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Changing Trade Barriers and Canadian Firms: Survival and Exit After the Canada-U.S. Free Trade Agreement

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ABSTRACT

This paper considers the implications of changing trade barriers for the survival of Canadian manufacturing firms. A segmented market Cournot model is developed to describe the effects of trade liberalization for heterogeneous firms operating in diverse industries. The predictions of this model are tested empirically using firm level data for both public and private corporations and tariff rates for both Canada and the United States. Our findings suggest that Canadian tariff reductions are associated with a decrease in the probability of survival for Canadian firms while declines in American tariffs increased that probability. The sensitivity of individual firms to tariff changes was mitigated by the characteristics of those firms. In particular, productivity and leverage had substantial roles in determining the vulnerability of a firm to failure as a result of trade liberalization.

Keywords: trade liberalization, productivity, survival

I. Introduction

Trade barriers in North America have declined substantially since the late 1980's. Beginning with the introduction of the Canada-U.S. Free Trade Agreement (FTA) in 1989, and furthered by the implementation of the North American Free Trade Agreement (NAFTA) in 1994, tariffs on most goods shipped between Canada, the United States and Mexico have been greatly reduced. Bilateral tariff reductions have uncertain effects on domestic firms. On one hand, tariff reductions effectively increase competition by exposing domestic firms to foreign competitors in the domestic market. This decline in protection threatens to reduce the market share of domestic firms less efficient than their foreign rivals. However, declining tariffs also provide domestic firms with access to foreign markets without the cost disadvantages imposed by high tariffs. Access to this larger market may be advantageous for domestic firms able to compete with foreign producers. The net effect of falling tariffs on domestic firms may depend on both the characteristics of the individual firm and the industry in which it operates.

This paper examines how tariff reductions affect the survival of Canadian firms with different attributes competing in diverse industries. We believe that tariff reductions will affect firm performance, and that the magnitude of this effect will vary amongst firms. The question remains, when the business environment in which firms operate changes, are all firms affected equally, or do some attributes make certain firms better able to survive the threats, or more capable of taking advantage of the opportunities, presented by the new environment? In this case, the change in the business environment considered is the implementation of the FTA. Here we consider how the threats and opportunities presented by the FTA affect the survival of heterogeneous Canadian firms.

This work is closely linked to the strategy literature[1] considering the implications of firm and industry characteristics for industry performance. In this literature, what determines performance has been discussed in two broad areas: firm effects and industry effects. The firm level hypothesis suggests that the success or failure of a given firm is primarily a result of the characteristics of the firm itself. For example, tariff reductions might select in favour of older, larger firms, while smaller, entrepreneurial firms may have more difficulty competing in a larger market place. From a growing literature surrounding the implications of trade liberalization for firm survival, Melitz (1999), shows that exposure to trade leads to less productive firms exiting the industry. Prior to the FTA, it was suggested that one of the major benefits of falling tariffs might be derived from inefficient firms exiting the industry and efficient firms increasing their output[2]. However, while recent papers by Head and Ries (1999), Trefler (2001) and Gu, Sawchuck and Whewell (2001) have found evidence of high turnover rates during the post-FTA period, they have not found evidence of increasing output per firm. In addition, the causes of the observed high turnover rates remain unclear. Gu, Sawchuk and Whewell (2001), for the case of the Canada-U.S. FTA, conclude that the FTA has increased the exit of less productive firms, and also induced a net exit of large firms. However, Beaulieu (2001), considering manufacturing

1 See for example: McGahan (1999), McGahan and Porter (1999).

2 See for example: Cox and Harris (1985).

plants in Ontario, finds no evidence that firm size affects the likelihood of exit during the post FTA period. This paper considers the contributions of both firm size and productivity, as well as additional financial variables, in measuring the firm level characteristics that influence survival following trade liberalization.

Although the success of firms may vary due to individual circumstances, the industry view of the firm suggests that firm's common context has a more significant effect on performance than individual characteristics. Some industry structures may impede entry, support differentiation or limit rivalry. Firms in these industries could be expected to benefit from their common context and experience more success than firms lacking this context. However, when extending this to the case of falling tariffs, we expect the opposite result. Industries that are protected domestically may be most successful with high tariffs and least successful when tariffs fall. To examine these industry effects, we add industry level dummy variables and tariff rates to our firm level variables, in order to comprehensively consider the implications of the FTA for the survival of heterogeneous firms operating in diverse industries.

This paper contains several important innovations. Many previous studies of Canadian industries in the post-FTA period have considered only the impact of falling Canadian tariffs, omitting the important prospects firms obtain from declining U.S. tariffs. By simultaneously investigating the effects of both Canadian and American tariff changes, this analysis provides a comprehensive picture of both the opportunities and threats created by the FTA for Canadian firms. In addition, to the expanded view of the industry level changes faced by firms, this paper also considers how detailed firm level characteristics affect performance. The response of firms to changing tariffs is considered in the context of the diverse financial structures of those firms. Using firm level data for both public and private corporations, this paper is able to consider how heterogeneous financial characteristics interact with industry level changes to influence the survival of firms facing an exogenous shock.

The findings suggest that both firm and industry level characteristics are important determinants of survival. Consistent with McGahan (1999), the results suggest that, at least for the short time horizon considered here, firm effects exert more influence on performance than industry effects. The tariff changes imposed by the Canada-U.S. Free Trade Agreement had substantial consequences for firms. Canadian tariff reductions are associated with a decrease in the probability of firm survival while American tariff reductions exhibit the opposite effect. The net effect of the FTA induced tariff decline is associated with beneficial implications for the survival of firms in 69% of Canadian manufacturing industries. However, the sensitivity of individual firms to falling tariffs is found to depend on their specific traits, in particular, productivity and leverage. The sensitivity of firm performance to changes in both U.S. and Canadian tariffs was found to decrease with rising productivity. However, rising leverage amplified the sensitivity of firms to the industry level shock created by the FTA.

Section 2 describes the data used in this paper. Section 3 presents the simple segmented markets Cournot model used to motivate our empirical work. Section 4 contains the empirical results for the survival analysis, and an extension to the relative importance of firm and industry characteristics. Section 5 offers some conclusions.

2. Data Description

The data set used in this analysis is in fact the merger of two data bases maintained by Statistics Canada. The first set of data is provided by the Longitudinal Employment Analysis Program (LEAP), which tracks every employer in Canada that registers a payroll deduction account with the Canadian tax authority (Revenue Canada). Employers register a payroll deduction with Revenue Canada if they hire employees. Accordingly, firms enter the LEAP data base in the year they first hire employees, and record their last entry in the data base in the last year they hire employees. For each year in which a firm hires employees, a measure of its annual employment, called average labour units (ALU), is recorded in LEAP. A firm's ALU for a given year is calculated by dividing the total payroll of the firm by a weighted average of annual wages for workers in that firm's province, size class and industry. Accordingly, the reported ALU for a given firm can be interpreted as the number of "standardized employees" working for a firm during that year. The total number of employees in LEAP is slightly less than the number of full time equivalent workers in the Canadian economy as LEAP excludes individuals who are self-employed.

The LEAP data set has been linked with a second file, The Corporate Tax Statistical Universe File (T2SUF). The T2SUF tracks every incorporated firm in Canada filing a T2 form with Revenue Canada. The linkage of these two files forms the T2LEAP data set used in this paper. In effect, the T2LEAP data set contains every firm in Canada that is both incorporated and hires employees. This represents almost all Canadian businesses. The addition of the T2SUF to the LEAP adds annual measures of several financial variables to the employment statistics. For the purposes of this paper, we use the T2SUF record of each firm's equity, assets and sales, converted to constant Canadian dollars using a 1986 price index. T2SUF also contains the date of incorporation, and if relevant, the date of un-incorporation for each firm. Accordingly, T2LEAP includes two measures of entry and exit. One based on the first and last year in which employees are hired, and the other based on the incorporation and un-incorporation dates of the firm. In addition to employment and financial data, each firm is classified by a 3-digit SIC code. The version of T2LEAP used in this paper contains firm information for 13 years, from 1984 to 1996. However, both the first and last years are subject to partial reporting, leaving the usable portion as 1985 to 1995 only.

Although T2LEAP contains business operating in all sectors of the economy, this paper considers only manufacturing firms. This choice is made for a number of reasons. Manufactured goods constitute a substantial portion of the Canadian economy and are largely tradable goods. While the Free Trade Agreement indirectly affects other sectors of the economy, the manufacturing sector is directly affected. In addition, this impact is measurable by observing the changing tariffs on manufactured goods imposed by the FTA. Using 3-digit SIC codes, we are able to match both Canadian and U.S. tariff rates to each firm by year and industry. Both the Canadian and U.S. tariffs were kindly provided by Keith Head and are compiled as in Head and Ries (1999)[3]. A final advantage of using manufacturing firms is that this allows us to compare our results with the broader trade agreement literature, which principally considers the manufacturing sector.

[3] U.S. tariffs are compiled using the 93 industry classification provided in Table A2.1 of the *Canada-U.S. Free Trade Agreement: An Economic Assessment* (Government of Canada, Department of Finance, 1988). Canadian tariffs are compiled from Lester and Morehen (1987). See Head and Ries (1999) for further details.

Even when only considering manufacturing, the T2LEAP data provides a number of advantages not readily found in other data sets. Primarily, it is firm level data, including detailed financial information, and consists of both public and private firms. Broadly, T2LEAP can be thought of as containing all firms producing goods in Canada. This allows us to consider a detailed model of firm behaviour, using tariffs as a direct measure of implications of the FTA, for firms of all sizes, financial structures and ownership arrangements.

3. Model

To model the response of firms to changing tariff levels, we first consider the segmented-markets Cournot model introduced by Brander (1981). In this model, firms make separate decisions for each market in which they compete, making quantity choices for one market independent of the choices made for other markets. Although costs vary across firms, each firm's marginal cost is constant, allowing for this independence. We assume a fixed number of heterogeneous firms selling goods in both the domestic and foreign markets. All firms produce goods in their home country and serve the other market with exports. There are N firms in our model, divided between n domestic firms and n^* foreign firms. The ith domestic firm has unit production costs c_i and fixed costs F_i, while the ith foreign firm entails unit production costs of k_i and fixed costs G_i. Variables corresponding to the foreign market are denoted with an * while those for the domestic market do not have an asterisk. Domestic firms produce a total of X units of output:

$$X = \sum_{j=1}^{n} \left(x_j + x_j^* \right) \tag{1}$$

where x_j is the amount the jth domestic firm sells in home country and x^*_j is the amount the jth domestic firm sells in the foreign market. Similarly, foreign firms produces a total of Y units; the sum over n^* of y_j units sold in domestic country and y^*_j units sold in the foreign country:

$$Y = \sum_{j=1}^{n^*} \left(y_j + y_j^* \right) \tag{2}$$

Goods shipped from the domestic country to the foreign country face ad valorem tariffs of the amount τ^* and goods moving from the foreign country to the domestic country face tariffs of τ. Accordingly, the profits of the ith domestic firm can be expressed as

$$\pi_i = (P - c_i)x_i + \left[P^* - c_i - \tau^* \right] x_i^* - F_i \tag{3}$$

and the ith foreign firm has profits of

$$\pi_i^* = \left[P - k_i - \tau \right] y_i + (P^* - k_i) y_i^* - G_i \tag{4}$$

Following Shy (1995), we adopt a method for calculating a Cournot-Nash equilibrium output and profit level without resorting to N first order conditions for the equilibrium output levels of all n

domestic and n^* foreign firms. To do this, we first assume a linear demand curve of the form $P = a - bQ$ for the domestic market and $P^* = a^* - bQ^*$ for the foreign market, where:

$$Q = \sum_{j=1}^{n} x_j + \sum_{j=1}^{n^*} y_j \quad \text{and} \quad Q^* = \sum_{j=1}^{n} x_j^* + \sum_{j=1}^{n^*} y_j^* \tag{5}$$

Since the market is segmented, firms will consider their choice of output for the domestic market separately from their choice of output for the foreign market. The *i*th domestic firm will maximize profits in the domestic market by solving

$$\begin{aligned} \max_{x_i} \pi_i &= \left[a - bx_i - b\left(\sum_{j\neq i}^{n} x_j \right) - b\left(\sum_{j=1}^{n^*} y_j \right) \right] x_i - c_i x_i \\ &+ \left[a^* - bx_i^* - b\left(\sum_{j\neq i}^{n} x_j^* \right) - b\left(\sum_{j=1}^{n^*} y_j^* \right) \right] x_i^* - (c_i + \tau^*) x_i^* - F \end{aligned} \tag{6}$$

which yields, assuming $x_i > 0$ for all i, a first order condition of the form

$$\frac{\partial \pi_i}{dx_i} = a - 2bx_i - b\left(\sum_{j\neq i}^{n} x_j \right) - b\left(\sum_{j=1}^{n^*} y_j \right) - c_i = 0. \tag{7}$$

For the foreign firm, profits will be maximized in the domestic market when

$$\frac{\partial \pi_i^*}{dy_i} = a - 2by_i - b\left(\sum_{j\neq i}^{n^*} y_j \right) - b\left(\sum_{j=1}^{n} x_j \right) - k_i - \tau = 0. \tag{8}$$

Rather than solving N equations for N output levels, we instead solve for the aggregate production level by rewriting equation (7) as

$$a - bx_i - bQ = c_i \quad j=1,\ldots,n, \tag{9}$$

and equation (8) as

$$a - by_i - bQ = k_i + \tau \quad j=1,\ldots,n^*. \tag{10}$$

Summing equation (9) over all x_j, from j=1,…,n and equation (10) over all y_j from j=1,…n* and then adding the two equations together, gives an expression for all sum of N firms

$$Na - bQ - bNQ = c_i + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j + n^* \tau . \tag{11}$$

Accordingly, the Cournot equilibrium output in the domestic industry and the price charged in the domestic market are given by

$$Q = \frac{1}{b(N+1)} \left[aN - \left(c_i + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j + n^* \tau \right) \right]$$

and

$$P = \frac{1}{(N+1)} \left[a + \left(c_i + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j + n^* \tau \right) \right].$$

Substituting the equilibrium value of Q into equation (9), we can solve for the equilibrium level of output the *i*th domestic firm sells in the domestic market

$$x_i = \frac{1}{b(N+1)} \left[a - Nc_i + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j + n^* \tau \right]. \tag{12}$$

Similarly, the equilibrium quantity the *i*th foreign producer sells in the domestic market can be derived from equation (10) as

$$y_i = \frac{1}{b(N+1)} \left[a - Nk_i - (n+1)\tau + \sum_{j=1}^{n} c_j + \sum_{j \neq i}^{n^*} k_j \right] \tag{13}$$

To see how domestic tariffs (those paid on foreign goods entering the domestic market) affect the equilibrium quantity domestic producers sell in the domestic market, we take the derivative of equation (12) with respect to domestic tariffs:

$$\frac{\partial x_i}{\partial \tau} = \frac{n^*}{b(N+1)} > 0 . \tag{14}$$

Clearly, equation (14) is strictly positive, indicating a positive relationship between the quantity sold by domestic firms and domestic tariffs. As domestic tariffs fall, the quantity domestic firms sell in their home market decreases. This is an intuitive result, as we would expect decreased protection of the domestic market would lead to increased competition from foreign firms and accordingly, loss of domestic market share.

Using symmetry we can solve for the equilibrium level of output and price in the foreign market.

$$Q^* = \frac{1}{b(N+1)}\left[a^* N - \left(c_i + n\tau^* + \sum_{j\neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j \right) \right]$$

$$P^* = \frac{1}{(N+1)}\left[a^* + \left(c_i + n\tau^* + \sum_{j\neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j \right) \right].$$

From this industry Cournot equilibrium, for domestic firms, the quantity sold in the foreign market can be written as

$$x_i^* = \frac{1}{b(N+1)}\left[a^* - Nc_i - (n^*+1)\tau^* + \sum_{j\neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j \right]. \tag{15}$$

Now consider the effect of foreign tariff changes on the equilibrium quantity domestic producers sell in the foreign market

$$\frac{\partial x_i^*}{\partial \tau^*} = \frac{-(n^*+1)}{b(N+1)} < 0\,. \tag{16}$$

Since equation (16) is strictly negative, we observe that the quantity domestic producers sell in the foreign market is negatively related to foreign tariffs. As foreign tariffs fall, reducing the cost advantage to foreign producers, domestic producers are able to increase the quantity of goods they sell in the foreign market. Since the market is segmented, and equations (14) and (16) do not depend on the different marginal costs faced by individual firms, we can extend these results to slightly more general statement. Regardless of the different production costs faced by firms, decreases in domestic tariffs, lower the total quantity sold by domestic firms and decreases in foreign tariffs, increase the total quantity sold by domestic firms. Moreover, this output change is constant across firms with different levels of efficiency (consider c_i as a measure of efficiency).

Inserting the Cournot equilibrium values of x_i, x_i^*, P and P^* into equation (3), and taking the derivative of domestic profits with respect to domestic tariffs gives

$$\frac{\partial \pi_i}{\partial \tau} = \frac{n^*}{(N+1)} x_i + \frac{n^*}{b(N+1)}\left(P - c_i \right) > 0. \tag{17}$$

Given that $P > c_i$, equation (17) is clearly positive. This positive relationship between domestic profits and domestic tariffs indicates that reductions in domestic tariffs will decrease the profits of domestic firms. To determine the effect of foreign tariffs on domestic profits, we take the derivative of equation (3) with respect to foreign tariffs

$$\frac{\partial \pi_i}{\partial \tau^*} = \frac{-(n^*+1)}{(N+1)} x_i^* + \frac{-(n^*+1)}{b(N+1)} (P^* - c_i - \tau^*) < 0. \tag{18}$$

Again, for firms to stay in the market, we assume that price must be greater than cost, $P^* > c_i + \tau^*$, which implies that equation (18) is strictly negative. This negative relationship implies that decreases in foreign tariff levels increase the profits of domestic firms. By symmetry we can also show that domestic tariff reductions increase the profits of foreign firms and foreign tariff reductions decrease the profits of foreign firms.

If equation (3) is re-written with the equilibrium values of x_i, x_i^*, P and P*,

$$\begin{aligned} \pi_i = & \frac{1}{b(N+1)^2} \left[a - Nc_i + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j + n^* \tau \right]^2 \\ & + \frac{1}{b(N+1)^2} \left[a^* - Nc_i - (n^*+1)\tau^* + \sum_{j \neq i}^{n} c_j + \sum_{j=1}^{n^*} k_j \right]^2 + F_i, \end{aligned} \tag{22}$$

we see that the profits of a given firm depend on both the fixed and variable costs faced by that firm, the costs incurred by the firm's competitors (both foreign and domestic), the number of firms in the industry (both foreign and domestic) and foreign and domestic tariffs for that industry. Accordingly, it is possible to group the determinants of current profits into industry characteristics: the number of other firms and their cost structures, as well as industry tariff rates; and firm characteristics: the costs faced by the domestic firm. Unlike most pervious work, in which industry effects were considered largely at the domestic level, we are actually considering two sets of competitors, foreign and domestic. The industry effects here comprise both the characteristics of foreign and domestic competitors as well as the two tariff rates, which effect firms in Canada and the United States differently. Firm effects are represented by the costs faced by each firm, both fixed and variable.

3.1 Survival

The previous section has considered how tariffs affect firm profits, where profits are a function of firm and industry characteristics. However, in this paper, we are most interested in how changing tariffs relate to firm survival. The proximate determinants of firm exit may involve an inability to meet liquidity requirements, demand shocks, labour unrest or any number of other short term crises. However, these events tend to be the catalysts of exit rather than the ultimate cause. The decision of whether to exit or remain in an industry depends fundamentally on the firm's prospects for profits. In the theoretical structure in the preceeding section, the number of firms, *N*, is fixed and we do not directly observe entry or exit. However, we can think of this structure as representing the response of firm profits to changing tariffs for a given period, with the number of firms changing between periods. The segmented markets Cournot model indicates how tariff changes affect the profits of a given firm at a given time and we will now extend that analysis to examine how changes in firm profits affect the decision of a firm to exit in the current period or remain in the market for the subsequent period.

Simplifying equation (22) where profits are determined by firm and industry level effects, let the profits of firm *i* at time *t* be defined as:

$$\pi_{it} = \beta X_{it} + \lambda Y_{it} + \varepsilon_{it}, \qquad (23)$$

where X_{it} is a vector of firm specific attributes of firm *i* at time *t* and Y_{it} is a vector of attributes specific to the industry in which the firm operates. Firm *i* will choose to stay in the market at a given point in time if its profits are greater than an unobserved firm specific critical value ζ_{it}. If profits are less than ζ_{it}, the firm will exit. Consequently, we can write the probability that firm *i* will survive as the probability that $\pi_{it} > \zeta_{it}$:

$$P_r(survive) = P_r(\beta X_{it} + \lambda Y_{it} + \varepsilon_{it} > \zeta_{it}). \qquad (24)$$

which can be re-written as

$$P_r(survive) = P_r[\beta X_{it} + \lambda Y_{it} > \zeta_{it} - \varepsilon_{it}], \qquad (25)$$

where:

$$\zeta_{it} - \varepsilon_{it} \sim N(\mu_t, \sigma^2).$$

Accordingly, equation (25) can be written as:

$$P_r[(\zeta_{it} - \varepsilon_{it}) < \beta X_{it} + \lambda Y_{it}] = \Phi\left[\frac{\beta X_{it} + \lambda Y_{it} - \mu_t}{\sigma}\right]. \qquad (26)$$

Where μ_t is a year dummy variable and β, λ, and σ are constants. The probability of survival described in equation (26) can be estimated empirically as a probit equation on X_{it}, Y_{it} and μ_t. When estimated empirically, the coefficients in equation (26), β/σ and λ/σ, represent the marginal effect of changes in X_{it} and Y_{it} on the latent variable Π_{it}. The coefficients do not directly capture the marginal effect of changes in firm and industry variables on the probability of survival. However, $\Phi$is monotonically increasing in profits, so the estimated coefficients reflect the direction and significance of the consequences changes in X_{it} and Y_{it} have for survival. Although the estimated coefficient of a given independent variable does not reflect the absolute size of the effect that variable has for survival, it does capture the magnitude of the effect relative to other independent variables. Accordingly, the estimated coefficients will describe the direction in which the underlying variables influence the probability of survival and the relative importance of firm and industry variables, but will not directly reveal the marginal contributions of each variable to firm survival.

For the components of X_{it} and Y_{it} we return to the Cournot model. Recall that industry effects were comprised of the number of competitors, their marginal costs and the foreign and domestic tariff rates. Empirically, the characteristics of competition within a given industry (the number of other firms and their cost structures) are accounted for by including in the probit equation an SIC dummy for that industry. The tariff changes for that industry are included more directly. From the Cournot results, rising domestic tariffs increase the profits of domestic firms staying in an industry, accordingly we expect domestic tariff increases to reduce the probability of exit for domestic firms. Similarly, since rising foreign tariffs reduce the profits of domestic firms staying in a given industry, foreign tariff increases are expected to increase the probability of exit for domestic firms.

In addition to industry effects, firm profits are affected by the set of firm specific attributes, X_{it}. In the Cournot model, firm effects are comprised of the firm's fixed and variable costs. We see that variable cost, c_i is monotonically related to the size of the firm. However, it is unlikely that firm size is the only determinant of variable cost. It is reasonable to suggest that variable cost is also a function of productivity. Firms with higher productivity will have lower per unit costs, all else equal. The second component of X_{it} is the firm's fixed cost, F_i. We will assume that fixed costs derive largely from the cost of debt. The cost of debt tends to be independent of output levels and can have substantial impact on the ability of firms to adjust to shocks in the competitive environment.

Theory tells us that efficient firms will survive and inefficient firms will fail. Zingales (1998) shows that it is not only efficient firms that survive an unexpected shock, but also those with "deeper pockets". Firms with superior access to financing, or larger reserves, are less likely to be foreclosed upon and hence more likely to survive. Lower levels of leverage generally provide firms with better access to additional funds and accordingly, give them an improved chance of survival. Firms with high levels of leverage face substantial cash flow demands to service their debt and these fixed costs infringe on their ability to take advantage of opportunities and adapt to threats. Zingales (1998) demonstrates that, even when the firm's efficiency level is controlled for, leverage is still relevant to the probability of survival.

Combining these results, X_{it} comprises of the cost of leverage, the size of the firm and the productivity of the firm. Y_{it} comprises 3-digit industry tariffs and a 2-digit industry SIC dummy variable to capture the effect of competing in that firm's industry. Interactions between tariffs and firm attributes will also be included. Table 1 contains a summary of the predicted effects discussed in this section. Re-writing equation (26), we obtain the preliminary estimating equation for the probability that firm *i* will survive year *t*:

$$\Pr(survive) = \Phi\left[\varphi(\tau_{it}) + \beta(X_{it}) + \alpha(\tau_{it} * X_{it}) + \delta(SIC_i) + \mu_t\right] \qquad (27)$$

where τ_{it}=(Canadian and U.S. tariffs) X_{it}=(leverage, size, productivity), μ_t=year(t) and the final component of Y_{it} is represented by an SIC dummy variable. Equation (27) will be estimated in the next section using a probit technique.

TABLE 1: Summary of Predictions

Comparative Static or Literature Source	Prediction
$\frac{\partial \pi_i}{\partial \tau} > 0$	Declining domestic protection increases threats – falling Canadian tariffs decrease the probability of survival
$\frac{\partial \pi_i}{\partial \tau *} < 0$	Opening foreign markets increase opportunities – falling U.S. tariffs increase the probability of survival
Gu, Sawchuck and Whewell (2001)	The FTA increases the exit of large firms.
Beaulieu (2001)	The affect of the FTA on survival is independent of firm size.
Zingales (1998)	More leveraged firms are less capable of adjusting to exogeneous shocks – firms with higher leverage rates will be more effected by falling tariffs.
Melitz (1999)	Trade liberalization (tariff reductions) leads to a decrease in the probability of survival for low productivity firms

4. *Empirical Results*

Using this estimating structure, and the T2LEAP database described in Section 1.2, we test empirically the effect of the tariff changes arising from the implementation of the Canada-U.S. Free Trade Agreement on the survival of Canadian firms. Tariffs are one of the most obvious, and measurable, indicators of the implications of trade policy. In the case of the Canada-U.S. Free Trade Agreement, they are particularly good indicators as this agreement was primarily trade oriented, and not combined in a larger package of macroeconomic reforms. Despite the fact that tariffs on manufacturing goods were falling in both Canada and the United States prior to the implementation of the FTA, this decline was much more dramatic in the years immediately following the agreement. In 1988, 21% of Canadian manufacturing industries were protected by tariffs of 10% or more, while by 1995, there were no industries in this position. Firms classified in the five 3-digit SIC codes for clothing in Canada, as well as those classified in the 3-digit SIC code for tobacco in the U.S., were all protected by tariffs in excess of 20% in 1988. By 1995, tariffs in these industries had fallen to between 2% and 5%. Prior to the agreement, substantial variation existed in tariff rates across industries, which led to diverse consequences and discernable differences in the effects of the FTA for different firms. These circumstances allow us to use the changing Canadian and U.S. tariff rates as proxies for the effect of the FTA itself on the survival of Canadian firms in existence prior to the implementation of the agreement.

In order to consider firm survival beginning in 1989, and to circumvent the difficulties involved in partial year reports, particularly in the case of the employment measure[4], we restrict the population of firms included in our analysis to those that operated for the full year in 1988. To ensure that the observations for 1988 represent a full year and not partial reports for operations that began a portion of the way through the year, firms must also have existed in 1987, although that may have been their first year of operation. Firms with fewer than two employees in either 1987 or 1988, and firms whose operations cease before January 1, 1989 are also eliminated.

The years 1989 through 1995 (the last complete year for which data is available) are considered as the post FTA period. From the population of firms existing prior to the FTA, the population of firms that survive a given year of the post FTA period is selected using similar criteria to those above. A firm is considered to have survived year *t* if year *t* is not the year in which the firm is unincorporated (the T2SUF measure of exit), if it has assets greater than zero in year *t+1*, if year *t* is not the last year in which the firm hires employees (the LEAP measure of exit), and if the firm has one or more employees in year *t+1*. For a firm to survive, it must meet all of these criteria, otherwise it is recorded as exiting during year *t*.[5]

TABLE 2 – Definitions of Existence & Survival

Characteristics of firms in existence prior to the FTA (Firms must meet all criteria to exist)
Employees in 1987>2
Employees in 1988>2
Incorporation date was prior to Jan 1, 1987
Un-incorporation date is after Jan 1, 1989
Final year in which employees were hired was post 1989
Characteristics of firms that survive year (t) (Firms exit if any one of the three criteria NOT met)
Final year in which employees are hired is NOT year (t) AND employees in year(t+1)>1
Year of unincorporation is NOT year (t)
Assets in year(t+1)>0

[4] Since ALU is an average for the entire year, a firm entering in December with 12 employees will have a recorded ALU of 1 for that year. In the next year, if that firm still has 12 employees, its ALU will be 12 – an apparent growth rate of 1100%, when in fact the growth rate is 0. See Brander et. al. (1999) for details.

[5] Firms that appear to cease operations for one or more years only to then start up again in subsequent years are dropped from the data set. For example, firms with asset=0 in one year and then assets greater than zero in subsequent years are dropped from the data set. Similarly, firms whose employment levels fall below the survival threshold and then rebound in later years are also dropped from the analysis.

Adding employment greater than one and assets greater than zero to the existing measures of exit in T2LEAP, corrects for cases in which firms did not legally unincorporate in the same year their operations ceased, and for cases when production had ended but a low level of employment was retained while the firm was shutting down. A summary of the conditions for existence and survival is found in Table 2. Different definitions of existing firms and firm survival were tried, including, varying the number of employees in 1988 and 1987 required for a firm to exist, and the results are generally robust (see Appendix 1 for details).

Now that the population of firms existing when the FTA was implemented, and the criteria for survival have been established, the next step is to see which firms survive each of the subsequent years. Beginning in 1989 with the population of existing firms defined above, we will examine which firms are still alive at the beginning of the next year, and which exit during the given year. For each subsequent year of data, the population of existing firms, or firms at risk of exit during that year, is redefined as the survivors from the previous year. New entrants are not considered, but rather, what characteristics of existing firms allow them to survive and conversely, what causes firms to fail.[6] Since the last full year of data is 1995, and the definition of survival relies on data for the year *(t+1),* 1994 is the last year for which survival is measured. Firms still alive in 1995 (surviving to the end of 1994), six years after the implementation of the FTA, are the last group of firms considered in this study.

Most of the firm and industry level characteristics on the right hand side of equation (27) are readily available from our data set. Firm size is measured as the number of average labour units, or employees, that firm has. Leverage is measured by the debt to asset ratio and SIC dummies are included at the 2-digit level. Canadian and U.S. tariffs are aggregated at the 3-digit level and measured as decimals. However, of particular interest is the change in the level of protection a given industry experiences, so in year t the change in tariffs from year $t-1$ to year t is included as the tariff term. Since the FTA eliminated Canadian and U.S. tariffs using a relatively even reduction schedule over an approximately ten year period, the magnitude of the tariff decline from one year to the next is representative of the total change in protection experienced by that industry.

Measurement of the remaining right hand side variable, productivity, is more difficult. T2LEAP does not contain sufficient data for classical measures of total factor productivity (TFP), however, it is possible to calculate approximate total factor productivity (ATFP). Originally suggested by Griliches and Mairesse (1990), and more recently by Hall and Jones (1999), this measure of productivity is derived from a very simple Cobb-Douglas production function. Suppose that firm i has a certain productivity level A_i and produces output Y_i using capital K_i and labour L_i. That firm's production can be described as

$$Y_i = A_i K_i^{\alpha} L_i^{1-\alpha}. \qquad (28)$$

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6 Adding entrants to the population of firms at risk of exit each year does not change the direction or significance of the results, see Appendix 1.2 for details.

If we solve for productivity, A_i, and take the natural log of both sides, equation (28) can be re-written as

$$\ln(A_i) = \ln\left(\frac{Y_i}{L_i}\right) - \alpha \ln\left(\frac{K_i}{L_i}\right). \qquad (29)$$

Equation (29) describes the efficiency of the firm at turning inputs into outputs. This is comprised of the firm's labour productivity and how much capital each worker has at her disposal. The T2LEAP data set provides us with the means to measure this definition of efficiency. Labour productivity is measured as total sales divided by the number of employees (ALU). There is no measure of capital per worker in T2LEAP, however, there is a measure of total assets. Using total assets per worker instead of capital per worker is valuable in the sense that the productivity measure will be a combination of the firm's sales per employee and the total resources available to each employee, rather than simply capital. Accordingly, using assets per worker is a broad evaluation of the efficiency at which workers turn inputs into outputs using their available resources. Following Hall and Jones (1999) and the generally accepted convention that labour accounts for two thirds of GDP, α is set equal to one third,[7] and the natural log of ATFP for a given firm in year t is defined as

$$\ln(ATFP_t) = \ln\left(\frac{sales_t}{alu_t}\right) - \frac{1}{3}\ln\left(\frac{assets_t}{alu_t}\right), \qquad (30)$$

where alu_t is the average labour units or total employees of the firm, $sales_t$ is the total sales and $assets_t$ the total assets of that firm in year t.

For each year of data, the population of firms at risk at the beginning of the year is divided into those that survive the entire year and those that exit during the year. In order to accurately measure the characteristics of all firms, the values of each independent variable from the preceding year are used. This is necessary for all firms exiting during the given year, since the values recorded for that year will be partial reports (at some point during the year they have actually fallen to zero) rather than reports for the full year. In order to accurately compare survivors and exits, we must use variables recorded for the same length of time, and accordingly choose to use the previous year when all firms were in operation for the entire 12 month period.

We begin by looking at some descriptive statistics concerning the two groups of firms, those that survive and those that do not. Looking at the aggregate of firms that are still alive in 1995, and the sum of those that have exited in the previous six years, some interesting points arise. The mean decrease in Canadian tariff rates between 1995 and 1988 was 5.8%. If we compare firms in industries which experienced tariff changes in excess of 5.8%, we find 70% of those firms are still alive in 1995. However, for industries in which tariffs declined by less than 5.8%, 75% of firms survived to 1995. This effect is even more pronounced if firms are divided at the 75th percentile of tariff changes (those with declines above 6.6% and those below). For industries in which Canadian tariffs fell by less than 6.6% over the six year period, 76% survive to the end of

7 Other values of α were tried and the results are robust – see Appendix 2 for details.

the period. However, in industries with larger declines in tariffs, only 66% of firms survive. Consistent with Gu, Sawchuck and Whewell (2001) this indicates lower survival rates amongst firms experiencing higher declines in protection.

Table 3 compares the mean levels of employment, productivity, leverage and tariffs for firms that survive with those that exit in each year. For each variable, the presence of an asterisk in the exiting firm column indicates that the mean value of that variable for surviving firms is significantly different, at the 5% level, from the mean value for exiting firms. For all years and all variables, the means for surviving and exiting firms are significantly different. Surviving firms are larger, more productive and less leveraged than firms that exit. When considering the tariff terms, for all years, surviving firms experienced significantly smaller declines in protection. This is demonstrated by surviving firms having lower mean changes in both Canadian and American tariffs rates. The lower mean change in Canadian tariffs is as expected, but the lower change in American tariffs seems at first counter intuitive. In the previous section, it was suggested that falling American tariffs would be beneficial to firm survival. However, since Canadian and U.S. tariff changes are quite correlated, it is not unreasonable for a group experiencing lower mean changes in one, to also experience lower mean changes in the other. With the exception of the U.S. tariff changes, the comparison of means reported in Table 3 describes the populations of survivors and exits much as we might have expected. To examine the causality of these effects, we will turn now to regression analysis.

Table 4 contains the probit results explaining the probability of survival for a given firm. All of the financial variables are measured in natural logs. Year dummy variables are included in all specifications to account for macroeconomic fluctuations and other year specific effects that may influence firm survival. Columns 1 and 2 include firm level variables: the number of employees, the amount of leverage, and productivity as measured by ATFP, as well as the change in Canadian and American tariff rates. Subsequent columns portray the results when we add interaction terms.

The coefficients of the firm level control variables are consistent with our expectations. For all specifications, the productivity terms are positive and significant, consistent with the theory that more productive firms have an improved chance of survival. This is also consistent with Baldwin and Gu (2001) who find that firms exiting the Canadian manufacturing industry between 1988 and 1997 had labour productivity levels 30% below surviving firms. Baldwin and Gu (2001) also find that new plants that manage to survive are considerably more productive than those that fail, and considerably larger than new plants that fail. Here we are considering the survival of existing firms rather than entrants, however, larger firms are also found to have an increased probability of survival. Size, in this case measured by the number of employees, is significant and positive across specifications. Often, size is considered an approximation for efficiency as only efficient firms are able to survive and grow. However, here a larger number of employees contributes positively to survival even when controlling for productivity. Consistent with Zingales (1998), the regression results also show that even when controlling for firm efficiency or productivity, leverage has a significant and negative impact on the probability that a firm will survive.

TABLE 3: Comparison of the Mean Values of Key Variables for Survivors and Exits, by year.

	Number of Firms		Firm Size (=# of employees = ALU_{t-1})		Productivity $\ln(atfp_{t-1}) = \ln(sale_{t-1}/worker_{t-1}) - (1/3)\ln(assets_{t-1}/worker_{t-1})$		Leverage $=debt_{t-1}/asset_{t-1}$		Change in Canadian Tariffs $=\text{Cdn tariff}_{t-1} - \text{Cdn tariff}_{t}$		Change in American Tariffs $=\text{U.S. tariff}_{t-1} - \text{U.S. tariff}$	
	Number of Firms that **Survive**	Number of Firms that **Exit**	Mean for Firms that Survive	Mean for Firms that Exit	Mean for Firms that Survive	Mean for Firms that Exit	Mean for Firms that Survive	Mean for Firms that Exit	Mean for Firms that Survive	Mean for Firms that Exit	Mean for Firms that Survive	Mean for Firms that Exit
1989	25,764	909	65.5	46.1*	3.10	2.97*	0.661	1.13*	0.94%	0.99%*	0.44%	0.43%*
1990	23,967	1,797	64.4	30.4*	3.08	2.87*	0.655	1.78*	0.93%	1.01%*	0.43%	0.46%*
1991	22,748	1,219	63.6	17.8*	3.06	2.85*	0.657	2.34*	0.90%	0.98%*	0.41%	0.44%*
1992	21,708	1,040	63.6	24.7*	3.05	2.82*	0.683	1.33*	0.87%	0.97%*	0.40%	0.43%*
1993	20,615	1,093	64.9	20.8*	3.08	2.83*	0.658	1.54*	0.87%	0.96%*	0.40%	0.43%*
1994	19,228	1,387	69.7	18.5*	3.16	2.96*	0.636	1.17*	0.56%	0.65%*	0.27%	0.31%*

* = Mean for Exiting Firms is significantly different from Mean for Surviving Firms at the 5% level.

To investigate the main questions of this paper, we turn our attention to the tariff terms. The tariff terms pick up the amount by which protection in a given firm's industry has decreased during the post FTA period. For all specifications, the larger the decrease in Canadian tariffs (or the larger the decrease in protection for a given industry), the lower the probability of survival. This is consistent with the predictions of the Cournot segmented-market model, which indicates that falling tariffs in the home country decrease the profits earned by domestic firms staying in that industry. It is also consistent with Beaulieu (2001) who finds that industries experiencing the largest declines in Canadian tariff rates are those with higher exit rates. In columns 2 through 5 of Table 4, the coefficient of the change in U.S. tariffs is slightly larger than the Canadian tariff coefficient, significant and positive. This is again consistent with the theoretical model. The larger the decrease in U.S. tariffs (or the larger the opening of the U.S. market to Canadian firms in the given industry), the lower is the probability of death for Canadian firms.

The first two columns of Table 4 contain the firm level variables and tariff changes discussed so far and are identical with the exception of the inclusion of 2-digit level SIC dummies in column 2 and their exclusion from column 1. The addition of SIC dummy variables reduces the size of the Canadian tariff term and adds significance to the U.S. tariff term. SIC dummy variables are included in all remaining specifications and are discussed in more detail below.[8] Beginning in the third column, the interaction of industry level tariff changes with firm levels characteristics is considered. Column 3 adds terms interacting both Canadian and U.S. tariffs with the size of the firm, column 4 adds interaction terms for productivity and tariffs, and column 5 adds an interaction between leverage and tariffs. Column 5, which includes all three interactions as well as the variables already discussed, is chosen as the preferred specification and will be the focus of the remainder of the analysis.

Both the Canadian and U.S. tariff interactions with firm size are insignificant. This is contrary to Gu, Sawchuk and Whewell (2001) whose empirical findings suggest that FTA tariff cuts induce a significant net exit of large firms. However, the insignificance of the size interactions is consistent with Beaulieu (2001) who finds no evidence of firm size affecting the likelihood of survival in the post-FTA period.

The Canadian tariff interaction with productivity is positive and significant, suggesting that although falling Canadian tariffs decrease the probability of survival, this effect is smaller for firms with higher productivity. This is consistent with Melitz (1999) who finds that trade liberalization induces a net exit of low productivity firms, and with Gu, Sawchuck and Whewell (2001) who infer that the Canada-U.S. Free Trade Agreement specifically, increased the exit of less productive Canadian manufacturing firms. Here, the results indicate that reduced trade barriers, in the form of Canadian tariff reductions, led to a higher probability of survival amongst firms with higher productivity levels. Intuitively, we might also expect highly productive firms to be better equipped to benefit from falling U.S. tariffs, and survive and expand into the larger, more competitive marketplace. However, the interaction term for U.S. tariffs and productivity is negative and significant, suggesting that although falling U.S. tariffs are beneficial for firm survival, this effect is smaller for highly productive firms.

8 Results without industry fixed effects can be found in Appendix 2.

TABLE 4 – Survival during the post-FTA period
Dependent Variable: =0 if firm died in year *t*
=1 if firm survived

	Column 1	Column 2	Column 3	Column 4	Column 5
Size	0.27*	0.29*	0.29*	0.29*	0.29*
=ln(alu$_{(t-1)}$)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*
Productivity	0.31*	0.32*	0.32*	0.32*	0.31*
=ln(sale$_{(t-1)}$/alu$_{(t-1)}$) -(1/3) ln(asset$_{(t-1)}$/alu$_{(t-1)}$)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*
Leverage	-0.33*	-0.32*	-0.32*	-0.33*	-0.29*
=ln(debt$_{(t-1)}$/asset$_{(t-1)}$)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*
Canadian tariff change	-16.37*	-6.99*	-9.67*	-21.25*	-38.09*
=Ctar(*t-1*)-Ctar(*t*)	*(1.42)*	*(2.19)*	*(3.34)*	*(7.52)*	*(7.91)*
U.S. tariff change	1.69	21.80*	29.47*	58.06*	82.56*
=Utar(*t-1*)-Utar(*t*)	*(2.44)*	*(4.42)*	*(6.29)*	*(13.45)*	*(14.09)*
Size&Cdn tariff			1.20	1.31	1.34
=ln(alu$_{(t-1)}$)* Δctar			*(1.10)*	*(1.10)*	*(1.11)*
Size&U.S. tariff			-3.31	-3.68	-3.66
=ln(alu$_{(t-1)}$)* Δutar			*(1.94)*	*(1.94)*	*(1.95)*
Productive&Cdn tariff				3.86	7.29*
=ln(productivity$_{(t-1)}$*Δctar				*(2.22)*	*(2.28)*
Productive&U.S. tariff				-9.35**	-12.43*
= ln(productivity$_{(t-1)}$)* Δutar				*(3.89)*	*(2.99)*
Leverage&Cdn tariff					-13.80*
= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)* Δctar					*(1.90)*
Leverage&U.S. tariff					20.49*
= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)*Δutar					*(3.29)*
2 digit SIC dummies	NO	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES
Constant	0.44*	0.27*	0.27*	0.25*	0.29*
	(0.03)	*(0.04)*	*(0.04)*	*(0.06)*	*(0.06)*
R^2	0.134	0.14	0.14	0.14	0.141

Standard Errors are in parentheses.
*= significant at 1%,
** = significant at 5%.

One possible explanation for this result is that highly productive firms were already exporting to the U.S. prior to the FTA, while firms with lower productivity levels were not. Accordingly, although the decline in U.S. tariffs is beneficial to high productivity firms already in the export market, the decline in protection is even more valuable to low productivity firms for whom it provides an opportunity to enter the much larger U.S. market. This is consistent with Melitz (1999) who suggests that marginal firms derive greater benefit from trade liberalization as it allows them to enter export markets which were previously inaccessible to them.

From these results, it appears that higher productivity shelters firms from the effects of changing tariffs. Firms that are highly productive are neither as adversely affected by falling domestic protection levels, nor as favourably impacted by falling levels of protection for the foreign market. To examine the net effect of the FTA on more or less productive firms, consider the combined effect of the two productivity interactions. Although the U.S. term is larger, the change in U.S. tariffs is smaller, in fact, for 66% of manufacturing industries, the net effect is positive—indicating that more productive firms indeed had an improved chance of survival following the implementation of the FTA. However, for industries with larger declines in U.S. tariff rates relative to Canadian tariffs changes, we observe the opposite effect. In these cases, the FTA induced trade liberalization is creating more opportunities than threats for Canadian firms. They are receiving greater access to the American market without facing as substantial increases to competition at home. Accordingly, it is not unreasonable to find that trade liberalization does not act to influence the exit of firms with lower productivity levels, but rather provides relatively improved opportunities that allow less efficient firms to continue operating. These results are at least partially consistent with Melitz (1999) and Gu and Baldwin (2001) who suggest that trade liberalization increases the exit of less productive firms. Here, when trade liberalization can be equated with relatively increased competition, tariff reductions also increase the probability that low productivity firms will exit. However, for industries where the FTA disproportionately increased access to the foreign markets as compared with decreased protection at home, firms with lower levels of productivity are more likely to survive.

The final interaction term, leverage, is significant for both Canadian and U.S. tariffs. The results indicate that not only do Canadian tariff reductions reduce the probability of survival for firms in a given industry, but this effect is even larger for firms with more leverage. For the U.S. interaction term we find a similar result. U.S. tariff reductions increase the probability of survival, however, when interacted with high leverage, we see that this effect is even larger. For the case of Canadian tariff reductions, we might expect firms with larger debt to asset ratios to be less able to adjust to increased competition from foreign firms. Zingales (1998) shows that firms with higher leverage are less able to invest following an exogeneous shock and suggests that for a negative shock, this impediment to investment may contribute to exit.

The explanation for highly leveraged firms benefiting more from U.S. tariff reductions is less forthcoming. One possible explanation for this stems from the limited liability effect of debt financing.[9] When firm debt is high, shareholders will be less interested in the return firms get if they go bankrupt, as in this instance bondholders will be the residual claimants, and more interested in maximizing the return in good states where the owners reap the financial rewards. Accordingly, high debt firms will pursue strategies that raise returns in good states of the world

9 See for example: Jensen and Meckling (1976), Brander and Lewis (1986).

and lower returns in bad states. As a result, it is not surprising that high debt firms gain more advantage from a move towards a good state (increased market access from falling U.S. tariffs) as their strategies are designed to make the most of good changes in industry level effects. These same strategies may lead to highly leveraged firms experiencing greater damage in response to unfavourable industry changes, such as falling domestic protection. This risk taking behaviour in highly leveraged firms leads to these firms obtaining more benefit from the opportunities created by the FTA, and more harm from the threats, than firms with lower leverage levels. As is the case with productivity, we find that rather than interacting with tariff changes in a single direction, low leverage levels appear to insulate firms, making them less sensitive to the effect of falling tariffs.

Despite this, the net affect is again consistent with our theoretical predictions for most industries. For 72% of manufacturing industries, the combined effect of the two leverage and tariff interactions is negative, suggesting falling tariffs threaten the survival of highly leveraged firms more than firms with low leverage, consistent with Zingales (1998). However, for industries where the U.S. tariff change dominates the Canadian tariff change, the probability of survival for more highly leveraged firms benefits from the FTA. Like the case of low productivity firms, trade liberalization in industries that acquire relatively more opportunities than threats from the falling tariffs, facilitates improved chances for the survival of firms with higher levels of leverage.

Examining the relative magnitude of the coefficients for Canadian and U.S. tariff terms and their interactions, allows for measurement of the net effect of falling tariffs on firm survival in Canada following the FTA. For the tariff terms themselves, the U.S. tariff coefficient is larger, however, the declines in U.S. tariff rates are smaller, making the net effect much closer to zero than it initially appears. For 31% of firms in existence prior to the implementation of the agreement, the net effect of the FTA induced tariff changes on survival is negative. These firms operate in 35 industries and account for 36% of all manufacturing employment in 1988. However, by 1995, only 32% of manufacturing employees worked in those industries. For the remaining 69% of manufacturing firms, the net effect of the FTA on their probability of survival is observed to be positive.[10] This positive outcome obtained by most Canadian manufacturing firms is driven by the dominating effect of access to the U.S. market. It is interesting to note that while a negative net-effect of FTA tariff reductions was observed in industries such as furniture, paper, printing, plastics and fabricated metal, among others, many of the industries that were perceived as greatly threatened prior to the FTA had positive net effects. In particular, for primary textiles, textiles and clothing industries, all of which incurred large declines in protection, the net tariff reductions positively impact their probability of survival following the FTA.

In addition to tariff changes at the three-digit level, the industry effects for firm survival were also documented by two-digit SIC dummy variables. The coefficients of the SIC dummy variables are not shown in Table 4, but can be found in Appendix 4. Of the 22 two-digit industries considered, membership in 14 of those industries had a significant impact on a firm's probability of survival. This effect is observed even with the inclusion of tariff rates at the three-digit level. These results suggest that the industry in which a firm operates has important implications for its survival. Relative to firms operating in food industries, firms in primary textiles are almost twice as likely to

[10] A list of industries experiencing positive and negative net-FTA effects can be found in Appendix 3.

exit during a given year. In fact, clothing and textile related industries show some of the largest negative coefficients, suggesting that firms in those industries are less likely to survive, holding tariff changes constant. It is interesting to note that the low probability of survival associated with textile and clothing industries appears not to be a ramification of the FTA (the net tariff effect is positive), but rather the result of some other characteristic of that industry.

To determine if the earlier results are robust across different subsets of the manufacturing industry, particularly those which show significant implications for firm survival when holding firm characteristics and tariffs constant, the results were tested for a number of sub groups within the manufacturing industry. These sub-sectors include textiles and clothing[11], wood and furniture[12], as well as paper and printing[13]. The results indicate tariff effects of the same sign and similar magnitude as those reported here for manufacturing as a whole.

Several previous papers, including Trefler (2001) and Gu, Sawchuck and Whewell (2001), have considered the affects of the FTA on manufacturing in Canada using only the changes in Canadian tariffs. Since Canadian and U.S. tariff changes are to some degree collinear, and also correlated with broader trends in globalization, the argument has been that Canadian tariffs alone still comprehensively capture the implications of the FTA for Canadian firms. The theoretical structure developed in Section 3 predicts that foreign tariffs influence firm profits, and by extension firm survival, independent from the effects of domestic tariffs. In fact, our model suggests that foreign tariffs will affect firms in the opposing manner to domestic tariffs. Accordingly, since we expect foreign tariffs to influence firm survival and for their implications to diverge from domestic tariffs, it is sensible to include both variables in our empirical analysis. The results presented confirm that both foreign and domestic tariffs have significant, and opposing, influences on firm survival.

As a further check on the reliability of the results, and their comparability with previous work, the specifications in Table 4 were re-estimated using only Canadian tariff changes. The results of these regressions can be found in Appendix 2, Table A4. In general, the exclusion of the U.S. tariff terms has a limited impact on the remaining variables. The only substantive changes observed for the preferred model are the smaller coefficients on Canadian tariffs and their interactions, and the loss of significance for the Canadian tariff and productivity interaction. The addition of U.S. tariffs to the model appears to provide greater explanatory power, the ability to discern the magnitude and direction of both the opportunities and threats created by the FTA, and a more comprehensive picture of the implications of the Agreement for firm survival.

4.1 Firm or Industry?

In the strategy literature, there has been considerable effort to determine what is more important to firm performance—firm effects or industry effects.[14] Here, the empirical analysis has shown that firm and industry effects, as well as their interactions, are all influential in determining a

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[11] Textiles and Clothing: SIC codes 180,181,182,183,190,191,192,193,199,240,243,244,245,249.

[12] Wood and Furniture: SIC codes 250,251,252,254,256,258,259,260,261,264,269.

[13] Paper and Printing: SIC codes 270,271,272,273,279,280,281,282,283,284.

[14] See for example – McGahan (1999) and McGahan and Porter (1999).

firm's probability of survival. To determine the relative importance of the contribution made by firm and industry characteristics to the survival of firms, several factors are considered. First, the amount of variation explained by firm and industry characteristics alone is examined by comparing the log likelihood of the preferred model (Column 5 in Table 4) to those obtained when estimating survival using only industry or firm characteristics. Modifying the estimating equation to include only industry characteristics as explanatory variables, equation (27) becomes:

$$\Pr(survive) = \Phi\left[\varphi(\tau_{it}) + \delta(SIC_i) + \mu_t\right] \quad (31)$$

where, τ_{it} is the change in Canadian and U.S. tariffs, SIC_i indicates the two-digit SIC dummy variable for firm i's industry and μ_t is a year dummy variable. Similarly, removing industry characteristics from equation (27) allows us to estimate the probability of survival using only firm level variables:

$$\Pr(survive) = \Phi\left[\beta(X_{it}) + \mu_t\right] \quad (32)$$

where X_{it} is the set of firm specific characteristics, specifically, size, productivity and leverage.

Comparing the log likelihood of the preferred specification, including industry and firm characteristics as well as their interactions, with the specifications in equations (31) and (32), allows us to measure the contribution of industry and firm level attributes respectively, to a given firm's chance of survival. The log likelihood for equation (31) is approximately 4% smaller than the log likelihood for the preferred model, while the log likelihood for equation (32) is approximately 2% smaller. This suggests that, overall, firm level characteristics have a greater impact of the probability of survival than industry level characteristics. These results are consistent with McGahan (1999) who finds that firm level effects are about twice as important as industry level effects in determining performance.

To consider the effects of specific variables more carefully, the preferred specification is evaluated at the mean level of all variables. This provides an approximation of the probability of survival for a firm which embodies the average of all characteristics. For this firm, the probability of survival for a given year is estimated as 0.93. Increasing the size of the firm (ALU) by one standard deviation from the mean, while holding all other variables constant at their mean levels, increases the probability of survival by 0.034 to 0.964. Similarly, increasing the mean level of productivity by one standard deviation increases the probability of survival by 0.022, while decreasing the amount of leverage by one standard deviation increases the probability of survival by 0.025. All three firm level variables contribute positively to firm survival, however, a firm experiences the largest gain from a one standard deviation increase in its size.

Considering the industry level characteristics, we observe that they too are important contributors to firm survival. Decreasing the change in Canadian tariffs by one standard deviation (effectively decreasing the amount by which protection of the domestic industry declined) increases the probability of survival by 0.0022. Similarly, increasing the change in U.S. tariffs by one standard deviation raises the probability of survival by 0.0058. The increases in the probability of survival derived from favourable shifts in industry tariffs are an order of magnitude smaller than those obtained from comparable adjustments to firm level characteristics. This is partially attributable to the small size and standard deviation of tariff changes from one year to the next.

Comparing the influence of SIC dummy variables on firm survival is slightly more problematic. Since a firm is either in an industry or not, it is not feasible to consider a one standard deviation change in industry affiliation. However, by comparing the probability of survival for a firm possessing the average of all characteristics (including the average effect of industry affiliation) with a firm embodying the mean of all characteristics but operating in the industry most favourable for survival, some spectrum for comparison can be created. The most favourable industry is determined by examining the coefficients of the 2-digit SIC dummy variables in the preferred model. The industry with the largest positive coefficient, (SIC28 – Printing, Publishing and Allied Industries) is selected as the most favourable industry. As before, the probability of survival for an "average" firm with average industry effects is 0.93. For a firm operating in Printing, Publishing and Allied Industries, however, the probability of survival is 0.948. Accordingly, the probability of survival for a firm in the most favourable industry is 0.018 higher than for the same firm operating with average industry effects. This again suggests that firm effects are larger than industry effects. However, when we instead consider a change from the average to a firm operating in the least favourable industry (SIC18 – Primary Textile Industries), we see the probability of survival decrease by 0.081 to 0.849. This substantially larger decrease in the probability of survival suggests both that the median industry effect is much smaller than the mean industry effect and that in some cases, industry effects may be very important determinants of survival.

Generally speaking, these results indicate that for the comparatively short time horizon considered here, relative to the mean, firm level characteristics are more important than industry characteristics for survival. However, the range of survival probabilities across industries is quite large. It is not unreasonable to think that in the long run, consistent with McGahan (1999) and McGahan and Porter (1999), industry effects might be more influential in determining firm performance.

5. Conclusions

There has been much discussion, both in the popular press and the academic literature, of the implications of free trade with the United States for Canadian firms. Most of the economic analysis prior to the agreement predicted positive long term gains from the FTA[15]. Following the implementation of the Agreement, further studies have suggested that, among other things, tariff cuts have increased productivity, increased the rates of entry and exit but have not increased the output per firm in Canada. However, many questions surrounding the effect of the FTA remain unanswered.

This paper has considered the implications of the Canada-U.S. Free Trade Agreement for the survival of those Canadian manufacturing firms in existence prior to the FTA. The empirical results are largely consistent with Cournot model described in the second section of the paper and with the established theory surrounding firm survival and trade liberalization. As predicted, Canadian tariff reductions are associated with a decrease in the likelihood of survival, whereas U.S. tariff reductions have the opposite effect. The associated net effect of the FTA on firm

[15] See for example: Cox and Harris (1985).

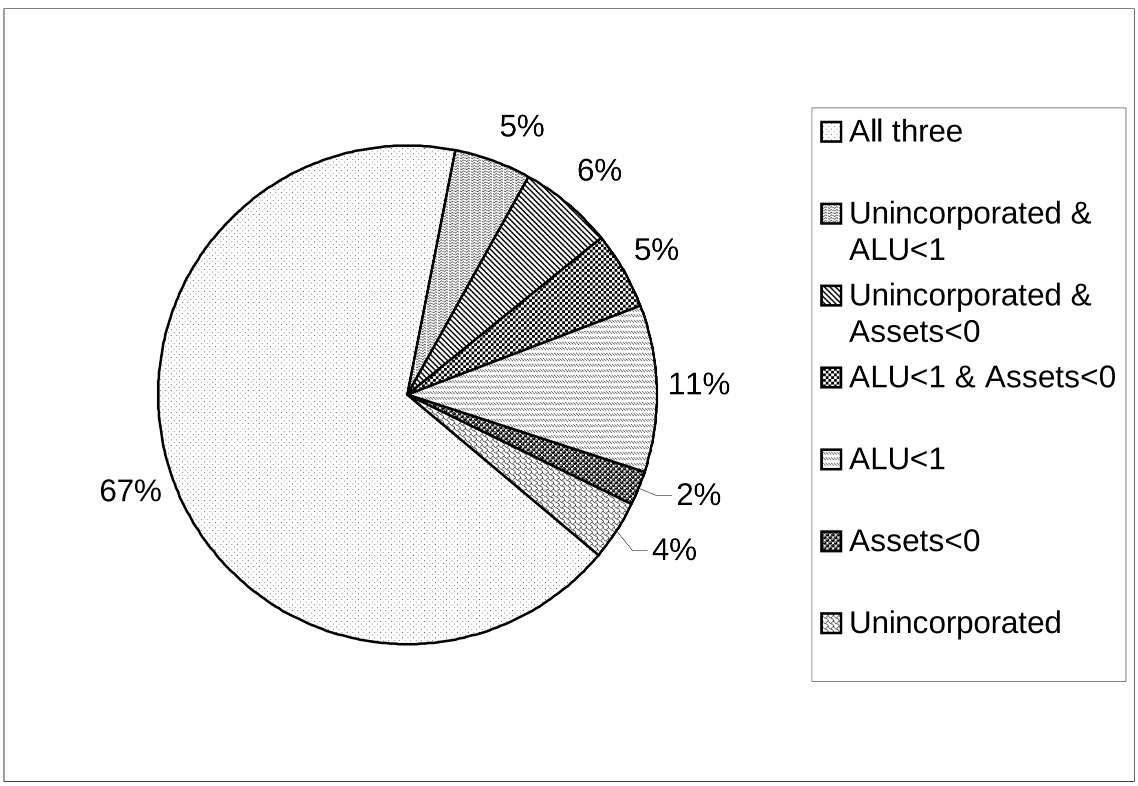
survival is positive for just over 2/3 of existing Canadian manufacturing firms. Larger, more productive firms have higher probabilities of survival and that highly leveraged firms have lower probabilities of survival. Somewhat surprisingly, firm size does not affect the sensitivity of firms to changes in tariffs. The regression analysis indicates that more productive firms are sheltered from both the positive and negative aspects of falling tariffs. For most industries, the net effect of tariff reductions has been to increase the probability of exit for low productivity firms. However, this result is not universal. Canadian firms operating in industries with disproportionately large declines in U.S. tariffs, find trade liberalization increasing the probability of survival for low productivity firms. Similarly, regression results initially suggest that low leverage levels insulate firms from the effects of falling tariffs. For most industries, the net effect of tariff reductions is associated with an increase in the probability of exit for low productivity firms. However, when considering the net effect of FTA tariff reductions, most industries see low leveraged firms with improved chances of survival. The exception being industries in which U.S. tariff decreases dominate the decline in domestic protection and provide opportunities for highly leveraged firms.

This analysis has shown that both firm and industry effects are important determinants of firm survival. On their own, firm level effects are noteworthy contributors to performance. However, the interaction between firm and industry characteristics also has substantial consequences. The effect of industry level tariff changes on the survival of individual firms is mitigated by the characteristics of those firms. A natural extension for further research would be an investigation of the role of entrants in the post-FTA period, paying particular attention to characteristics that differentiate entrants from exits and survivors. In addition, exploring the contributions of differing ownership structure, geographic location and export intensity would further enrich our understanding of which qualities promote survival following trade liberalization.

APPENDIX 1

To test the robustness of the definitions of both exit and existence, the model was re-estimated using a variety of modifications to those definitions. Varying the number of employees in 1987 and 1988 required for existence between one and three changed the magnitude of coefficients between 0.1% and 0.8% but the direction and significance were unaffected. Similar results were obtained when firms that were incorporated in 1988 but not in 1987 were added to the sample of existing firms. In terms of the criteria for exit listed in Table 1.2, firms are considered as exiting if they meet any one of three criteria. Figure A1.1 below compares which exiting firms meet all, two or only one of those three criteria. Sixty-seven percent of all firms recorded as "exits", exit by all three criteria—they are unincorporated, have less than one employee and have no assets. Of the 33% of firms that are recorded as "exits" but exit by fewer criteria, 16% exit by two of the three criteria and 17% exit by only one of the criteria. The largest group of exits meeting less than three criteria are those firms recorded as exits using only one measure: ALU<1. Re-estimating the preferred specification from Table 1.4, including the 11% of firms that exit by only the criteria of ALU<1 as survivors rather than exits, does not affect the significance and direction of coefficients. However, the magnitude of coefficients is, on average, 1% smaller and the coefficient of the size term (ALU) is 5% smaller.

FIGURE A1 – Exit by Category



APPENDIX 2

Robustness of Results to Different Specifications and Definitions

Inclusion of entrants in the population at risk of exit – TABLE A1:

The body of this paper analyzes the effect the FTA had for the survival of firms in existence prior to the implementation of the agreement in 1989. The population at risk of exit in each subsequent year is defined as the survivors from the previous year, and new entrants are not considered. Table A1 contains the same specifications as Table 4, however, the population of firms at risk of exit in each year is defined as the survivors from the previous year plus new entrants. Comparing the preferred specification (the last column in each table) across the two tables suggests that the addition of entrants does not alter the direction and significance of the results. However, the magnitude of the coefficients does change.

Including entrants decreases the magnitude of all coefficients and cuts the pseudo R^2 in half. The largest percentage change in magnitude occurs in the ALU or size coefficient, falling by 48%. Although we can not directly infer the marginal effects of a variable on the probability of survival, we can compare the relative effects of different variables. Including entrants in the regression leads to size being relatively less important in determining survival than when we consider only the population of incumbent firms. This is perhaps not surprising as entering firms are often small as a result of newness rather than failure to grow. So where size in Table 4 is more directly related to existing firms which have not become large, in Table A2 the size measure captures both the effect of smallness as a result of failure to grow and smallness as a result of newness. Since new firms may be otherwise viable and small size is simply a correlate of being new, when we include these small new firms, it is not surprising that size becomes relatively less important in determining survival. Compared with size, the other two firm effects, leverage and productivity, become more relatively important when entrants are added. Compared with Table 4, the coefficients of productivity and leverage fell by 32% and 34% respectively. From this we can infer that for entrants, size is a relatively less important determinant of survival but high productivity and low leverage are relatively more important.

In terms of the tariff terms and their interactions, the percentage change in coefficient magnitude from Table 4 to Table A1 is smaller than for firm level variables. The Canadian tariff coefficient and the Canadian tariff interactions are about 25% smaller in Table A1. However, the U.S. tariff coefficient and its interactions fall by about 20%. Accordingly, including entrants amplifies the market access effect relative to effects of falling domestic protection. This is consistent with new entrants in the post FTA period taking their full information about the FTA mandated tariff changes into consideration when choosing strategies or deciding to enter in the first place. These firms are able to take advantage of U.S. market access while avoiding reliance on domestic protection for survival.

Comparing Table 4 and Table A1 indicates that the direction and significance individual variables have for survival is robust across the population of firms already in operation when the FTA was implemented, and those firms combined with firms entering in the post FTA period. However, the relative importance of individual variable changes. Calculating the relative importance of firm and industry level variables as in Section 4.1 of the paper indicates a small increase in the importance of industry effects as compared with firm effects. However, in the short run considered here, firm effects remain more important.

Changing the definition of ATFP – Table A2:

In the body of the paper, ATFP is defined setting α=1/3 in accordance to the generally accepted convention of labour accounting for 2/3 of GDP. This is also consistent with the use of ATFP by Hall and Jones (1999). Although this 1/3 value is far from arbitrary, it is also instructive to test the robustness of the results to variations in the value of α. Table A2 reports one such variation, defining ATFP with α=1/4. Comparing the preferred specification in Table 4 with the same specification in Table A2 (the last column of each table) we see that the results are extremely similar, however the pseudo R^2 is somewhat smaller in Table A2.

Survival in the post-FTA period excluding SIC dummy variables – Table A3:

Excluding dummy variables for industry affiliation (at the 2-digit level) from the regressions does not change the coefficients of firm level variables to a great degree, however, it substantially alters the tariff terms and lowers the pseudo R^2. Although the same variables are significant in the preferred specification (the last columns of Table 4 and Table A3) and their signs do not change, the relative magnitude of the tariff coefficients and their interactions changes noticeably. Excluding industry affiliation leads to an increase in the size of Canadian tariff terms relative to American tariff terms. Without industry fixed effects, falling Canadian tariffs appear to result in much larger declines in the probability of survival, in most cases dominating the market access effect created by falling U.S. tariffs. When the SIC dummies are included, the industry effects not associated with falling tariffs are captured by the SIC code and both the U.S. and Canadian tariff terms are larger, with the market access effect largely dominating the decline in domestic protection.

Considering only Canadian tariffs and their interactions – Table A4:

Table A4 is discussed in the body of the paper. In general, compared with using only Canadian tariffs (Table A4), incorporating both Canadian and U.S. tariffs (Table 4) provides greater explanatory power, the ability to discern between the threats and opportunities created by the FTA, and creates a more comprehensive picture of the effects of the FTA for the survival of Canadian firms.

TABLE A1– Survival during the post-FTA period where the population at risk of exit in a given year is defined as the survivors from the previous year plus *entrants*

	Column 1	Column 2	Column 3	Column 4
Size **=ln(alu$_{(t-1)}$)**	0.10* *(0.01)*	0.12* *(0.01)*	0.14* *(0.01)*	0.15* *(0.01)*
Productivity **=ln(sale$_{(t-1)}$/alu$_{(t-1)}$) -(1/3) ln(asset$_{(t-1)}$/alu$_{(t-1)}$)**	0.18* *(0.01)*	0.18* *(0.01)*	0.21* *(0.01)*	0.21* *(0.01)*
Leverage **=ln(debt$_{(t-1)}$/asset$_{(t-1)}$)**	-0.18* *(0.01)*	-0.18* *(0.01)*	-0.18* *(0.01)*	-0.19* *(0.01)*
Canadian tariff change **=Ctar(*t-1*)-Ctar(*t*)**	-15.24* *(1.11)*	-17.11* *(2.80)*	-20.23* *(7.44)*	-27.64* *(7.64)*
U.S. tariff change **=Utar(*t-1*)-Utar(*t*)**	5.28* *(1.86)*	19.22* *(4.94)*	47.52* *(12.68)*	65.32* *(13.03)*
Size&Cdn tariff **=ln(alu$_{(t-1)}$)* Δctar**		0.55 *(0.84)*	0.31 *(0.90)*	0.22 *(0.84)*
Size&U.S. tariff **=ln(alu$_{(t-1)}$)* Δutar**		-0.18 *(1.39)*	-0.88 *(0.91)*	0.12 *(1.39)*
Productive&Cdn tariff **=ln(productivity$_{(t-1)}$*Δctar**			1.13 *(2.24)*	5.55* *(1.43)*
Productive&U.S. tariff **= ln(productivity$_{(t-1)}$)* Δutar**			-8.96** *(3.76)*	-9.95* *(2.79)*
Leverage&Cdn tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)* Δctar**				-10.17* *(1.69)*
Leverage&U.S. tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)*Δutar**				16.29* *(2.80)*
2 digit SIC dummies	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES
Constant	0.12* *(0.03)*	0.07** *(0.04)*	0.15* *(0.06)*	0.27* *(0.06)*
R^2	0.07	0.07	0.07	0.071

Standard Errors are in parentheses.
*= significant at 1%,
** = significant at 5%.

TABLE A2 – Survival during the post-FTA period, alternate definition of ATFP:

$$\ln(ATFP_t) = \ln\left(\frac{sales_t}{alu_t}\right) - \frac{1}{4}\ln\left(\frac{assets_t}{alu_t}\right)$$

	Column 1	Column 2	Column 3	Column 4	Column 5
Size **=ln(alu$_{(t-1)}$)**	0.27* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*
Productivity **=ln(sale$_{(t-1)}$/alu$_{(t-1)}$) -(1/4) ln(asset$_{(t-1)}$/alu$_{(t-1)}$)**	0.29* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*	0.29* *(0.01)*
Leverage **=ln(debt$_{(t-1)}$/asset$_{(t-1)}$)**	-0.32* *(0.01)*	-0.31* *(0.01)*	-0.31* *(0.01)*	-0.32* *(0.01)*	-0.28* *(0.01)*
Canadian tariff change **=Ctar(*t-1*)-Ctar(*t*)**	-16.55* *(1.40)*	-6.54* *(2.19)*	-9.37* *(3.34)*	-24.23* *(7.90)*	-39.51* *(8.22)*
U.S. tariff change **=Utar(*t-1*)-Utar(*t*)**	4.57 *(3.24)*	21.05* *(4.42)*	28.82* *(6.29)*	60.55* *(14.08)*	82.36* *(14.62)*
Size&Cdn tariff **=ln(alu$_{(t-1)}$)* Δctar**			1.27 *(1.10)*	1.43 *(1.11)*	1.45 *(1.11)*
Size&U.S. tariff **=ln(alu$_{(t-1)}$)* Δutar**			-3.36 *(1.94)*	-3.77 *(1.94)*	-3.73 *(1.95)*
Productive&Cdn tariff **=ln(productivity$_{(t-1)}$*Δctar**				4.47** *(2.13)*	7.14* *(2.18)*
Productive&U.S. tariff **= ln(productivity$_{(t-1)}$)* Δutar**				-9.42** *(3.74)*	-13.31* *(3.81)*
Leverage&Cdn tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)* Δctar**					-13.56* *(1.88)*
Leverage&U.S. tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)*Δutar**					18.87* *(3.27)*
2 digit SIC dummies	NO	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES
Constant	0.41* *(0.02)*	0.27* *(0.04)*	0.27* *(0.05)*	0.26* *(0.06)*	0.30* *(0.06)*
R^2	0.13	0.139	0.139	0.139	0.139

Standard Errors are in parentheses.
*= significant at 1%,
** = significant at 5%.

TABLE A3 – Survival during the post-FTA period WITHOUT SIC CODES
Dependent Variable: =0 if firm died in year *t*
=1 if firm survived

	Column 1	Column 2	Column 3	Column 4
Size **=ln(alu$_{(t-1)}$)**	0.27* *(0.01)*	0.28* *(0.01)*	0.28* *(0.01)*	0.28* *(0.01)*
Productivity **=ln(sale$_{(t-1)}$/alu$_{(t-1)}$) -(1/3) ln(asset$_{(t-1)}$/alu$_{(t-1)}$)**	0.31* *(0.01)*	0.31* *(0.01)*	0.31* *(0.01)*	0.30* *(0.01)*
Leverage **=ln(debt$_{(t-1)}$/asset$_{(t-1)}$)**	-0.33* *(0.01)*	-0.33* *(0.01)*	-0.33* *(0.01)*	-0.28* *(0.01)*
Canadian tariff change **=Ctar(*t-1*)-Ctar(*t*)**	-16.37* *(1.42)*	-20.67* *(2.93)*	-34.19* *(7.29)*	-51.27* *(7.63)*
U.S. tariff change **=Utar(*t-1*)-Utar(*t*)**	1.69 *(2.44)*	13.32* *(6.29)*	39.37* *(12.55)*	63.10* *(13.05)*
Size&Cdn tariff **=ln(alu$_{(t-1)}$)* Δctar**		1.87 *(1.09)*	1.99 *(1.09)*	2.01 *(1.10)*
Size&U.S. tariff **=ln(alu$_{(t-1)}$)* Δutar**		-4.98 *(1.90)*	-5.22 *(2.90)*	-5.15 *(1.89)*
Productive&Cdn tariff **=ln(productivity$_{(t-1)}$*Δctar**			4.49** *(2.20)*	8.01* *(2.25)*
Productive&U.S. tariff **= ln(productivity$_{(t-1)}$)* Δutar**			-8.67** *(3.82)*	-13.58* *(2.99)*
Leverage&Cdn tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)* Δctar**				-14.62* *(1.89)*
Leverage&U.S. tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)*Δutar**				20.84* *(3.25)*
2 digit SIC dummies	NO	NO	NO	NO
Year Dummies	YES	YES	YES	YES
Constant	0.44* *(0.03)*	0.43* *(0.04)*	0.44* *(0.05)*	0.49* *(0.05)*
R^2	0.134	0.134	0.134	0.135

Standard Errors are in parentheses.
*= significant at 1%,
** = significant at 5%.

TABLE A4 – Survival during the post-FTA period (Canadian Tariffs ONLY)
Dependent Variable: =0 if firm died in year *t*
=1 if firm survived

	Column 1	Column 2	Column 3	Column 4
Size **=ln(alu$_{(t-1)}$)**	0.27* *(0.01)*	0.28* *(0.01)*	0.28* *(0.01)*	0.28* *(0.01)*
Productivity **=ln(sale$_{(t-1)}$/alu$_{(t-1)}$) -(1/3) ln(asset$_{(t-1)}$/alu$_{(t-1)}$)**	0.31* *(0.01)*	0.31* *(0.01)*	0.31* *(0.01)*	0.30* *(0.01)*
Leverage **=ln(debt$_{(t-1)}$/asset$_{(t-1)}$)**	-0.33* *(0.01)*	-0.33* *(0.01)*	-0.33* *(0.01)*	-0.28* *(0.01)*
Canadian tariff change **=Ctar(*t-1*)-Ctar(*t*)**	-15.61* *(0.90)*	-14.68* *(1.85)*	-22.62* *(3.97)*	-21.89* *(4.51)*
Size&Cdn tariff **=ln(alu$_{(t-1)}$)* Δctar**		-0.38 *(0.67)*	-0.36 *(0.67)*	-0.23 *(0.67)*
Productive&Cdn tariff **=ln(productivity$_{(t-1)}$*Δctar**			0.43 *(1.25)*	1.53 *(1.28)*
Leverage&Cdn tariff **= ln(debt$_{(t-1)}$/asset$_{(t-1)}$)* Δctar**				-4.84* *(1.11)*
2 digit SIC dummies	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES
Constant	0.44* *(0.03)*	0.43* *(0.04)*	0.44* *(0.05)*	0.50* *(0.05)*
R^2	0.134	0.134	0.134	0.135

Standard Errors are in parentheses.
*= significant at 1%,
** = significant at 5%.

APPENDIX 3

The Sign of the Net Effect of FTA Tariff Reductions for Firm Survival by Industry

Industries where the net effect of the FTA was negative (31% of firms):

Bakery Products: 107
Soft Drinks: 111
Rubber: 151, 152
Plastics: 161, 162, 163, 169
Sawmill & Other Mills: 251
Furniture: 261, 264, 269
Paper & Allied Products: 271, 272, 273, 279
Printing, Publishing, etc: 281, 282
Fabricated Metal: 302, 303. 304, 305, 307, 309
Transportation: 323, 324, 327, 328, 329
Non-Metal Mineral: 354, 356, 357
Soap, Cleaning & Toilet Preparation: 375, 376
Other Manufacturing Products: 399

Industries where the net effect of the FTA was positive:

Food Industries: 101, 102, 103, 104, 105, 106, 108, 109
Distillery Products, Brewery Products & Wine: 112, 113, 114
Tobacco Products: 121, 122
Other Rubber: 159
Leather & Allied Products Industries: 171
Primary Textiles: 181, 182, 183
Textile Products: 191, 192, 193, 199
Clothing: 243, 244, 245, 249
Wood: 252, 254, 256, 258, 259
Publishing: 283, 284
Primary Metals: 291, 292, 294, 295, 296, 297, 299
Power Boiler, Hardware & Machine Shop: 301, 306, 308
Machine Industries: 311, 312, 319
Aircraft, Motor Vehicle Parts & Railroad: 321, 325, 326
Electrical: 331, 332, 333, 334, 335, 336, 337, 338, 339
Non-Metal Mineral: 351, 352, 355, 358, 359
Refined Petroleum & Coal: 361, 369
Chemical: 371, 372, 373, 374, 377, 379
Other Manufacturing: 391, 392, 393, 397

APPENDIX 4

<u>Detailed Regression Results for the Preferred Model (Column 5, Table 4), Including the SIC Dummy Variables</u>

Dependent variable: dummy=1 if firm survives
=0 if firm exits

Number of obs = 141475
LR chi2(37) = 12057.94
Prob > chi2 = 0.0000
Pseudo R2 = 0.1408

Log likelihood = -36775.46

surv	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln(alu)	.2881886	.0073144	39.400	0.000	.2738526	.3025246
ln(atfp)	.3141049	.0133349	23.555	0.000	.287969	.34024071
ln(leverage)	-.2896887	.0115823	-25.011	0.000	-.3123896	-.2669871
Ctar(diff)	-38.09229	7.912475	-4.814	0.000	-53.60046	-22.58411
Utar(diff)	82.55558	14.08806	5.860	0.000	54.9435	110.1677
ctar*ln(alu)	1.340118	1.107386	1.210	0.226	-.8303186	3.510556
utar*ln(alu)	-3.65863	1.946843	-1.879	0.060	-7.474374	.1571088
ctar*ln(atfp)	7.292039	2.280387	3.198	0.001	2.822563	11.76152
utar*ln(atfp)	-14.43135	3.991487	-3.616	0.000	-22.25453	-6.60818
ctar*ln(lev)	-13.7990	1.89999	-7.263	0.000	-17.52295	-10.07513
utar*ln(lev)	20.4936	3.29088	6.227	0.000	14.04358	26.94361
yr90	-.7525557	.0228927	-32.873	0.000	-.7974245	-.7076869
yr91	-.8535739	.0226381	-37.705	0.000	-.8979438	-.8092041
yr92	-.7775073	.0229407	-33.892	0.000	-.8224702	-.7325444
yr93	-.7847706	.0230962	-33.978	0.000	-.8300382	-.7395029
yr94	-.9320548	.0236438	-39.421	0.000	-.9783958	-.8857138
sic11	-.461026	.0730123	-6.314	0.000	-.6041274	-.3179246
sic12	-.0065912	.3763281	-0.018	0.986	-.7441807	.7309983
sic15	-.0346862	.0757022	-0.458	0.647	-.1830599	.1136875
sic16	-.0599049	.0356395	-1.681	0.093	-.1297569	.0099472
sic17	-.3805526	.0608395	-6.255	0.000	-.4997958	-.2613094
sic18	-.5175628	.0760925	-6.802	0.000	-.6667013	-.3684243
sic19	-.2345745	.0396085	-5.922	0.000	-.3122059	-.1569432
sic24	-.4275087	.0387423	-11.035	0.000	-.5034422	-.3515753
sic25	-.0515591	.0262955	-1.961	0.050	-.1030973	-.0000209
sic26	-.1701805	.0380973	-4.467	0.000	-.2448498	-.0955111
sic27	-.1258725	.0523066	-2.406	0.016	-.2283916	-.0233534
sic28	.1267568	.0257947	4.914	0.000	.0762001	.1773135
sic29	-.1031929	.0561196	-1.839	0.066	-.2131852	.0067994
sic30	.0676781	.0241334	2.804	0.005	.0203774	.1149787
sic31	-.0607978	.02911	-2.089	0.037	-.1178523	-.0037434
sic32	-.081172	.0336285	-2.414	0.016	-.1470827	-.0152613
sic33	-.2020649	.0323749	-6.241	0.000	-.2655186	-.1386113
sic35	.0240011	.0338391	0.709	0.478	-.0423224	.0903246
sic36	.0781597	.1435987	0.544	0.586	-.2032885	.3596079
sic37	-.1993853	.0375665	-5.308	0.000	-.2730143	-.1257562
sic39	.0500525	.0276861	1.808	0.071	-.0042113	.1043164
constant	.2932678	.0569483	5.150	0.000	.1816511	.4048845

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