10 *gdp, rer* (3)	.08	1.70	.14	3.97	.12	3.95	.11	1.51	.06		.074	4.92
11[e] *gdp, rer* (3)	.09	1.92	.11	3.02	.10	3.18	.14	1.79	.01		.066	4.39
Industry Level, IV												
12[e] *gdp, rer* (3)	.21	1.65	.11	1.18	.26	8.16	.14	1.56	.28	.044	.101	4.27
13[e] *gdp, rer* (3)	.26	1.85	.05	0.42	.22	4.88	.66	1.79	.15	.030	.092	3.50
Plant Level, IV												
14[e] *gdp, rer* (3)	.32	2.60	.05	0.56	.10	3.05	.18	1.99	.06	.771	.111	4.66
15[e] *gdp, rer* (3)	.29	2.33	.09	0.95	.15	3.40	-.12	-0.58	.05	.520	.117	4.86

Notes :

a) The dependent variable is the log of labour productivity. The estimating equation is equation (6) for the industry-level regressions and equation (7) for the plant-level regressions.

b) β^{CA} is scaled so that it gives the log-point impact of the Canadian tariff concessions on labour productivity in the most-impacted, import-competing industries. β^{US} is scaled so that it gives the log-point impact of the U.S. tariff concessions on labour productivity in the most-impacted, export-oriented industries. The 'Total FTA Impact' column gives the joint impact of the tariff concessions on labour productivity in all 213 industries

c) The 'Hausman' column reports the *p* -value for a Hausman test. Rejection of exogeneity is indicated by a *p* -value of less than 0.010.

d) The number of observations is 211 for the industry-level regressions and 3,726 for the plant-level regressions.

e) In rows 5 and 7, the business conditions variable is omitted so that business conditions are controlled for implicitly by double-differencing ([1996-1988] less [1986-1980]). In row 8, the 2 'outlier' observations with the largest Canadian tariff cuts are omitted. In row 9, all 9 observations associated with the automotive sector are omitted. In row 11, the plant controls are omitted. In rows 12 and 14, only the Canadian and U.S. tariff variables are endogenized. In rows 13 and 15, the two tariff variables and the U.S. control are endogenized.

Table 5. Producer Price Changes Under the FTA

A. Correlation Between Changes in Tariffs and Imports

	Without Controls (Δm_{ijk})	With Controls (Δm_{ijk} - $\Delta m_{ijk'}$)			
		U.K.	Germany	France	Japan
1. Canadian imports from the U.S.	-0.21 *	-0.17 *	-0.23 *	-0.24 *	-0.26 *
2. U.S. imports from Canada	-0.20 *	-0.17 *	-0.19 *	-0.17 *	-0.22 *

B. Correlation Between Changes in Tariffs and Producer Prices

	Without Controls (Δp_{ijk})	With Controls (Δp_{ijk} - $\Delta p_{ijk'}$)			
		U.K.	Germany	France	Japan
1. U.S. producer prices for goods shipped to Canada	0.03	-0.02	0.05	0.01	0.02
2. Canadian producer prices for goods shipped to the U.S.	0.01	-0.03	-0.02	-0.01	0.03

Notes: The 'Without Controls' column reports the correlation between the change in the bilateral tariff ($\Delta \tau^o_{ijk}$) and the change in either imports (Δm_{ijk}) or producer prices (Δp_{ijk}). Each 'With Controls' column reports the correlation between the change in the bilateral tariff ($\Delta\tau^o_{ijk} - \Delta\tau^o_{ijk'}$) and the change in either imports ($\Delta m_{ijk} - \Delta m_{ijk'}$) or producer prices ($\Delta p_{ijk} - \Delta p_{ijk'}$) where k' is the country listed in the column heading e.g., the U.K. Changes are for the period 1988-96 (Canada) or 1989-96 (United States). An asterisk (*) indicates that the correlation is significant at the 1 percent level.

Table 6. Trade Diversion and Intra-Industry Trade

	Canadian Tariffs		U.S. Tariffs		Total FTA Impact		Business Conditions	U.S. Control	Adj.	Haus-
	β^{CA}	t	β^{US}	t	*TFI*	t	δ	γ	R^2	man[e]
U.S. Imports from Canada as a Share of Total U.S. Imports										
6 Industry	-.05	-.37	.16	2.03	.02	1.90	.24 *		.08	
Industry	-.23	-.71	.17	.82	.03	.82	.24 *		.06	.539
Canadian Imports from the U.S. as a Share of Total Canadian Imports										
6 Industry	.46	7.20	.19	3.29	.05	4.59	.44 *		.60	
Industry	.72	4.93	.04	.28	.03	1.03	.44 *		.54	.073
Canada-U.S. Intra-Industry Trade										
6 Industry	-.06	-1.41	.01	.27	.00	.06	.17 *		.07	
Industry	-.17	-1.45	.08	.73	.01	.57	.17 *		.07	.568

Notes :

a) See notes (*a*)-(*e*) of table 2.

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

c) All dependent variables are in logs. There are 211 observations in each regression.

Table 7. Output, Number of Plants, Capital, and Intermediate Inputs

	Canadian Tariffs		U.S. Tariffs		Total FTA Impact		Business Conditions	U.S. Control	Adj.	Haus-
	β^{CA}	*t*	β^{US}	*t*	*TFI*	*t*	δ	γ	R^2	man
Gross Output Per Plant in Production Activities[b]										
6 Industry	-.05	-.65	.03	.54	.00	-.05	.30 *		.18	
Plant	-.05	-1.36	.06	2.01	.01	.72	.16 *		.05	
Machinery & Equipment - 3-digit SIC[c]										
1 Industry	.04	.45	-.01	-.20	.00	.19	.91 *	.09	.86	
Purchased Materials and Energy as a Share of Output										
1 Industry	-.05	-1.62	-.03	-1.25	-.02	-2.45	.38 *	.10	.23	
10 Plant	-.04	-1.88	-.04	-2.37	-.02	-3.73	.04	.26	.01	
Number of Plants[b]										
6 Industry	-.03	-.70	-.06	-1.31	-.04	-1.72	.31 *		.10	

Notes:

a) See notes (*a*)-(*d*) of table 2.

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

c) Machinery and Equipment is for the pre-FTA period 1984-1986 and the FTA period 1988-1995. The regression is at the 3-digit SIC level and has 105 observations.

d) All dependent variables are in logs. The number of observations in the industry-level (plant-level) regressions is 213 (3,801) for output, 211 (3,751) for purchased materials and energy, and 213 for the number of plants.

Table 8. FTA-Induced Plant-Level TFP Growth

Mark-up μ	TFP Growth Due To: Canadian Tariff Concessions in the Most-Impacted, Import-Competing Industries	U.S. Tariff Concessions in the Most-Impacted, Export-Oriented Industries	Both Tariff Concessions in All Industries
1.0	2.2%	6.0%	2.8%
1.2	3.6%	6.1%	3.3%
1.4	5.1%	6.2%	3.7%

Notes: This table is calculated using equation (9) with *q* from the plant-level change in gross output (table 7), *l* from the plant-level change in the employment of production workers (table 2), *k* from the industry-level change in machinery and equipment (table 7), and *m* from the plant-level material share (*m-q* of table 7) plus plant-level output (*q* of table 7). The factor shares θ_j are the observed 1988 factor shares.

Table A1. The 71 Most-Impacted, Import-Competing Industries

SIC	INDUSTRY DESCRIPTION	$\Delta\tau_{i1}^{CA}$	$\Delta\tau_{i1}^{US}$	SIC	INDUSTRY DESCRIPTION	$\Delta\tau_{i1}^{CA}$	$\Delta\tau_{i1}^{US}$
1131	Brewery Products Industry	-.331	-.012	3612	Lubricating Oil And Grease Industry	-.079	-.004
3271	Shipbuilding And Repair Industry	-.241	-.012	2641	Metal Office Furniture Industry	-.079	-.001
1931	Canvas And Related Products Industry	-.183	-.008	2811	Business Forms Printing Industry	-.078	-.016
2433	Men's and Boy's Pants Industry	-.170	-.053 *	1921	Carpet, Mat And Rug Industry	-.078	-.021
2443	Women's Dress Industry	-.162	-.076 *	1083	Sugar And Chocolate Confectionery Industry	-.077	-.024
2491	Sweater Industry	-.159	-.125 *	3751	Paint And Varnish Industry	-.073	-.036 *
2451	Children's Clothing Industry	-.159	-.031 *	2542	Wooden Kitchen Cabinet And Bathroom Vanity Ind.	-.073	-.002
2441	Women's Coat and Jacket Industry	-.157	-.049 *	1141	Wine Industry	-.071	-.030 *
1993	Household Products Of Textile Materials	-.156	-.017	3771	Toilet Preparations Industry	-.070	-.024
2442	Women's Sportswear Industry	-.154	-.053 *	3993	Floor Tile, Linoleum And Coated Fabrics Inds.	-.070	-.045 *
2494	Hosiery Industry	-.152	-.040 *	2721	Asphalt Roofing Industry	-.069	-.044 *
1911	Natural Fibres Processing And Felt Processing	-.150	-.041 *	3791	Printing Ink Industry	-.069	-.017
2434	Men's and Boy's Shirt and Underwear Industry	-.147	-.072 *	2492	Occupational Clothing Industry	-.066	-.031 *
2432	Men's and Boy's Suit and Jacket Industry	-.147	-.065 *	3542	Structural Concrete Products Industry	-.066	-.015
2431	Men's and Boy's Coat Industry	-.143	-.079 *	3021	Metal Tanks (Heavy Gauge) Industry	-.066	-.011
2493	Glove Industry	-.140	-.020	3029	Other Fabricated Structural Metal Products Inds.	-.065	-.033 *
2496	Foundation Garment Industry	-.137	-.029 *	3931	Sporting Goods Industry	-.065	-.010
1712	Footwear Industry	-.127	-.082 *	1821	Wool Yarn And Woven Cloth Industry	-.061	.004
2612	Upholstered Household Furniture Industry	-.112	-.001	2733	Paper Bag Industry	-.061	-.042 *
1998	Tire Cord Fabric Industry & Other Textiles Products	-.108	-.047 *	3243	Non-Commercial Trailer Industry	-.060	.009
2611	Wooden Household Furniture Industry	-.106	-.002	1621	Plastic Pipe And Pipe Fittings Industry	-.058	-.031 *
2499	Other Clothing And Apparel Industries	-.103	-.040 *	3311	Small Electrical Appliance Industry	-.058	-.024
2581	Coffin And Casket Industry	-.101	-.004	1051	Cereal Grain Flour Industry	-.057	-.008
2495	Fur Goods Industry	-.097	-.053 *	3032	Prefabricated Portable Metal Buildings Industry	-.057	.000
2444	Women's Blouse and Shirt Industry	-.094	-.104 *	2941	Iron Foundries	-.057	-.002
2649	Other Office Furniture Industries	-.090	-.002	1093	Potato Chip, Pretzel And Popcorn Industry	-.056	.017
1041	Fluid Milk Industry	-.089	-.006	3991	Broom, Brush And Mop Industry	-.055	-.040 *
1991	Narrow Fabric Industry	-.089	-.002	2792	Stationery Paper Products Industry	-.054	-.013
2619	Other Household Furniture Industries	-.089	-.012	1052	Prepared Flour Mixes And Prepared Cereal Foods	-.054	-.021
3761	Soap And Cleaning Compounds Industry	-.088	-.032 *	2819	Other Commercial Printing Industries	-.052	-.003
1829	Other Spun Yarn And Woven Cloth Industries	-.088	-.081 *	2799	Other Converted Paper Products Industries	-.051	-.013
3242	Commercial Trailer Industry	-.087	-.004	3031	Metal Door And Window Industry	-.051	-.032 *
3792	Adhesives Industry	-.084	-.025 *	2821	Platemaking Typesetting And Bindery Industry	-.051	-.012
1713	Luggage, Purse And Handbag Industry	-.082	-.073 *	1012	Poutry Products Industry	-.051	-.017
2543	Wooden Door And Window Industry	-.079	-.039 *	3594	Non-Metallic Mineral Insulating Materials Inds.	-.049	-.058 *
1691	Plastic Bag Industry	-.079	-.023				

Notes: This table reports 1988-96 changes in tariff concessions for those industries in the most-impacted, import-competing group. An asterisk indicates that the industry is also in the most-impacted, export-oriented group of industries.

Table A2. Sensitivity to Different Definitions of Labour Productivity

	Canadian Tariffs		U.S. Tariffs		Total FTA Impact		Business Conditions	U.S. Control	Adj.	Haus-
	β^{CA}	*t*	β^{US}	*t*	*TFI*	*t*	δ	γ	R^2	man
1. Labour Productivity - Production Activities - Hours Adjusted - Output Deflators										
1 Industry	.15	3.11	.04	1.14	.06	3.79	.25 *	.16	.31	
10 Plant	.08	1.70	.14	3.97	.07	4.92	.12 *	.00	.06	
2. Labour Productivity - Production Activities - Hours Adjusted - Value-Added Deflators										
1 Industry	.17	2.96	.03	.67	.06	3.26	.19 *	.13	.16	
10 Plant	.10	2.06	.16	4.58	.09	5.69	.07	.20 *	.07	
3. Labour Productivity - All Activities - Not Hours Adjusted - Output Deflators										
1 Industry	.11	2.27	-.03	-.93	.02	1.29	.20 *	.24 *	.19	
10 Plant	.09	2.19	.13	4.07	.07	5.54	.11 *	.13	.09	

Notes:

a) See notes (*a*)-(*d*) of table 2.

b) All dependent variables are in logs. The number of observations in the industry-level (plant-level) regressions is 211 (3,726) for measures 1 and 2 and 213 (3,801) for measure 3.

Table A3. Employment and Labour Productivity for Subsamples

	Canadian Tariffs		U.S. Tariffs		Adj.	
	β^{CA}	t	β^{US}	t	R^2	n
Employment - All Workers						
All Industries	-.12	2.35	-.03	.67	.24	213
Most-impacted, Import-Competing	-.07	.19	-.14	2.63	.24	71
Most-impacted, Export-Oriented	-.16	1.83	-.09	.94	.12	71
All Plants	-.12	3.76	.00	-.15	.04	3,801
Most-impacted, Import-Competing	-.16	3.03	.03	-.63	.06	1,112
Most-impacted, Export-Oriented	-.09	1.59	-.02	.47	.02	964
Labour Productivity						
All Industries	.15	-3.11	.04	-1.14	.31	211
Most-impacted, Import-Competing	.15	-2.06	.04	-.83	.27	71
Most-impacted, Export-Oriented	.20	-2.63	-.02	.27	.32	71
All Plants	.08	-1.70	.14	-3.97	.06	3,726
Most-impacted, Import-Competing	.12	-1.58	.07	-1.18	.04	1,110
Most-impacted, Export-Oriented	.05	-.60	.13	-2.09	.05	961

Notes:

a) See notes (*a*)-(*d*) of table 4.

b) Each row of this table reports estimates of equations (6) or (7) for different subsamples. In each block of 3 rows, the first row is based on the full sample, the second row is based on the most-impacted, import-competing sample, and the third row is based on the most-impacted, export-oriented

c) The business conditions and U.S. control regressors are included in the regression, but their