The Effect of Tariff Reductions on Firm Size and Firm Turnover in Canadian Manufacturing

Wulong Gu, Gary Sawchuk, and **Lori Whewell Rennison**

Statistics Canada, Ottawa; Industry Canada, Ottawa; Department of Finance Canada, Ottawa

Abstract: Using panel data on 81 Canadian manufacturing industries over the 1983–1996 period, the authors show that the estimated impact of recent tariff cuts was a positive and significant increase in the exit rate of firms. Supplementing this finding with recent research showing that exiting firms tend to be less productive than those that survive, this provides support for recent trade models asserting that increased exposure to international trade induces the exit of least efficient firms, thereby contributing to productivity growth.
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1 Introduction

The Canada-U.S. Free Trade Agreement (FTA) committed the two countries to gradually eliminate all manufacturing tariffs over a ten-year period beginning in 1989. The agreement, further strengthened in 1994 with the North American Free Trade Agreement (NAFTA), resulted in a reduction in Canada's average tariff rate in manufacturing against the United States from 5.6 percent in 1988 to 1.0 percent in 1996 (Trefler 2001). Now that sufficient time has passed since the implementation of the FTA, recent studies have begun to assess the impacts of this

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major policy development on the Canadian economy.[1] Of particular interest for this study is the recent evidence by Trefler (2001) and Sawchuk and Trefler (2002) which shows that the FTA tariff cuts generated substantial productivity gains in Canadian manufacturing. Trefler (2001) found that the FTA tariff cuts raised labor productivity by 17 percent during the 1989–1996 period for industries subject to large tariff cuts. Sawchuk and Trefler (2002) concluded that the FTA explained 4.7 percentage points or one quarter of the 20 percentage-point increase in labor productivity in Canadian manufacturing over the 1988–1996 period.[2] Our study attempts to shed new evidence on two potential sources of these FTA-induced productivity gains: increased firm size and increased firm turnover.

An empirical investigation into the mechanism through which tariff reductions could lead to productivity growth is an important exercise for two reasons. First and foremost, the empirical literature has not yet arrived at a definitive answer. For example, previous studies have suggested that firm turnover may have played a role, but it has not yet been proven empirically. Second, a better understanding of the link between tariff reductions and productivity helps form our expectations about the potential effect of other competition-enhancing developments on Canadian manufacturing firms.

Prior to its implementation, the FTA was primarily expected to improve Canadian productivity through increased specialization and economies of scale (Harris 1984; Cox and Harris 1985). It was believed that in a relatively small market such as Canada's, excessively high tariffs on imports forced industries to operate at a sub-optimal scale, producing too many varieties of goods at a relatively high cost. The FTA tariff reductions and the integration of the two markets were expected to cause firms to specialize as they produced for a larger market, resulting in larger-scale operations, higher productivity, and lower costs.

However, the link between tariff reductions and increased firm size has not been found to hold empirically. Using firm-level data from Statistics Canada's Annual Survey of Manufacturers (ASM), Head and Ries (1999) found no evidence of scale effects arising from the FTA tariff

[1] See, for example, Gaston and Trefler (1997), Beaulieu (2000), Trefler (2001), and Sawchuk and Trefler (2002).

[2] Bernard et al. (2002) examined the effect of tariff reductions on productivity growth in U.S. manufacturing. They found that productivity growth is faster in industries with falling tariff and freight costs.

cuts in Canadian manufacturing. Consistent with a number of studies for developing countries (Roberts and Tybout 1991; Tybout and Westbrook 1995; Tybout 2001), their econometric evidence showed that Canadian tariff cuts actually reduced average firm size. In a more recent study for Canada, Trefler (2001) also finds that the FTA had no statistically significant impact on output per plant in the manufacturing sector. However, as acknowledged by Head and Ries (1999), the ASM data used in these analyses are subject to under-measurement of small firms, particularly during the early 1990s, which may have affected the results.

More recently, a number of theoretical papers have suggested that firm turnover (entry and exit) provides a source of productivity benefits from the FTA tariff reductions (Melitz 2002; Bernard et al. 2000). General equilibrium trade models have moved away from the standard representative-firm framework that largely ignored the implications of exposure to trade on firm turnover and the reallocation of resources among firms. Recent trade models introduce firm-level heterogeneity, thus overcoming this limitation. Melitz (2002) develops a model with heterogeneous firms and shows that trade liberalization and the opening of new export markets force the least productive firms to exit, contributing to productivity growth. Bernard et al. (2000) also introduce firm-level heterogeneity into a model of trade by adapting a Ricardian framework to firm-specific comparative advantage. They show that lower trade barriers and increased import competition tend to force out the least productive plants.[3] Bernard et al. (2002) show that firms in the U.S. manufacturing industries with falling trade costs are more likely to exit, a finding that is consistent with these heterogeneous firm models.

In a separate literature on firm dynamics, empirical research has confirmed that plant turnover makes a significant contribution to productivity growth (Baldwin and Gorecki 1991; Baldwin 1995; Baldwin and Gu 2002). In particular, Baldwin and Gu (2002) show that plant turnover contributed 15–20 percent of manufacturing productivity growth over the 1988–1997 period, as more productive plants entered and replaced less-productive exiting plants. The specific role of trade liberalization in inducing firm turnover over the 1990s has not yet been tested, although

[3] The source of increased plant exits differs between Melitz (2002) and Bernard et al. (2000). In Melitz, the least productive plants are forced out by new plants that enter following the declines in foreign tariffs and the opening of new export markets. In Bernard et al. (2000), plant exits are due to increased competition from foreign firms.

it has been suggested by a number of empirical studies (Trefler 2001; Head and Ries 2001).

In this study, we attempt to fill the existing research gaps relating to the impact of falling tariffs on firm size and firm turnover using a largely unexplored data set. Our data set is constructed from Statistics Canada's Longitudinal Employment Analysis Program (LEAP) database, which contains data on firm entry, exit and total number of firms among manufacturing industries over the 1983–1996 period.[4] The benefit of the database is that it allows us to study both the pre- and post-FTA periods; also it provides more consistent coverage of small firms than the ASM database. The latter attribute allows us to confirm whether previous findings on tariff reductions and firm size (suggesting the lack of a significant relationship) still hold when the number of small firms is measured more comprehensively. Following Trefler (2001) and Sawchuk and Trefler (2002), we focus on the effects of Canadian tariff reductions only.

The rest of the paper is organized as follows. In Section 2, we present the data for the regression analysis. Section 3 summarizes the regression results on the impact of tariff reductions on firm size and firm turnover. A short summary and discussion of findings in Section 4 concludes the paper.

2 Data Sources

To examine the effects of tariff cuts on firm size and firm turnover, we use a panel data set of 81 manufacturing industries mostly at 3-digit SIC (Standard Industry Classification) levels of industry aggregation over the 1983–1996 period.[5] The variables in the data set include the number of firms, the number of entrants and exits, real gross domestic product (in 1992 dollars), average tariff rates, and average firm size (defined as real output per firm).

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[4] Since beginning this research, we have become aware of only one other study using this database—a recent working paper by Baggs (2002) in which the LEAP is used to examine the effects of trade liberalization on the probability of firm survival.

[5] See the Appendix for a list of industries. There were a total of 83 individual industries, but two industries were removed because the estimates of tariff rates or real gross output were not available.

The number of firms and the number of entrants and exiters are estimated from Statistics Canada's LEAP database. The database is constructed from Payroll Deduction Accounts obtained from Revenue Canada that are then aggregated into firms.[6] The accounts track the employment and payroll characteristics of individual firms over the 1983–1996 period. Every employer (both corporate and unincorporated) in Canada is required to register a payroll deduction account with Revenue Canada and issue a T4 slip to each employee that summarizes the employee's earnings in a given fiscal year. As such, the LEAP database includes all firms with salaried workers in Canada.

In the LEAP database, entrants in a given year are defined as those firms that have payroll data in the current year, but did not have payroll data in the previous year. Similarly, exits in a given year are identified from firms that had payroll accounts in the previous year, but did not have payroll data in the current year. Corrections are made in the LEAP database to remove false entrants and exits as a result of reorganizations, ownership changes, and new locations (for details, see Baldwin et al. 2000).

Data on the number of firms and the numbers of entrants and exits are disaggregated by employment size as approximated by average labor units (ALUs). ALUs of a firm are defined as total annual payroll divided by average earnings per employee for the industry and province to which the firm belongs. To calculate ALUs, the LEAP database uses the estimates of average annual earnings per employee from Statistics Canada's Survey of Employment, Payrolls and Hours.

The use of the LEAP database is an important contribution of this study to the literature. Previous empirical studies have estimated the number of entrants and exits in Canadian manufacturing using the Annual Survey of Manufacturers (ASM). While a rich survey in terms of the collection of plant-level data, the ASM has several important drawbacks when used to measure firm turnover.[7] First, the LEAP database is derived from administrative data for all businesses (referred to as firms hereafter) that file tax returns. As an administrative database, it has almost universal coverage of the target population. In contrast, the ASM

[6] The database is maintained and updated regularly by Statistics Canada. For additional information on the LEAP database, see Baldwin et al. (2000) and Statistics Canada (1988).

[7] Baldwin et al. (2002) provide a detailed discussion of the use of different data sources for measuring entry and exits.

covers establishments (where an establishment is defined as the smallest unit capable of reporting certain specified input and output data, such that a business or firm may have more than one establishment), which collects data via a questionnaire for large establishments and using administrative tax data for smaller ones. However, the ASM does not target the entire population of small plants; it excludes a number of very small entities. A second complication is that the coverage of smaller plants in the ASM fell in certain years due to budget cutbacks. A period of low coverage included the early 1990s—a critical time for studying the impacts of the FTA. To use the ASM over the low-coverage periods, it is more appropriate to construct longer-period average estimates of the number of plants, entrants and exits when the coverage is consistent. However, the LEAP database, given its broad coverage, allows us to obtain annual estimates of the number of firms, entrants and exits over the entire 1983–1996 period.

For tariff rates, we use data provided by Daniel Trefler that were employed in Trefler (2001). These data represent overall Canadian tariffs against the United States and the rest of the world.[8] Tariff rates for the 213 manufacturing industries at the 4-digit SIC level are aggregated into 81 manufacturing industries for our analysis, using imports as weights. To estimate real gross output (in 1992 dollars) for the 81 manufacturing industries, we divide nominal gross output by the industry-level output deflators. This data is obtained from the ASM since LEAP does not collect information on output.

3 Empirical Evidence

In this section, we empirically examine the relationship between tariff reductions and firm size, exit rates, and entry rates. Using our panel data set of 81 manufacturing industries over the 1983–1996 period, we

[8] Trefler (2001) argues that the exclusion of U.S. tariff data does not pose a significant problem in the regression framework. Specifically, he notes that in 1988 Canadian and U.S. tariffs were highly correlated, as the tariffs were largely protecting the same industries. Moreover, the positive correlation between Canadian tariffs, U.S. tariffs, effective tariffs and non-tariff barriers suggests that the tariff variable in our empirical analysis will essentially pick up the effects of all sources of FTA-related tariff cuts (Trefler 2001).

estimate the following panel specification:

$$y_{it} = \alpha_i + \beta_t + \gamma\tau_{it} + \varepsilon_{it},$$

where y_{it} represents firm size (output per firm) in logarithm form, the number of entrants as the share of the number of firms (entry rates), and the number of exits as the share of the number of firms (exit rates) for industry i in year t. τ_{it} is the Canadian tariff rate for industry i in year t. ε_{it} is an error term. In all specifications, we introduce industry-fixed effects (α_i) and year-fixed effects (β_t). The year-fixed-effect variables control for the macroeconomic factors (such as recession and exchange rate movements) that have similar impacts acoss all industries. The industry-fixed-effect variables control for unobserved heterogeneity in industry characteristics that may affect firm size, exit rates, and entry rates. As such, we focus on intra-industry changes in firm size and firm turnover rather than cross-industry differences. We estimate the above equation using OLS, allowing for heteroskedasticity across industries and first-order autocorrelation within industries. We check the robustness of our results by first-differencing the data to remove industry-fixed effects, and then adding year dummies to control for year-fixed effects. We report both sets of results.

3.1 Descriptive Statistics

Figure 1 shows tariff rates for different quartiles of Canadian manufacturing industries over the 1983–1996 period.[9] There are large differences in Canadian tariffs across industries. In 1983, the top quarter of Canadian manufacturing industries were protected with tariffs in excess of 10 percent. In contrast, the bottom quarter had tariff rates that were less than 3 percent. While all three quartiles of Canadian tariffs have generally been declining since 1983, the pace of tariff reductions picked up after the implementation of the Canada-U.S. FTA in 1989. During the FTA period 1988–1996, the median manufacturing tariff declined by cumulative 4.8 percentage points or 0.6 percentage points per year, while prior to the FTA the median tariff declined by only 0.9 percentage points or 0.2 percentage points per year.

[9] Average tariff rates for total manufacturing are calculated as a weighted sum of tariff rates for 4-digit manufacturing industries, using imports as weights.

Figure 1: *Quartiles of Canadian Tariff Rates*

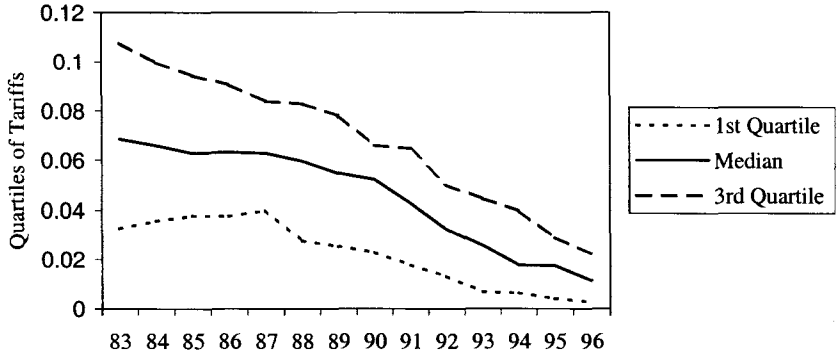


Figure 2: *Number of Firms and Average Firm Size* (1983 = 100)

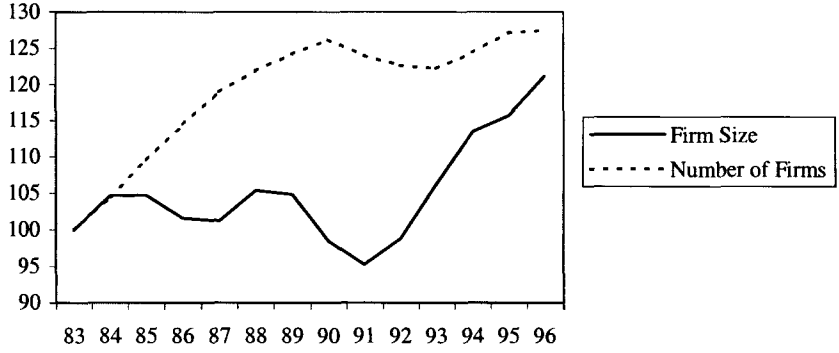
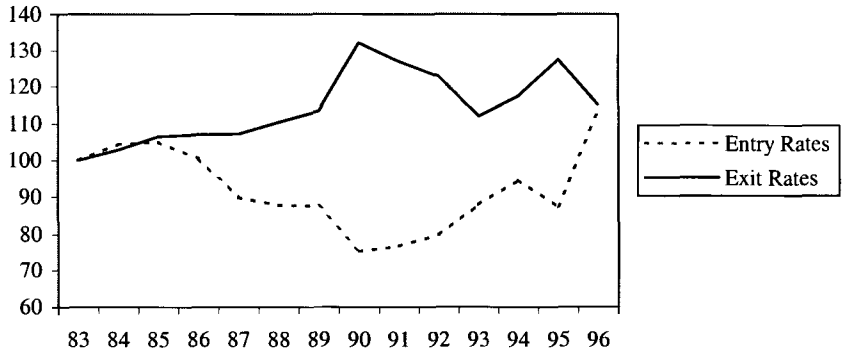


Figure 2 shows the number of firms and average firm size in the manufacturing sector as a whole over the 1983–1996 period. Average firm size is defined as real gross output per firm, measured using real output from the ASM file and the number of firms from the LEAP file. The chart shows that the number of firms in Canada increased steadily in the pre-FTA period, but changed very little in the FTA period. In contrast, real output per firm increased much faster during the FTA period.[10] The growth of output per firm increased from 1.04 percent per year in the period 1983–1988 to 1.75 percent per year in the FTA period

[10] Although the number of firms and average firm size showed slight declines during the recession of the early 1990s, they bounced back in the subsequent recovery.

Figure 3: *Entry and Exit Rate* (1983 = 100)



1988–1996. Casual observation of these trends could be interpreted as support for the view that tariff reduction is associated with increased firm size.

Figure 3 presents entry and exit rates for total manufacturing over the 1983–1996 period. The entry rate is measured as the ratio of the number of entrants to the number of firms; the exit rate is defined as the number of exiting firms divided by the total number of firms. It is clear from the figure that the entry and exit rates exhibit large cyclical fluctuations. The entry rate declined before 1990 but trended upwards thereafter. The firm exit rate was higher on average in the FTA period than in the pre-FTA period.

To examine the variations of tariffs, firm size, and firm turnover across industries, Table 1 shows their mean values averaged over the 1983–1996 period at the 2-digit SIC level. The evidence in the table confirms what we know about Canadian tariffs from Figure 1—there were large variations in Canadian tariffs across industries. For example, within the Refined petroleum & coal products, Printing, publishing & allied, and Transportation equipment (including autos) industries, tariff rates have been very low, averaging about 1 percent over the 1983–1996 period. In contrast, average tariff rates in industries such as Clothing, Textiles, and Leather & allied products were extremely high at about 21 percent over the 1983–1996 period.

There were also substantial differences in firm size between industries. Average firm size was largest in capital-intensive industries such as Refined petroleum & coal products, Transportation equipment, Primary

Table 1: *Mean Values of Tariff Rates, Firm Size and Firm Turnover, 1983–1996*

Industry	Tariff rates (%)	Firm size[a]	Exit rates (%)	Entry rates (%)
Food	3.75	12.35	8.78	11.77
Beverage	7.79	20.85	11.45	17.05
Tobacco products	4.09	29.51	7.29	11.80
Rubber products	6.26	19.29	7.89	12.83
Plastic products	7.77	4.11	9.07	12.23
Leather and allied products	16.19	2.92	13.97	14.74
Primary textile	12.34	15.86	9.90	11.49
Textile products	11.74	2.37	10.85	13.20
Clothing	20.90	1.71	14.11	15.52
Wood	2.52	2.98	11.74	12.75
Furniture and fixture	9.11	1.65	13.35	14.73
Paper and allied products	4.03	36.46	8.19	11.38
Printing, publishing and allied	1.17	1.78	11.13	12.82
Primary metal	2.68	35.49	8.88	12.00
Fabricated metal products	5.78	2.14	7.56	9.74
Machinery industries	2.04	4.22	8.12	11.20
Transportation equipment	1.19	36.97	10.88	12.13
Electrical and electronic products	3.41	9.19	9.90	13.07
Non-metallic mineral products	4.79	3.15	9.56	10.68
Refined petroleum and coal	0.57	157.07	10.89	16.45
Chemical and chemical products	3.67	18.97	8.56	11.60
Other manufacturing	4.50	1.35	10.69	13.41
Simple average	6.19	19.11	10.13	12.84

[a] Firm size is calculated as gross output in 1992 million dollars per firm.

metal, and Paper & allied products. For Clothing, Furniture & fixture, and Printing, publishing and allied, firms were on average very small.

For total manufacturing, on average, 10.13 percent of firms exited per year over the 1983–1996 period and 12.84 percent of firms entered. There is a high correlation between entry rates and exit rates across industries. Industries with high exit rates tend to have high entry rates. The correlation coefficient between exit rates and entry rates is 0.7227 and is statistically significant at the 1 percent level.

To examine the relationship between tariff cuts and changes in firm size, exit rates and entry rates, we have divided our total sample of 81 manufacturing industries into four quartiles on the basis of the size of their tariff reductions over the 1983–1996 period.[11] For each quartile,

[11] The top three quartiles each have 20 industries. The bottom quartile has 21 industries. The list of industries in each quartile is shown in the Appendix.

we have calculated changes in tariff rates, firm size, exit rates, and entry rates over the 1983–1996 period. The change for a quartile is calculated as a weighted sum of the changes for individual industries comprising the quartile, using the number of plants as weights.

The results in Table 2 show a negative correlation between changes in tariffs and changes in exit rates across manufacturing industries. The larger the tariff reduction in industries, the faster is the increase in exit rates. Over the 1983–1996 period, the increase in exit rates was 2.00 percentage points for the top quartile—those industries with largest tariff cuts. For the second, third, and fourth quartiles, the increase in exit rates was 1.70, 1.24, and 0.77 percentage points, respectively.

Table 2: *Changes in Firm Size, Exit and Entry Rates by Size of Tariff Cuts, 1983–1996*

Quartiles of industries	Tariff cuts	Firm size[a]	Exit rates	Entry rates
Largest tariff cuts	−10.50	4.18	2.00	−1.97
Medium-high tariff cuts	−6.76	7.62	1.70	−0.40
Medium-low tariff cuts	−4.66	0.22	1.24	4.14
Low tariff cuts	−0.50	32.14	0.77	3.92

[a] Firm size is calculated as gross output in 1992 million dollars per firm.

In the raw data, there is no monotonic relationship between changes in tariff rates and changes in average firm size. Average firm size increased in all four quartiles of Canadian manufacturing industries between 1983 and 1996 and the increase was fastest among the industries with lowest and highest tariff reductions.

There appears to be a positive correlation between changes in Canadian tariffs and changes in entry rates. The increase in entry rates was smaller for the industries that experienced large tariff reductions. This would suggest that Canadian firms are less likely to enter the industries that are more open to competition from foreign firms. However, this raw correlation between tariffs and entry rates is not confirmed in empirical analysis below. Our regression results show that the relationship between tariffs and entry rates is not statistically significant.

3.2 The Effects of Tariff Cuts on Firm Size

Table 3 presents the results of panel regressions on firm size. As discussed above, we include industry- and year-fixed effects in the empirical specifications. We also allow for heteroskedasticity between industries and the first-order autocorrelation (AR(1)) within industries.[12]

Table 3: *Effects of Tariffs on Firm Size*

	(1)	(2)		(1)	(2)
Tariffs	0.3523	0.4414	Year dummies for		
	(1.48)	(1.50)	1991	−0.0782	−0.0777
Tariffs × turnover		−0.3611		(−4.82)	(−4.79)
		(−0.47)	1992	−0.0738	−0.0732
Year dummies for				(−4.28)	(−4.24)
1984	0.0254	0.0255	1993	−0.0456	−0.0448
	(3.01)	(3.01)		(−2.46)	(−2.42)
1985	0.0365	0.0370	1994	−0.0065	−0.0052
	(3.34)	(3.35)		(−0.34)	(−0.27)
1986	0.0325	0.0329	1995	0.0069	0.0080
	(2.62)	(2.64)		(0.35)	(0.40)
1987	0.0347	0.0346	1996	0.0411	0.0424
	(2.60)	(2.59)		(1.96)	(2.01)
1988	0.0534	0.0536			
	(3.78)	(3.79)	Number of		
1989	0.0582	0.0585	observations	1,134	1,134
	(3.97)	(3.99)	AR(1)		
1990	−0.0138	−0.0134	coefficient	0.6847	0.6792
	(−0.90)	(−0.87)	Log likelihood	1,145.675	1,143.447

Note: All regressions include industry dummies. The figures in parentheses are t-ratios.

In specification (1), the estimated coefficient on tariff rates is positive. This indicates that average firm size tends to be smaller in the industries with lower Canadian tariffs, which is consistent with the evidence in Tybout (2001) on the negative effect of import competition on average firm size. However, the estimated effect of tariffs on average firm size is not statistically significant at the 10 percent level. This implies that the tariff cuts had no significant effect on firm size in Canadian manufacturing. Consistent with the findings of Head and Ries (1999) and Trefler

[12] The hypothesis that error terms are homoskedastic between industries is rejected at the 1 percent level using a likelihood test. The estimated AR(1) coefficient is quite large in the regressions.

(2001), there is no evidence that the rise in firm scale over the 1990s observed in Figure 2 stemmed from FTA-related tariff reductions.[13] Even with the more complete firm coverage in the LEAP database, there is still no evidence to suggest that the main source of productivity growth from the FTA tariff cuts was increased scale.

As an aside, a number of studies show that entry barriers play an important role in determining how firms respond to tariff cuts (Roberts and Tybout 1995; Head and Ries 1999). That is, industries with high turnover (or low entry barriers) should show relatively mild adjustments in response to tariff cuts. To examine the issue, we introduce an interaction term between tariff rates and turnover in specification (2) of Table 3.[14] The estimated coefficient of the interaction is negative but not statistically significant at the 10 percent level. We conclude that neither firms in high-turnover industries (low entry barriers) nor firms in low-turnover industries (high entry barriers) have changed firm size in response to tariff reductions in Canadian manufacturing.

3.3 The Effects of Tariff Cuts on Firm Entry and Exit

We now turn to the impact of tariff cuts on firm entry and exit in the next two tables. Our hypothesis is that the FTA tariff cuts accelerated the pace of firm turnover and forced the exit of the least productive firms, thereby generating the observed post-FTA productivity gains in Canadian manufacturing.

Table 4 presents the panel regression results on the effect of tariffs on entry rates in Canadian manufacturing industries. The results show that tariffs do not have a statistically significant effect on entry rates, suggesting that tariff reductions over the FTA period had little effect on the decision of firms to enter manufacturing industries.

However, there is evidence to suggest that trade liberalization increased the exit rate of manufacturing firms over the period. Table 5 presents the regression results on the effect of tariffs on exit rates. In specification (1), tariff rates are found to have negative and significant

[13] Head and Ries (1999) examine other potential sources of the rise in plant size and find that the observed increase in firm size can be linked to currency depreciation against the United States and a compositional shift towards high-scale industries in Canada.

[14] Turnover is measured by the number of entrants and exits, divided by the number of firms.

Table 4: *Effects of Tariffs on Entry Rates*

	All firms (1)	Small firms (0–20 ALU) (2)	Medium or large firms (at least 20 ALU) (3)		All firms (1)	Small firms (0–20 ALU) (2)	Medium or large firms (at least 20 ALU) (3)
Tariffs	0.0428	0.0513	0.0132	Year dummies for			
	(0.72)	(0.64)	(0.56)	1991	−0.0228	−0.0331	−0.0033
Year dummies for					(−5.23)	(−5.36)	(−1.75)
1984	0.0074	0.0131	0.0030	1992	−0.0169	−0.0259	−0.0026
	(2.06)	(2.37)	(1.66)		(−3.68)	(−4.02)	(−1.34)
1985	0.0069	0.0139	0.0007	1993	−0.0101	−0.0180	−0.0016
	(1.75)	(2.41)	(0.39)		(−2.08)	(−2.67)	(−0.77)
1986	0.0028	0.0063	0.0022	1994	0.0015	−0.0031	−0.0023
	(0.71)	(1.09)	(1.22)		(0.31)	(−0.44)	(−1.13)
1987	−0.0102	−0.0115	0.0005	1995	−0.0087	−0.0173	−0.0026
	(−2.52)	(−1.99)	(0.28)		(−1.66)	(−2.39)	(−1.20)
1988	−0.0093	−0.0072	−0.0022	1996	0.0263	0.0313	−0.0035
	(−2.27)	(−1.22)	(−1.23)		(4.85)	(4.17)	(−1.57)
1989	−0.0101	−0.0108	−0.0009	Number of			
	(−2.45)	(−1.83)	(−0.50)	observations	1,134	1,134	1,134
1990	−0.0264	−0.0365	−0.0022	AR(1) coefficient	0.2031	0.0791	−0.0294
	(−6.26)	(−6.08)	(−1.15)	Log likelihood	2,280.138	1,832.547	3,139.928

Note: All regressions include industry dummies. The figures in parentheses are t-ratios. ALU denotes average labor unit.

Table 5: *Effects of Tariffs on Exit Rates*

	All firms (1)	Small firms (0–20 ALU) (2)	Medium or large firms (at least 20 ALU) (3)		All firms (1)	Small firms (0–20 ALU) (2)	Medium or large firms (at least 20 ALU) (3)
Tariffs	−0.0827	−0.0993	−0.0589	Year dummies for			
	(−2.32)	(−2.33)	(−2.13)	1991	0.0192	0.0223	−0.0002
Year dummies for					(7.46)	(7.07)	(−0.07)
1984	0.0008	0.0029	−0.0039	1992	0.0136	0.0152	−0.0021
	(0.35)	(1.02)	(−1.91)		(5.01)	(4.61)	(−0.95)
1985	0.0022	0.0050	−0.0025	1993	0.0053	0.0057	−0.0064
	(0.93)	(1.71)	(−1.22)		(1.87)	(1.63)	(−2.70)
1986	0.0019	0.0056	−0.0025	1994	0.0096	0.0096	−0.0037
	(0.81)	(1.89)	(−1.24)		(3.28)	(2.70)	(−1.53)
1987	0.0013	0.0057	−0.0052	1995	0.0166	0.0208	−0.0119
	(0.54)	(1.93)	(−2.54)		(5.43)	(5.65)	(−4.78)
1988	0.0052	0.0112	−0.0048	1996	0.0051	0.0081	−0.0157
	(2.12)	(3.74)	(−2.32)		(1.62)	(2.11)	(−6.09)
1989	0.0051	0.0091	−0.0028	Number of			
	(2.08)	(3.03)	(−1.36)	observations	1,134	1,134	1,134
1990	0.0259	0.0303	0.0058	AR(1) coefficient	0.1032	0.0387	−0.0192
	(10.38)	(9.91)	(2.71)	Log likelihood	2,817.305	2,495.831	3,015.812

Note: All regressions include industry dummies. The figures in parentheses are t-ratios. ALU denotes average labor unit.

effect on the exit rates. The estimated coefficient shows that a percentage point decline in tariff rates is associated with 0.08 percentage point increase in the exit rate. For the most affected industries—the top quartile of industries with the largest tariff cuts—the average tariff cut was 8 percentage points during the 1988–1996 period. We conclude that the tariff cuts in the FTA period increased the exit rate by 0.7 percentage points for the most affected industries. In 1988, the average exit rate for the most affected industries was about 10 percent. The FTA-induced increase in the exit rate thus represents a 7 percent increase.

In specification (2), we report the effect of tariffs on exit rates among small firms with less than 20 ALUs. In specification (3), we present the effect of tariffs on exit rates among medium-sized or large firms with more than 20 ALUs. Our results show that the tariff reductions increased the exit rates for both types of firms. The difference in the estimated effects of tariffs on exit rates is not statistically significant at the 10 percent level between small and large firms. The estimated coefficients on tariff rates suggest that, for the most affected industries, the tariff reduction in the FTA period increased the exit rate of small firms by 0.8 percentage points. It increased the exit rate of large firms by 0.5 percentage points.

For all panel regressions in Table 5, we allow for heteroskasticity between industries and the first-order autocorrelation (AR(1)) within industries. While the hypothesis that error terms are homoskedastic between industries is rejected at the 1 percent level using a likelihood test, the estimated AR(1) coefficient is quite small in the regressions. As such, we re-run all regressions assuming that there is no autocorrelation within industries. The results are almost identical.

In sum, three main findings emerge from our analysis above. First, the FTA tariff reduction had little effect on average firm size in Canadian manufacturing. Second, the tariff reduction forced the exit of Canadian manufacturing firms. As the firms that exit tend to be less productive than those that survive (Baldwin and Gu 2002), we infer that the FTA tariff cuts forced the least productive firms to exit thus contributing to productivity growth. This link is supported by recent empirical research by Baggs (2002) using the LEAP database linked to the T2 tax file, which finds that net effect of tariff reductions in Canadian manufacturing has been to increase the probability of exit among low-productivity firms. Third, our findings suggest that the FTA tariff cut had no effect on the decision of firms to enter the manufacturing industries.

3.4 Robustness Checks

The results reported above are based on panel regressions that include industry- and year-fixed effects. As an alternative method, we first-difference all the data and then include year dummies. The results from the first-differencing method are quite similar to the results from the fixed-effects model. Once again, we find that tariff reductions increased the exit rate of Canadian manufacturing firms, but had little effect on the firm size and entry decision. The estimated effect from the first-differencing method suggests that the tariff cuts in the FTA period 1988–1996 raised the exit rate by 2 percentage points (or 20 percent) for the most affected industries.

The estimated effect of tariff reductions on the exit rate from the first-differencing method is larger than the one from the fixed-effects method. The results from the fixed-effects method above show that the tariff cuts increased the exit rate by 0.7 percentage points or 7 percent for the most affected industries.

The pace of tariff cuts increased during the FTA period. As a robustness check, we re-run the panel regressions for the FTA period only. Overall, the results are similar to those from the whole period 1983–1996. We conclude that our results on the effects of tariff reductions on firm size and firm turnover are not sensitive to the estimation techniques used, nor to the sample period chosen for the analysis.

The 1990s was a period of accelerating changes in technology and other supply and demand conditions. The year-fixed effects that are common to all industries in our regressions may not capture these changes (Trefler 2001). To control for these changes, we introduce output in the corresponding U.S. industry in our regression analysis.[15] The results are similar to those without the U.S. control. We conclude that our results on firm size and firm turnover are robust to the inclusion of control variables for technology changes and other supply and demand changes.

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[15] The U.S. data on output are downloaded from the NBER website (http://www.nber.org/nberces/nbprod96.htm) and are available at the 4-digit level of 459 manufacturing industries. These data are aggregated to the 81 Canadian manufacturing industries for our analysis.

4 Conclusions

Recent evidence suggests that tariff reductions from the Canada-U.S. FTA generated substantial productivity gains in Canadian manufacturing. The objective of this study has been to extend the literature on the effect of tariff reductions upon productivity growth to provide empirical evidence on sources of the productivity gains. While early proponents of the FTA suggested that tariff reductions would lead to increased firm size, which would in turn lead to productivity growth, our study finds that the initial link is not there—tariff reductions cannot be empirically linked to the observed increase in firm size in Canadian manufacturing.[16] This result confirms the findings of previous studies by using a more comprehensive data set (in terms of consistent coverage of small firms)—suggesting that the finding is robust.

The other channel through which trade liberalization has been theorized to affect productivity is through increased firm turnover. A key contribution of our study has been to provide empirical evidence that tariff reductions contributed to the increase in firm turnover over the 1990s. In particular, we find strong and robust evidence that the FTA tariff cuts led to an increase in the exit rate of Canadian manufacturing firms. As recent research has also shown that the firms that exit tend to be less productive than those that survive, we can infer that the FTA tariff cuts induced the least productive firms to exit. Our calculation shows that the tariff cuts in the FTA period 1988–1996 increased the exit rate by 0.7–2.0 percentage points for the most affected industries.

While we have focused our attention on the effects of tariff cuts on firm size and firm turnover, the response of firms to changes in tariff rates involves more than the scale of production and the decision to enter and exit. For example, in response to reductions in trade barriers, firms may improve production efficiency through product specialization in response to reductions in trade barriers. Therefore, examining the various aspects of how Canadian firms adjust to tariff reductions and increased exposure to international trade should be the focus of future research.

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[16] This is not to say that firm size does not increase productivity growth. However, it was not a consequence of trade liberalization per se that led to larger-scale operations as expected prior to the signing of the FTA.

Appendix Table: Industries by Tariff Cuts

1980 SIC	Industries
	Industries with large tariff cuts
264	Office Furniture Industries
269	Other Furniture and Fixture Industries
332	Major Appliances (Electric & Non-elect.)
273	Paper Box and Bag Industries
261	Household Furniture Industries
376	Soap and Cleaning Compounds Industry
326	Railroad Rolling Stock Industry
272	Asphalt Roofing Industry
307	Heating Equipment Industry
279	Other Converted Paper Products Industries
180	Primary Textile Industries
301	Power Boiler and Heat Exchanger Industry
303	Ornamental & Architectural Metal Prods.
377	Toilet Preparations Industry
375	Paint and Varnish Industry
337	Electrical Industrial Equipment Inds.
150	Rubber Products Industries
309	Other Metal Fabricating Industries
324	Truck and Bus Body & Trailer Inds.
282	Platemaking, Typesetting & Bindery Ind.
	Industries with medium-high tariff cuts
190	Textile Products Industries
329	Other Transportation Equipment Inds.
306	Hardware, Tool and Cutlery Industries
302	Fabricated Structural Metal Products
160	Plastic Products Industries
356	Glass and Glass Products Industries
379	Other Chemical Products Industries
330	Other Electrical and Electronic Products
312	Commercial Refrigeration Equipment Ind.
281	Commercial Printing Industries
254	Sash, Door and Other Millwork Industries
244	Women's Clothing Industries
374	Pharmaceutical and Medicine Industry
250	Other Wood Industries
252	Veneer and Plywood Industries
271	Pulp and Paper Industries
105	Flour, Cereal Food and Feed Industries
373	Plastic and Synthetic Resin Industry
328	Boatbuilding and Repair Industry
297	Copper Rolling, Casting and Extruding

1980 SIC	Industries
	Industries with medium-low tariff cuts
390	Other Manufacturing Industries
335	Electronic Equipment Industries
350	Other Non-metallic Mineral Products
243	Men's and Boys' Clothing Industries
240	Children and Misc. Clothing Industries
305	Wire and Wire Products Industries
292	Steel Pipe and Tube Industry
304	Stamped, Pressed & Coated Metal Products
107	Bakery Products Industries
371	Industrial Chemicals Industries n.e.c.
319	Other Machinery and Equipment Industries
171	Leather and Allied Products Industries
103	Fruit and Vegetable Industries
291	Primary Steel Industries
294	Iron Foundries
102	Fish Products Industry
296	Aluminum Rolling, Casting and Extruding
299	Other Metal Rolling, Casting & Extruding
110	Beverage Industries
108	Sugar and Sugar Confectionery Industries
	Industries with low tariff cuts
336	Office, Store & Business Machines Inds.
101	Meat and Poultry Products Industries
109	Other Food Products Industries
323	Motor Vehicle Industry
106	Vegetable Oil Mills (except Corn Oil)
354	Concrete Products Industries
104	Dairy Products Industries
361	Refined Petroleum Products Industries
325	Motor Vehicle Parts & Accessories Inds.
369	Other Petroleum and Coal Products Inds.
311	Agricultural Implement Industry
352	Cement Industry
283	Publishing Industries
295	Non-ferrous Metal Smelting and Refining
372	Agricultural Chemical Industries
251	Sawmills, Planing & Shingle Mills
321	Aircraft and Aircraft Parts Industry
284	Combined Publishing and Printing Inds.
308	Machine Shop Industry
120	Tobacco Products Industries
327	Shipbuilding and Repair Industry

Note: Industries are divided into four quartiles on the basis of their tariff cuts over the 1983–1996 period.

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