The Long-Run Labor Market Effects of the Canada-U.S. Free Trade Agreement*

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Abstract

This paper assesses the long-run effects of the 1989 Canada-U.S. Free Trade Agreement (CUSFTA) on the Canadian labor market using matched longitudinal administrative data for the years 1984-2004. We simultaneously examine the labor market effects of increased export expansion and import competition, generally finding adverse effects of Canadian tariff cuts and favorable effects of U.S. cuts, though both effects are small. Workers initially employed in industries that experienced larger Canadian tariff concessions exhibit a heightened probability of layoffs at large firms, but little impact on long-run cumulative earnings. Lower earnings and years worked at the initial employer are offset by gains in other manufacturing industries, construction, and services. Canadian workers quickly transitioned out of industries facing import competition, with the bilateral nature of the FTA providing import-competing workers employment options in alternative manufacturing industries benefiting from larger U.S. tariff cuts.

JEL codes: F13, F16, F66, J23, J31 **Keywords:** Trade policy, Free trade agreement, Employment, Earnings, Canada, Firm Heterogeneity

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1 Introduction

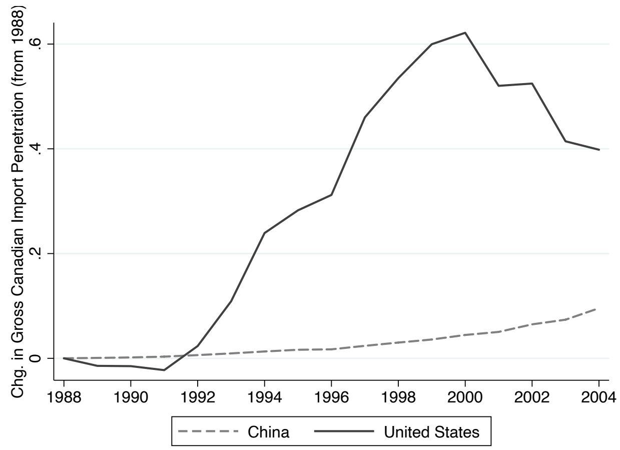
While international economists have long studied the distributional consequences of trade liberalization, traditional approaches assumed full employment and costless worker transitions (Stolper and Samuelson, 1941). However, recent empirical findings by Autor, Dorn, Hanson and Song (2014), Dix-Carneiro and Kovak (2017), and many others have documented persistently depressed labor market outcomes for workers and regions facing increased import competition.[1] The consistency of this finding across different research designs, trade shocks, and countries has led to growing pessimism regarding the path of worker adjustment following trade shocks.

In this paper, we document the short- and long-run labor market effects of the 1989 Canada-U.S. Free Trade Agreement (FTA). While this shock generated changes in trade flows that were at least as large as those studied in prior research (see our discussion of Figure 1 below), we find starkly different effects on Canadian workers than one might expect given the recent literature. While Canadian tariff cuts led to an increased likelihood of layoff and reduced earnings from workers' initial employers, workers quickly recovered lost earnings by transitioning to other firms, industries, and sectors. Canadian tariff reductions did not lower total years worked or cumulative earnings for workers during the 16 years following the FTA's enactment, and the reciprocal U.S. tariff reductions tended to offset the modest negative effects of Canadian tariff cuts on average. In other words, the tariff cuts had the expected effects, but worker adjustment to changing labor demand was relatively speedy and successful.

We carry out this study using 21 years of high-quality, longitudinal, matched worker-firm administrative data from Statistics Canada covering 1984-2004. We apply the research design of Autor et al. (2014) to the context of bilateral changes in trade policy by comparing the career trajectories of otherwise similar workers initially employed in industries that were subsequently subject to different Canadian and United States tariff concessions legislated by the FTA. The bilateral nature of this agreement allows us to study the effects of both import competition and export expansion in response to a policy change. We examine a large number of individual-level labor market outcomes includ-

[1] Autor et al. (2021) and Dix-Carneiro and Kovak (2017) examine long-run persistence in the regional impacts of import competition. Autor et al. (2014), Dix-Carneiro and Kovak (2019), Pierce et al. (2020), and Utar (2018) show similar persistent effects at the worker level. Many other papers document depressed labor market outcomes in regions facing increased import competition but do not focus on persistence, including Autor et al. (2013a), Dauth et al. (2014, 2021), Hakobyan and McLaren (2016), Kovak (2013), Topalova (2010), Utar (2014), and many others (see Autor et al. (2016) for a survey).

Figure 1: Import Penetration Ratio for Canadian Imports from China and the U.S.



Notes: The y-axis plots the change in Canadian import penetration accounted for by Chinese or U.S. imports from 1988 to the year on the x-axis. Specifically, it follows Autor et al. (2014) equation (1) by plotting $(\text{imports}^c_t - \text{imports}^c_{1988})/(\text{absorption}_{1988})$, where $c \in$ {China,U.S.} and absorption is industry output plus imports minus exports. All values deflated to 1988 dollars using the Canadian CPI.

ing displacement, years worked, cumulative earnings, and transitions into other firms, other industries, or unemployment during the 16 years following the FTA's implementation. Because our sample starts in 1984, we can control for a variety of initial conditions and pre-trends including worker, firm, and industry wage trajectories, firm and industry employment trajectories, and capital intensity.

The CUSFTA provides a nearly ideal setting in which to study the causal effects of changing bilateral trade policy (Trefler, 2004). The Agreement cut tariffs to zero on nearly all non-agricultural trade between Canada and the U.S., with minimal changes to non-tariff barriers for trade in goods. The FTA was not part of a larger reform package, nor was it passed in response to a crisis or other macroeconomic shocks. As we will show, the tariff changes were not confounded by pre-existing trends in industry performance. Given the large size of the U.S. economy in comparison to Canada's, the FTA drove substantial increases in trade from the Canadian perspective. Figure 1 shows that U.S. import penetration in Canada increased by 40 percentage points from 1988 to 2004. This is roughly 4 times larger than the growth in Chinese import penetration in Canada during this period and the growth in Chinese import penetration in the U.S. during 1991-2011 (Autor et al., 2014, Table I).

We find that workers initially employed in manufacturing industries that subsequently lost tariff protection in Canada experienced an increased probability of a job separation, while those facing U.S. tariff concessions had lower probabilities of separation. For example, an interquartile (25^{th} to 75^{th} percentile) increase in the size of the Canadian tariff cut caused a 3 percentage point higher layoff probability for workers with low labor force attachment initially employed at large firms. For the same group, an interquartile increase in the U.S. tariff concession led to a 2 percentage point lower layoff probability. Thus, the adverse effects of increased import competition and the favorable effects of increased access to the U.S. export market partly offset each other on average. These effects on workers' outcomes at their initial firms are consistent with the large effects of the FTA on plant exit and plant employment documented in Head and Ries (1999) and Trefler (2004).

In spite of the changes in the probability of separating from one's initial employer, we find little effect on total years worked or on cumulative earnings during the 16 years following the FTA's implementation. Consistent with the separation results, larger Canadian tariff cuts did indeed reduce years worked and earnings at the initial employer and at other firms in the initial industry. However, these losses were fully offset by increased years worked and earnings in other manufacturing industries, construction, and services. Moreover, the favorable effects of U.S. tariff reductions also offset the losses from Canadian cuts on average, leading to a very small net impact on workers' employment and earnings.

These findings contrast with the large and persistent effects of the China Shock in Autor et al. (2014) or of Brazilian trade liberalization in Dix-Carneiro and Kovak (2017).[2] In one sense, our results are more in line with those of Dauth et al. (2014, 2017, 2021), who find offsetting effects of increased import and export flows in the German context. We similarly find that the effects of increased export market access offset those of import competition on average. However, our results are distinct in finding a stronger role for worker adjustment across industries. Although Canadian workers face substantial effects of tariff cuts on employment and earnings in their initial firms and industries, the effects of each tariff change on overall cumulative earnings and employment are small because Canadian workers are able to fully offset gains or losses by shifting to other industries including within manufacturing. While German workers also exhibited transitions, these were insufficient to fully offset the effects of trade shocks in their initial industry.

To understand these contrasting results, we first rule out four potential explanations for our finding of small overall effects: i) FTA tariff changes were too small to drive substantial

[2] As discussed in Section 5.4, the earnings effects we document for high-attachment workers are an order of magnitude smaller than the parallel effects of the China Shock in the U.S. documented by Autor et al. (2014). In addition, Autor et al. (2021) extend the results of Autor et al. (2013a) forward 12 years to 2019. They find persistent regional effects of the China Shock through the end of this sample period in spite of U.S. imports from China plateauing after 2012.

effects, ii) U.S. and Canadian tariff changes offset *within* each industry, iii) Canada's industrial geography (relative to the U.S.) facilitated transitions across industries, and iv) the FTA was implemented in the midst of a strong labor market. After ruling out these explanations, we present four findings explaining the relatively smooth labor market adjustment in Canada. First, Canadian workers quickly moved from industries facing large increases in import competition to industries facing smaller shocks, in contrast to the U.S. experience (Autor et al., 2014). Second, we find evidence that the bilateral nature of the FTA facilitated import-competing Canadian workers' successful transitions. Workers subject to Canadian tariff cuts were able to replace lost years of employment by transitioning to closely related industries benefiting from U.S. tariff cuts, where we measure industry relatedness based on pre-FTA worker transitions, as in Borusyak et al. (2022). Third, the CUSFTA tariff changes did not induce mass layoffs. Fourth, total industry-level employment did respond to import competition, but these adjustments occurred primarily among new entrants to the labor market rather than among incumbent workers. We also find that the China Shock in Canada increased mass layoffs and affected both incumbent and newly entering workers' employment, suggesting that the Canadian labor market does not adjust smoothly to all import competition shocks, which reinforces the importance of the FTA's bilateral nature.

As in the prior empirical work on the CUSFTA, firm size plays an important role (Head and Ries, 1999; Beaulieu, 2003; Trefler, 2004).[3] Canonical models of heterogeneous firms and trade, such as Melitz (2003) and its asymmetric-country extension in Demidova and Rodríguez-Clare (2013), predict that larger Canadian firms should benefit most from increased access to the U.S. export market because those more productive firms can bear the fixed costs of exporting. Our results confirm this prediction: workers initially employed at larger firms experience bigger reductions in the probability of separation when facing larger U.S. tariff reductions. However, in contrast to the canonical models, larger firms also exhibit the biggest increases in separations when facing larger Canadian tariff reductions. As discussed below, this surprising result is consistent with the empirical findings of Head and Ries (1999), Autor et al. (2013b), and Pierce et al. (2020), and can be rationalized by the niche-market mechanism formalized by Holmes and Stevens (2014) and the complementary product-cycle arguments of Eriksson et al. (2021). Our heterogeneity analysis also reveals that while the tariff cuts had small effects on average, a relatively small group of workers, those with low labor force attachment initially employed at large

[3] See Kovak and Morrow (2022) for an extended literature review.

firms, have nontrivial effects of both Canadian and U.S. tariff cuts. However, the adverse effects of Canadian tariff reductions and the favorable effects of U.S. cuts have very similar magnitudes for this group of workers, so the net effects of the FTA remain close to zero on average.

This study possesses three virtues relative to the existing literature. First, it examines the effects of a well-defined policy change, so our findings can inform ongoing trade policy debates. In this sense, it is most closely linked to studies analyzing the effect of the NAFTA on various aspects of the American, Canadian, and Mexican economies (e.g. Hanson (2003), Chiquiar (2008), and Hakobyan and McLaren (2016)), the effect of trade liberalization in developing countries (e.g. McCaig (2011), Brambilla et al. (2012), and McCaig and Pavcnik (2018) for Vietnam, Topalova (2007, 2010) for India, and Kovak (2013) and Dix-Carneiro and Kovak (2017) for Brazil), and the end of the Multi Fibre Arrangement (e.g. Harrigan and Barrows (2009) and Utar (2014, 2018)).

Second, because of the bilateral nature of the CUSFTA, we are able to examine the effects of increased access to U.S. export markets along with the effects of increased import competition in Canada. All of our analyses simultaneously include measures of Canada's tariff cuts facing U.S. exports and measures of U.S. tariff cuts facing Canadian exports. Studies examining unilateral trade liberalizations are often restricted to studying the effects of imports alone, and those studying both imports and exports generally examine changes in trade flows rather than explicit trade policy changes.[4] In addition, we present evidence that bilateral U.S. tariff cuts in related industries that are linked by pre-FTA worker transitions helped Canadian workers stay within manufacturing, lessening the quantity of workers that would need to be absorbed into services to maintain full employment. Therefore, we contribute an analysis of an explicit trade policy change that substantially and simultaneously affects both import competition and access to an important export market.[5]

Third, by relying on longitudinal matched employee-firm data, we can examine where displaced workers went and whether these displacements affected their long-run earnings. In this sense our work is distinct from all the papers we are aware of examining the effects of the CUSFTA on the Canadian economy, which focus on outcomes at the plant

[4]See, for example, Baziki et al. (2021), Biscourp and Kramarz (2007), Costa et al. (2016), Dauth et al. (2014), Dauth et al. (2021), and Hummels et al. (2012). Feenstra et al. (2019) study the effect of increased exports to China from the U.S.

[5]Our analysis is most closely related to a robustness test in McCaig and Pavcnik (2018) that considers the effects of tariff changes in the U.S. and Vietnam as part of the U.S.-Vietnam Bilateral Trade Agreement, though they use repeated cross-sections rather than longitudinal data.

or industry level (e.g. Gaston and Trefler (1997), Head and Ries (1999), Beaulieu (2003), Trefler (2004), and Lileeva (2008)), and the vast majority of papers studying other policy-based trade liberalization episodes, although Utar (2014, 2018) and Dix-Carneiro and Kovak (2017) are notable exceptions.

2 The Canada-U.S. Free Trade Agreement

The Canada-US Free Trade Agreement was signed on January 2, 1988 by Canadian Prime Minister Brian Mulroney and U.S. President Ronald Reagan.[6] The Agreement went into effect on January 1, 1989, phasing out tariffs for nearly all non-agricultural goods traded between Canada and the U.S. In addition to tariff cuts, the agreement liberalized foreign investment in Canada, required nondiscrimination in new regulations applying to the service sector and to foreign investment, and created an appeals mechanism to ensure appropriate application of treaty commitments, along with a variety of other minor provisions (Copeland, 1989).[7]

The tariff cuts were phased in from 1989 to 1998. Online Appendix Figure A1 presents the evolution of Canadian tariffs on U.S. manufacturing exports and U.S. tariffs on Canadian manufacturing exports between 1988 and 1998.[8] For simplicity, we refer to Canadian tariffs on U.S. exports as "Canadian tariffs" and U.S. tariffs on Canadian exports as "U.S. tariffs" except where explicitly stated. In 1988, Canadian tariffs varied greatly, with those in the 95th percentile seeing protection of more than 20 percent, while the least protected industries already had zero tariffs. Average Canadian tariffs declined from approximately 9 percent in 1988 to zero in nearly all product categories in 1998. Figure A1 also graphs the corresponding U.S. tariff cuts. While U.S. tariffs were initially much lower (≈ 3 percent), their mean and variance fell similarly.

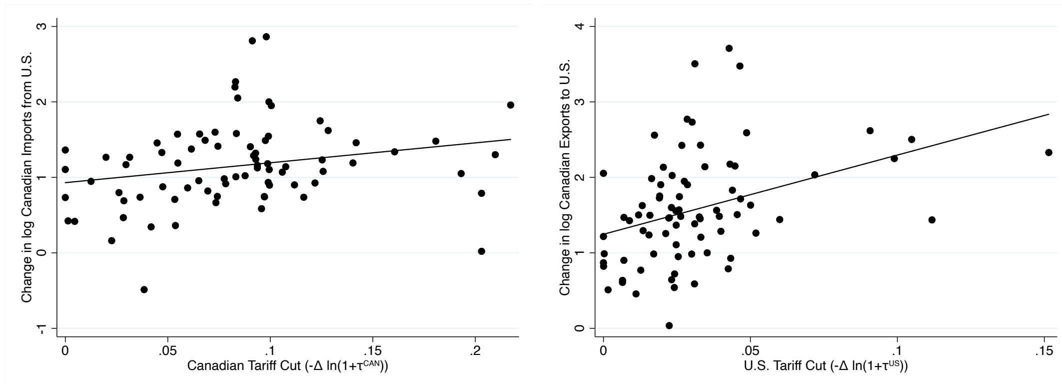
Because of the linear phase-in of the tariff cuts, there is minimal variation in the timing of cuts across industries. All of our analyses therefore rely on cross-industry variation in

[6] Because Canadian passage of the FTA was far from certain and prior attempts at passing free trade agreements between Canada and the U.S. were unsuccessful, we do not expect to observe anticipatory effects. See footnote 12 in Kovak and Morrow (2022) for additional detail on the Agreement's passage.

[7] Greenland et al. (2021) find increased stock market returns for U.S. firms in service industries benefiting from nondiscrimination under CUSFTA. See Breinlich (2014) and Greenland et al. (2021) for stock return analyses of CUSFTA tariff cuts.

[8] Tariffs on the majority of Canadian imports experienced linear tariff reductions during a 10-year period (schedule C tariff lines), with the remainder phased in linearly over a 5-year period (schedule B), implemented immediately in January 1989 (schedule A), or having no cut due to pre-existing free trade (schedule D) (Head and Ries, 1999).

Figure 2: Tariff Cuts and Bilateral Trade: Canada (left) and United States (right)



Notes: Each figure plots the change in log bilateral trade against the tariff cut in the importing country from 1988 to 1998 for each of 78 4-digit NAICS manufacturing industries. Each dot is an industry. The left panel plots the change in log imports into Canada from the U.S. against negative one times the change in log one plus the Canadian tariff. The right panel plots the change in log exports from Canada to the U.S. against negative one times the change in log one plus the U.S. tariff from 1988-1998.

tariff cuts between 1988 and 1998 to examine the effects of the CUSFTA on the Canadian labor market. In order to interpret our results as the causal effect of the tariff changes, it must be the case that i) the observed tariff cuts were unrelated to counterfactual industry performance and ii) the tariff cuts were uncorrelated with other aspects of the FTA that might have affected industry outcomes. We address the former requirement in Section 5.1, showing that the tariff cuts were unrelated to pre-FTA industry performance. On the latter point, the CUSFTA is nearly ideal relative to other large liberalization episodes (Trefler, 2004). While most large-scale trade liberalizations, particularly those in lower-income countries, involved significant reductions in non-tariff barriers and other reforms, the non-tariff provisions of the FTA primarily focused on limiting new non-tariff barriers and prohibiting new discriminatory regulations (Copeland, 1989). The CUSFTA tariff cuts were also incorporated into the subsequent NAFTA agreement, so they were relevant throughout our study period, which extends through 2004.[9]

Figure 2 shows that the tariff cuts expanded bilateral trade across industries as expected. The left panel shows that industries with larger Canadian tariff cuts saw increased imports from the U.S., while the right panel shows that larger U.S. tariff cuts drove increased Canadian exports to the U.S. In both cases, the estimated coefficients are consistent with the related literature.[10]

[9]NAFTA accelerated the tariff cuts prescribed by the CUSFTA for some products, but this accounted for a relatively small share of trade (Besedes et al., 2020).

[10]For Canadian imports, the estimated slope is 2.63 (s.e. 1.33, p=0.05) and, for U.S. imports, it is 10.49 (s.e. 2.44, p<0.01). Results are stronger if we control for the change in MFN tariffs. Using a CES

3 Data

Our main research design compares labor market outcomes for Canadian workers whose initial industries faced different tariff cuts in Canada or the U.S. as a result of the FTA. We observe individual workers' labor market outcomes over time using Statistics Canada's matched T2-LEAP-LWF data set, which covers 1984-2004. The heart of this database is the Longitudinal Worker File (LWF), which assembles individual T4 tax records providing longitudinal employment and earnings information.[11] The LWF represents a 10 percent random sample of Canadian workers appearing in the underlying tax records during 1984-2004, and we observe complete labor market histories for the workers in our sample.[12] As discussed below, we restrict attention to workers initially employed in manufacturing, but we are able to follow them even if they move into other sectors, including agriculture, mining, and services.

The LWF contains yearly data on each worker's employer(s), wage income, basic demographic information, province of employment, and industry affiliation at the 4-digit NAICS level. There are 328 of these industries, of which 86 are within manufacturing. As discussed below, we drop 2 industries that do not map onto our tariff data and 6 additional industries subject to quantitative trade restrictions.[13] This provides us with 78 manufacturing industries in our sample.[14] The LWF also includes a unique field based on Records of Employment (ROE), which Canadian employers must submit whenever a worker experiences an interruption in earnings.[15] Morissette et al. (2013) describe ROEs in detail. The ROE classifies each separation as either temporary (returned to the firm

framework, Romalis (2007) finds an elasticity of substitution between 2 and 5 for Canadian imports, and between 6 and 9 for U.S. imports in response to the CUSFTA tariff cuts. Online Appendix Figure A2 confirms that Canadian imports from the U.S. grew more quickly for HS-6 products with larger Canadian tariff cuts and that this difference grew steadily over time. We thank Teresa Fort for suggesting this figure.

[11] All references to "income" and "earnings" refer to wage income reported on tax form T4. This is the Canadian equivalent of the W2 form that U.S. workers receive from each employer.

[12] The 10 percent random sample is taken over unique Social Insurance Numbers (SIN) for workers appearing in the data at any point. If a worker's SIN is in the 10 percent sample, they are included in *all* years in which they received T4 income.

[13] The two industries that do not map onto HS product codes are 3151 ("Clothing Knitting Mills") and 3328 ("Coating, Engraving, Heat Treating and Allied Activities").

[14] The T2-LEAP-LWF data set holds industry code of each firm fixed over time, so our results do not reflect the firm industry switching emphasized by Bloom et al. (2019).

[15] The Canadian Employment Insurance Act requires every employer to issue an ROE when an employee working in insurable employment has an interruption in earnings. The ROE information is used to determine eligibility and benefits for Employment Insurance (EI) and must be issued even if the employee does not intend to file a claim. Employers are subject to financial penalties and/or charges of fraud when failing to issue accurate ROEs.

in the year of separation or the following year) or permanent (otherwise) and provides a reason for the separation, including firing, returning to school, ending seasonal work, quit, or work shortage (equivalent to layoff). This information allows us to focus our main analysis on permanent layoffs, which avoids diluting effects by inadvertently including temporary or voluntary separations (Flaaen et al., 2019).

Statistics Canada merges the longitudinal worker-level information in the LWF with firm-level data for their employers. T2 corporate income tax returns report interest, sales, gross profits, equity, assets, etc. for all incorporated firms in Canada, and the Longitudinal Employment Analysis Program (LEAP) database reports firms' total employment over time. Unlike Trefler (2004) who uses the Canadian Annual Survey of Manufactures, we possess data on firms (tax entities) rather than plants. Consequently, changes in continuing firm employment can be due to either plant entry and exit or changes in employment within continuing plants. In addition, a firm disappears from our sample if all of its workers *in our sample* experience separations despite it continuing to employ workers not in our sample. This limits our ability to undertake firm-level analyses and further motivates our focus on worker-level outcomes.

While the LWF data are very rich, particularly in their ability to track workers across employment status and different jobs over time, they have a few important limitations. First, the T2-LEAP-LWF data have relatively coarse geographic information at the province level, precluding us from using these data to implement local labor market analyses by commuting zone. Second, we cannot observe non-labor income except Employment Insurance payments and have no information on occupation or education. To account for heterogeneity in worker skill in our empirical analysis, we normalize workers' earnings by their pre-FTA earnings and control for the share of workers in the industry earning less than the national median income. We also stratify our samples by labor force attachment in most analyses.

We calculate tariff changes in each worker's initial industry primarily using data provided by Global Affairs Canada. Legislated tariffs from 1988 through 1998, including tariffs facing Canadian exports to the U.S., U.S. exports to Canada, and Canadian Most Favored Nation (MFN) tariffs facing other exporters are taken directly from the CUSFTA agreement.[16] U.S. MFN Tariffs are derived from Feenstra (1997).[17] In both cases,

[16]We are extremely grateful to Emily Yu at Global Affairs Canada for providing us with digitized data that describes the phase-in schedule for the CUSFTA tariff cuts between 1988-1998.

[17]To proxy U.S. MFN tariffs, we divide total duties paid by total customs imports in 1989 from Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Spain, Sweden,

we aggregate tariffs to the 4-digit NAICS industry level using concordances from Pierce and Schott (2012) and the U.S. Census Bureau.[18] We set the initial tariff in Auto Pact sectors to zero.[19] We drop from our sample six 4-digit NAICS industries that were subject to quantitative restrictions, as described in Lester et al. (1988), because legislated tariff changes do not accurately capture changes in protection in these industries.[20]

4 Empirical Approach

Our empirical analysis compares labor market outcomes of otherwise similar Canadian workers who were initially employed in industries facing different Canadian or U.S. tariff cuts. We measure the tariff cuts as negative one times the change in log one plus the tariff rate from 1988 to 1998: $-\Delta \ln(1+\tau_j^c)$, where $c \in \{\text{CAN}, \text{US}\}$ is the country imposing the tariff in industry j. Because tariffs went to zero in all industries, this measure is equivalent to the initial value of $\ln(1+\tau_j^c)$.

We relate these tariff changes to labor market outcome Y_{ifjk} for worker i initially employed in firm f in manufacturing industry j using the following worker-level specification:

$$Y_{ifjk} = \beta_0 - \beta_1 \Delta \ln(1+\tau_j^{\text{CAN}}) - \beta_2 \Delta \ln(1+\tau_j^{\text{US}}) + \mathbf{X}'_i \beta_3 + \mathbf{X}'_f \beta_4 + \mathbf{X}'_j \beta_5 + \epsilon_{ifjk}. \quad (1)$$

The subscript k represents time windows over which we calculate the worker's post-FTA outcomes: 1989-1993, 1989-1998, or (most frequently) 1989-2004. The first time span covers the initial phase-in of tariff cuts until the year before NAFTA came into force, the second covers the full phase-in of the CUSFTA tariff cuts, and the third extends to the final year of the sample. Because we multiply the tariff changes by negative one, a positive estimate of β_1 implies that workers whose initial industry faced larger Canadian tariff cuts experienced more positive values of the outcome Y. The vectors $\mathbf{X}'_i$, $\mathbf{X}'_f$, and $\mathbf{X}'_j$ are worker, initial firm, and initial industry level controls, described below. ϵ_{ifjk} is an

and the U.K.

[18]When calculating average tariffs at the 4-digit NAICS level, we weight 8-digit HS codes by 1988 imports to the relevant country. See Kovak and Morrow (2022) Appendix A for details.

[19]While there were strictly positive statutory tariffs in sectors 3361, 3362, and 3363, waivers were easily obtained, leading to free trade in practice. See Trefler (2004) for more details.

[20]The relevant industries are Meat Products, Poultry Products, Dairy Products, Flour and Breakfast Cereals, Sugar, Distilleries and Breweries, Wineries, Tobacco and Tobacco Products (Lester et al., 1988), which we concord to 3112 ("Grain and Oilseed Milling"), 3113 ("Sugar and Confectionery Product Manufacturing"), 3115 ("Dairy Product Manufacturing"), 3116 ("Meat Product Manufacturing"), 3121 ("Beverage Manufacturing), 3122 ("Tobacco Manufacturing").

error term, clustered by the worker's initial four-digit NAICS industry.

Tariff cuts are assigned to workers based on their *initial* industry of employment, so even if a worker switches industries after 1988, the same initial-industry tariff cuts remain associated with that worker, analogous to Autor et al. (2014) and Utar (2018). To assign an initial firm and industry, we define the worker's base year as the final year in 1986-1988 in which the worker had strictly positive earnings and a valid industry code. We then define the initial industry as the industry of employment in that base year. The initial firm and initial province are defined analogously.

Our sample consists of workers initially employed in manufacturing who were born between 1940 and 1964, ensuring they were of working age (22-64) during 1986-2004. We require that workers had positive earnings in at least one year during 1986-1988 to assign an initial firm and industry of employment. We drop workers initially employed in the Canadian Territories.[21] Following Autor et al. (2014), we examine both high and low labor force attachment workers. High-attachment workers are defined as those who earned at least the equivalent of 1,600 annual hours of work at the nominal provincial minimum wage in *every* year between 1985 and 1988 (inclusive). Low-attachment workers are the remainder of workers meeting other sample requirements.[22]

We include extensive controls in equation (1) to ensure that we are comparing outcomes for otherwise similar workers facing different tariff cuts.[23] $\mathbf{X}'_i$ is a vector of worker level controls including the worker's gender, birth year indicators, log real average earnings during 1986-1988, the change in log real earnings from 1986 to 1988, indicators for labor market experience and tenure in the worker's initial firm, and the initial province of employment. All nominal earnings are converted into real 2002 dollars using the Canadian CPI. A worker is defined as having "low" labor market experience if they had positive earnings in two or fewer years in the period 1984-1988, "medium" if they had positive earnings in three or four years, and "high" if they had positive earnings in all years in the period 1984-1988. Tenure is distinct from experience in that it refers to the worker's tenure in a given firm whereas labor market experience measures employment regardless

[21]In accordance with Statistics Canada disclosure guidelines, sample sizes are rounded to the nearest 100 throughout the paper. In addition, we omit workers in the Territories (Yukon, Northwest Territories, and Nunavut) to avoid disclosure concerns due to very small populations, totalling less than 0.33 percent of Canada's overall population during our sample period.

[22]Online Appendix Section A.3 discusses the characteristics of high- and low-attachment workers, showing that women and younger workers are less likely to be high-attachment. Kovak and Morrow (2022) Appendix B describes the sample and variable construction in detail.

[23]For all of our main results, we have implemented specifications with many different subsets of the controls discussed here. Estimates were similar in all cases.

of employer. A worker is defined as "low" tenure if they have fewer than two years of experience at their initial firm, "medium" if they have two or three years, and "high" if they have four or more years as of their base year. In addition, we control for an interaction between the worker's age and their log real average earnings during 1986-1988.

Initial-firm controls, $\mathbf{X}'_f$, include indicators for firm size. Following Autor et al. (2014), "small" firms are defined as those with 99 or fewer workers, "medium" sized firms have 100 to 999 workers (inclusive), and "large" firms are those with 1000 or more workers.[24] We also include average log real earnings per worker in 1988 within the firm as well as the average of the change in log worker real income within the firm between 1986 and 1988.

We also include extensive initial-industry controls, $\mathbf{X}'_j$. These include the log share of workers earning less than the aggregate median income in 1988, average log earnings per worker in 1988, the log industry capital-labor ratio in 1988, the change in the log of the share of aggregate employment accounted for by the industry between 1986 and 1988, and the mean change in log income for those employed in the industry between 1986 and 1988. While our data cannot directly distinguish between skilled and unskilled workers, the share of workers below the median income proxies for the industry's unskilled labor intensity. The change in the log of the industry's share of aggregate employment captures whether certain industries were already shedding or gaining employment for reasons unrelated to the FTA. We also control for a measure of industry responsiveness to the business cycle to avoid confounding the changes in bilateral trade policy with the early-1990s Canadian recession.[25] We control for the 1988 to 1998 change in log one plus the MFN tariff facing non-FTA countries in Canada and the U.S. to account for substitution between potential trading partners. When considering heterogeneous results by initial firm size, we interact both the CUSFTA and MFN tariff changes with the firm size indicators. In all of our specifications, we include industry-level pre-trends in the dependent variable and its interactions with initial firm size indicators and indicators for the worker's tenure at their initial firm.[26] We also address the rise of China by controlling for the change in Chinese import penetration in Canada in the worker's initial industry, following Acemoglu et al. (2016).[27] Finally, we include 2-digit NAICS fixed effects, so

[24]This measure is based on the Statistics Canada national average labour units (nalus) measure.

[25]Using the NBER Manufacturing Database for 1958-1989, we regress log industry employment on log GDP and a linear time trend, and use the coefficient on GDP as our measure of cyclicality.

[26]For example, when we examine the determinants of the probability of a work-shortage related separation between 1989 and 2003, we control for the unconditional probability of a separation in the same industry in the years 1984 through 1988.

[27]Specifically, we control for the change in real imports into Canada from China between 1989 and

we compare outcomes for workers initially in different 4-digit industries within the same 2-digit manufacturing industry.

Our empirical analyses examine workers' labor market outcomes. We first examine an indicator for whether a worker experienced a permanent work-shortage related separation (layoff) from their initial employer during the relevant time period. This dependent variable allows us to measure how Canadian and U.S. tariff cuts in the worker's initial industry affected their probability of a layoff by their initial firm. We also examine cumulative years worked T_{ifjk} as well as years worked in the initial firm, initial industry outside the initial firm, in other manufacturing industries, and outside manufacturing.[28]

We also study the FTA's effects on workers' cumulative earnings, $\tilde{E}_{ifjk}$, where

$$\tilde{E}_{ifjk} \equiv \frac{\left[\sum_{t=1989}^{2004} \sum_{j'} \sum_{f'} E_{if'j't}\right]}{\overline{E}_{i,88-86}}. \tag{2}$$

The numerator is worker i's cumulative real earnings from 1989 to 2004 from employment in any firm f' and in any industry j', including those other than the worker's initial firm and industry. We focus only on earnings, so results are not affected by public programs.[29] To account for unobserved worker heterogeneity, we normalize these cumulative earnings by the worker's pre-FTA yearly earnings, $\overline{E}_{i,88-86}$, calculated as average yearly real earnings in 1986-1988 (averaging over years with strictly positive earnings). Given this normalization, $\tilde{E}_{ifjk} = 16$ means that the worker on average earned their real pre-period income in each of the 16 years spanning 1989-2004. Because the numerator of (2) decomposes additively into earnings from different firms, industries, and sectors, we additionally investigate how the sources of workers' earnings adjusted in response to the FTA tariff changes.[30]

In some specifications, we consider heterogeneous effects by the size of the worker's initial employer, interacting the tariff cut variables with indicators for small (1-99 employees), medium (100-999), and large ($\geq$ 1000) initial firms. This analysis is motivated by the findings of Head and Ries (1999), Lileeva (2008), and Autor et al. (2013b) who

2004, divided by 1988 real industry absorption (output plus imports minus exports) in Canada.

[28] The maximum number of years worked between 1989 and 2004 inclusive is 16. When decomposing years worked into industries, each year's employment is assigned to the industry of primary employment (that with the most earnings).

[29] Our data do allow us to observe Employment Insurance receipts. See Stepner (2019) for a full treatment of how redistributive taxes and transfers offset earnings losses in Canada.

[30] We use scaled cumulative earnings rather than the change in log earnings because it allows for an exact additive decomposition of its components and does not drop observations with zero earnings.

emphasize the firm reallocation effects that trade can induce. We also examine workers' labor market transitions by observing their employment status in the year following a permanent separation. For the purposes of this transition analysis, and because our earnings information is reported at the yearly level, we define a worker as being unemployed if their yearly earnings fall below the equivalent of 1600 hours worked at the relevant provincial minimum wage.[31] For employed workers, we then observe whether they are working for a different firm in the same industry, a different industry within manufacturing, or in a different sector in the year following separation. Because the indicators for each of these post-separation conditions sum to the overall separation indicator, we perform an additive decomposition revealing how workers transitioned following a permanent separation.

5 Results

5.1 Exogeneity of Trade Policy

The main threat to interpreting our results as the causal effects of the FTA is that the tariff changes may have been correlated with unobserved factors affecting workers' outcomes. Since all of the tariffs fell to zero (Online Appendix Figure A1), the relevant question is whether the initial tariff levels were correlated with counterfactual industry performance. To assess the importance of this concern, we estimate the following specification examining the correlates of the initial tariffs at the four-digit NAICS industry level:

$$\ln\left(1+\tau^{c}_{j,1988}\right) = \beta_0 + \beta_1 \ln\left(1+\tau^{-c}_{j,1988}\right) + \mathbf{X}'_j\beta_2 + \epsilon_j \qquad (3)$$

where $c, -c \in \{\text{CAN}, \text{US}\}$, $\mathbf{X}_j$ is the vector of industry level controls discussed in Section 4, and we present specifications with and without controlling for the other country's $(-c)$ initial tariff.

The results in columns (2) and (4) of Online Appendix Table A2 show that the strongest correlate of a country's initial tariff is the other country's initial tariff; other factors are far less important.[32] To assess whether industries facing larger tariff cuts were

[31] Note the distinction between this unemployment measure and those in surveys such as the U.S. Current Population Survey and the Canadian labor Force Survey, which ask about employment and job search activity within a specified reference period.

[32] Although the initial Canadian and U.S. tariff levels are closely related, they are far from perfectly collinear, making it possible for us to separately identify their effects (see Section 5.6). The R^2 from an industry-level bivariate regression of initial Canadian tariffs on initial U.S. tariffs is 0.41, although this rises to 0.61 when weighted by the number of workers in each industry.

on similar trajectories prior to the FTA, we examine how the initial tariff level related to growth in the industry's share of employment from 1984 to 1988 ($\Delta_{1984-1988} \ln(emp_j / \sum_{j'} emp_{j'})$) and the growth in the industry's average earnings from 1986 to 1988 ($\Delta_{1986-1988}$ Mean log earnings$_j$). For Canadian tariffs (columns (1) and (2)), the associated coefficients on pre-FTA growth are statistically indistinguishable from zero and are economically small.[33] For U.S. tariffs (columns (3) and (4)), we find a statistically significant negative relationship between growth in the industry's share of employment and the initial tariff level, implying that industries with larger U.S. concessions had relatively declining shares of employment prior to the FTA. However, the relationship is again economically small. While these estimates rule out the presence of substantial confounding pre-trends, our analyses nonetheless control for pre-FTA firm- and industry-level pre-trend measures to allay remaining endogeneity concerns, as discussed in Section 4.

5.2 Permanent Work-Shortage Related Separations

We start by examining whether bilateral tariff cuts affected the likelihood of a permanent layoff from the initial firm (Sections 5.3 and 6.1 examine worker transitions across industries and sectors). We estimate equation (1), setting $Y_{ifjk} = 1$ if worker i was initially employed at firm f in industry j, and had a permanent work-shortage related separation from initial employer f between 1989 and 2003 (inclusive), and zero otherwise.[34] We do this separately for low-attachment and high-attachment workers, with results in Table 1.

Columns (1) and (3) estimate homogenous effects and find the expected signs for both low- and high-attachment workers: increased import competition due to a Canadian tariff cut raises the probability of a permanent layoff, while increased access to the U.S. export market due to a U.S. tariff cut lowers the probability. However, neither of these effects can be statistically distinguished from zero and (as discussed below) they are very small. A possible explanation is that trade liberalization affected large and small firms differently, as predicted by standard models of firm heterogeneity and trade. For example, Melitz

[33]Very large changes in the industry's share of employment or average wage are associated with small tariff changes. Even a 25 percent increase in an industry's employment share is associated with less than a 1.5 percentage point difference in tariff.

[34]For separations alone, we stop our analysis in 2003 for two reasons. First, we cannot tell if separations in the final year of our data set (2004) are temporary or permanent. Second, we cannot see where separated workers go in the subsequent year. We do not consider permanent separations from a firm that was not their initial employer. For example, if they quit their initial employer and then had a permanent separation from a second employer, $Y_{ifjk} = 0$ for this worker. We do not consider temporary separations, as suggested by Statistics Canada. We thank René Morissette for this guidance.

Table 1: Probability of Separation from Initial Firm (1989-2003)

	Low-Attachment		High-Attachment	
	(1)	(2)	(3)	(4)
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	0.081		0.104	
	(0.151)		(0.180)	
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$		-0.485		-0.335
		(0.329)		(0.292)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$		0.241		-0.037
		(0.203)		(0.216)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$		0.489**		0.378
		(0.200)		(0.277)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.164		-0.045	
	(0.199)		(0.288)	
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$		0.617*		0.502
		(0.316)		(0.346)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$		-0.489*		0.059
		(0.290)		(0.345)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$		-0.796**		-0.635
		(0.355)		(0.440)
Observations	20,600	20,600	63,100	63,100
R-Squared	0.068	0.070	0.037	0.038

Notes: Dependent variable is an indicator for experiencing a permanent work-shortage based separation from the worker's initial firm during 1989-2003. The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry. A positive (negative) coefficient means that larger tariff cuts in the worker's initial industry lead to increased (reduced) probability of separation. Columns (1) and (3) present results of estimating equation (1) for low and high labor force attachment workers, respectively. Columns (2) and (4) present analogous regressions interacting the tariff cuts with initial firm size (small=1-99, medium=100-999, large=1000+). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

(2003) and Demidova and Rodríguez-Clare (2013) predict that trade liberalization reduces employment at smaller and less productive domestic firms while increasing employment at larger and more productive exporting firms. These opposite-signed effects for different size firms may therefore partly offset, potentially leading to small and statistically insignificant average effects.

With these theoretical predictions in mind, columns (2) and (4) of Table 1 interact the tariff changes with an exhaustive set of initial firm size indicators. The effects of U.S. tariff concessions on low-attachment workers (column (2)) are statistically significant and consistent with standard firm heterogeneity models. Workers initially at large firms are less likely to be laid off when their industry gains freer access to the U.S. market, but workers at small firms in the same industry are more likely to be laid off. The effects for high-attachment workers (column (4)) are similar, but have smaller magnitudes and larger standard errors leading to insignificant estimates. These results are consistent with the empirical findings of Trefler (2004) and Lileeva (2008) who find positive effects of U.S. tariff concessions for Canadian exporters but negative effects for Canadian non-exporters.

Turning to Canadian tariff cuts, we find displacement effects that are concentrated among workers initially employed at large firms, with statistically significant increases in separations for low-attachment workers (column (2)). As we discuss in detail in Section 6.1, this pattern of heterogeneity runs counter to standard models of heterogeneous firms, which predict employment reductions at small firms when facing increased import competition. Yet, our findings are in line with prior empirical work on the effects of the CUSFTA in Canada and the effects of Chinese import competition in the U.S.

We now assess the magnitudes of these results by comparing the predicted layoff probabilities for workers whose initial industries faced tariff cuts at the 75^{th} percentile vs. the 25^{th} percentile of the tariff cut distribution. This interquartile range is 6.4 log points for Canadian tariff cuts and 2.5 log points for U.S. tariff cuts.[35] We focus on the effects for workers at large firms, as these generally have the largest magnitudes.

The estimates in column (2) suggest that low-attachment workers at large firms facing larger Canadian tariff cuts had a 3 percentage point higher probability of separation than otherwise similar workers in less affected industries. This difference is an 18 percent increase over the unconditional mean separation rate of 17 percent during 1989-2003.[36] Low-attachment workers initially at large firms who faced larger U.S. concessions had a 2 percentage point (12 percent) lower probability of separation.

The effects for high-attachment workers at large firms are smaller than those for low-attachment workers and are statistically insignificant. The interquartile difference in Canadian tariff cuts increased the separation probability by 2.4 percentage points relative to a mean separation probability of 11.6 percent. The stabilizing effect of U.S. concessions is more comparable to that of low-attachment workers at approximately 1.6 percentage points.[37]

While the effects of the change in bilateral policy on separations for workers initially

[35] These cuts differ slightly from those in Figure A1 because these correspond to percentiles in our worker sample. To avoid disclosure concerns, the reported interquartile ranges reflect the difference in mean tariff cut in narrow windows around the 75^{th} and 25^{th} percentiles.

[36] $\frac{0.064*0.489}{0.17} = 0.184$

[37] For completeness, an interquartile comparison of Canadian tariff concessions increases the mean probability of separation by 0.5 percentage point (3 percent) and 0.7 percentage point (5.7 percent) for low- and high-attachment workers, respectively, while the same comparison for U.S. concessions reduces the mean probability of separation by 0.4 percentage points (2.4 percent) and 0.1 percentage point (1 percent) for the same groups, respectively.

at large firms are nontrivial, the homogenous effects in columns (1) and (3) of Table 1 are much smaller. Our subsequent results will reinforce the conclusion that the bilateral tariff cuts had relatively small overall labor market effects.[38] The remainder of this section presents homogenous effects of the tariff cuts on additional outcomes, while Section 6 returns to the topic of heterogeneous worker responses across firm sizes and within-industry reallocations.

5.3 Years Worked

Did these bilateral cuts and their ensuing changes in worker separations affect the total number of years affected individuals worked? To answer this question, we estimate equation (1) in which the dependent variable is the number of years in 1989-2004 with strictly positive earnings. Table 2 presents results for low-attachment workers in Panel A and for high-attachment workers in Panel B. In column (1) we estimate the effect on total years worked, while in columns (2)-(7) we additively decompose this overall effect into years at the initial firm of employment; at other firms in the same 4-digit NAICS industry; in other manufacturing industries; in construction; in mining, agriculture, or firms with missing industry codes; and in services, respectively.[39]

The bilateral cuts did not yield statistically significant effects on years worked for low-attachment workers (Panel A, column 1). We discuss magnitudes below. These overall effects reflect offsetting effects on time spent in different employment situations. Low-attachment workers facing larger Canadian tariff cuts spent less time employed at their initial firm (column 2) or employed at other firms in their initial industry (column 3). This lost time was largely made up for with more time in other manufacturing industries (column 4), construction (column 5), and services (column 7). Low-attachment workers facing larger U.S. tariff cuts spent more time employed at their initial firm and at other firms in the same industry, but this was offset by reductions in time spent employed

[38]Kovak and Morrow (2022) Appendix Table A3 further reinforces a causal interpretation of the findings in Table 1 by showing qualitatively different results for non-layoff separations (firing, quits, etc.), ruling out various potential sources of spurious correlations between the tariff cuts and labor supply. Kovak and Morrow (2022) Appendix Tables A9-A11 also present results for separations, years worked, and cumulative earnings controlling for the tariff cuts facing Mexican imports to Canada under NAFTA, yielding similar conclusions to our main results. While separations results are less precise in some specifications, estimated coefficients of interest for years worked and earnings are larger and more precisely estimated.

[39]See the Table 2 notes for details on the firm/industry category definitions. Because the maximum potential years worked is the same for all workers (16), the effect of tariff cuts on years non-employed is equal to the estimated coefficient in column (1) times negative one; hence, there is no column for non-employment.

Table 2: Years Worked (1989-2004)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low-Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-1.174	-7.231***	-2.830*	3.433*	1.914**	0.0422	3.497**
	(1.232)	(2.535)	(1.616)	(1.783)	(0.810)	(0.646)	(1.523)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-2.623	5.361	6.398**	-9.815***	0.865	-0.317	-5.114*
	(2.328)	(3.655)	(2.971)	(2.996)	(1.727)	(1.013)	(2.870)
R-squared	0.096	0.132	0.048	0.047	0.045	0.029	0.062
Panel B: High-Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	3.391**	-0.451	-3.004	5.579*	1.116	-0.0531	0.204
	(1.370)	(4.450)	(1.814)	(3.183)	(0.746)	(0.540)	(1.512)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-3.750*	8.296	4.707	-10.50*	0.375	-0.986	-5.645**
	(1.961)	(7.789)	(4.585)	(5.318)	(1.515)	(0.699)	(2.638)
R-squared	0.058	0.101	0.035	0.042	0.021	0.024	0.061

Notes: Dependent variable is the number of years worked (with nonzero earnings) during 1989-2004. The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry. A positive (negative) coefficient means that larger tariff cuts in the worker's initial industry lead to increased (decreased) years worked. Column (1) examines total years worked, (2) years worked at the initial firm, (3) at firms other than the initial firm, but in the same initial 4-digit industry, (4) in manufacturing industries (NAICS=3xxx) other than the initial industry, (5) in construction (NAICS=22xx,23xx), (6) in mining (NAICS=21xx), agriculture (NAICS=1xxx), or in a firm with unknown industry code, or (7) in services (NAICS≥4xxx). Each worker-year is assigned to only one category in columns (2) through (7) based on the primary (highest-earning) job, so the coefficients in columns (2) through (7) sum to the overall effect in column (1). The effect on years non-employed equals the estimate in column (1) times negative one. All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

in other manufacturing industries and in services. Results for high-attachment workers are qualitatively similar except that there is little effect of Canadian tariff cuts on years worked at the initial firm, and the overall effect on years worked is positive and statistically significant. In addition, when facing import competition, low-attachment workers are approximately equally likely to shift into services and other manufacturing industries, while for high-attachment workers shifts into other manufacturing industries are much more common. We return to this point in section 5.6. Overall, these findings provide direct evidence that Canadian workers offset gains or losses in employment in the initial firm or industry by moving across firms, industries, and sectors in response to the tariff changes.

Figure 3 presents the magnitude interpretation for the effects in Table 2 and also shows how the effects evolved over time. We explain the layout of Panel (a) in detail, as other panels and subsequent figures are interpreted similarly. The black bars correspond to the results in Table 2, examining years worked during 1989-2004. The height of each bar represents the predicted change in the outcome for an interquartile difference in tariff cuts, expressed as a share of the unconditional mean outcome for the relevant group. For example, the interquartile difference in Canadian tariff cut reduced low-attachment workers' years worked at the initial firm by 0.46 years ($= -7.231 \cdot 0.064$). Since the unconditional mean of years worked is 11.6 for low-attachment workers, the interquartile gap in tariff cuts drove a 4.0 percent reduction in years worked at the initial firm.[40] The light and medium gray bars show parallel results for the 1989-1993 and 1989-1998 periods, respectively.[41] To make the results for these shorter time windows comparable to the 16-year window 1989-2004, we multiply the predicted values by 16 over the window length to predict the effect magnitude that would have been observed if it had persisted for 16 years.[42] Stars represent whether the associated regression estimate is statistically different from zero at the 1 (***), 5 (**), or 10 (*) percent level.

The results in Figure 3 suggest that the effects of the FTA gradually grew over time.[43] Examining the Initial Firm bars in Panel (a), an interquartile difference in Canadian tariff cut induces a 3.0 percent reduction in years worked at the initial firm between 1989 and 1993, and a 4.0 percent reduction between 1989 and 2004. Because these are scaled to 16-year equivalents, this difference is not driven by the longer time window for 2004. Yet, as with the separation results, the magnitudes are small: an interquartile difference in Canadian tariff concessions induces only 5.5 fewer months employed at the initial firm over 16 years. Offsetting this small effect are more years spent in other manufacturing industries, construction, and services. Because it takes time for workers to shift into these other industries, the magnitude of the overall reduction in years worked in Panel (a) falls by more than half from 1993 to 2004 (from -1.7 to -0.6 percent).

Panel (b) presents the effect of U.S. concessions. As expected, most signs are reversed relative to Panel (a): a worker more exposed to larger U.S. concessions worked more years at the initial firm and in the initial industry, and fewer years in other sectors. Panels (c) and (d) present results for high-attachment workers. As with separations, the estimates for high-attachment workers are generally somewhat smaller than for low-attachment workers, particularly for years worked at the initial firm and industry, and many are indistinguishable from zero.

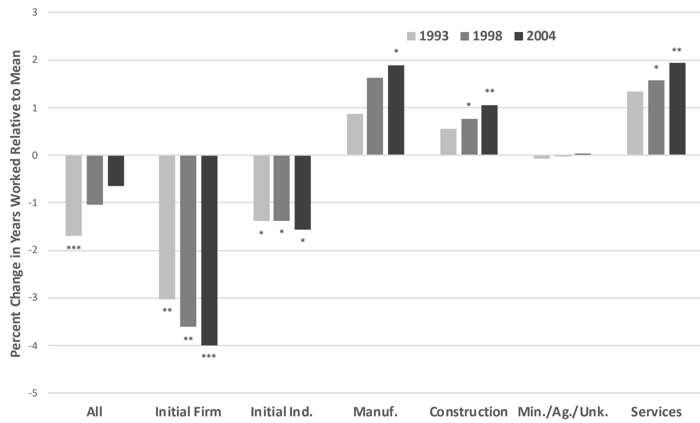
[40]These estimates correspond to the second black bar from the left in panel (a) of Figure 3.

[41]The regression results for these shorter time periods appear in Online Appendix Tables A3 and A4.

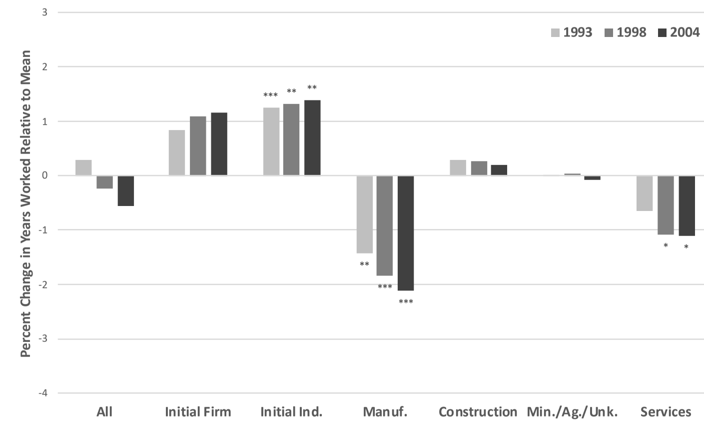
[42]Specifically, we multiply the 1989-1993 values by 16/5, and the 1989-1998 by 16/10.

[43]This pattern is consistent with the results of Besedes et al. (2020) who find gradual increases in trade in response to the CUSFTA, even in industries in which tariffs immediately went to zero.

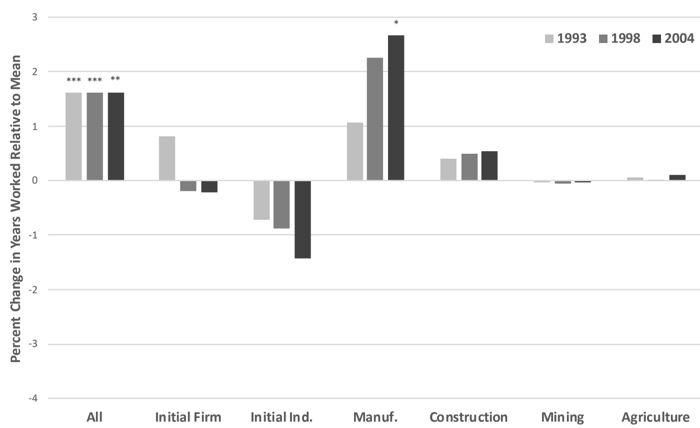
Figure 3: Evolution of Effects on Years Worked



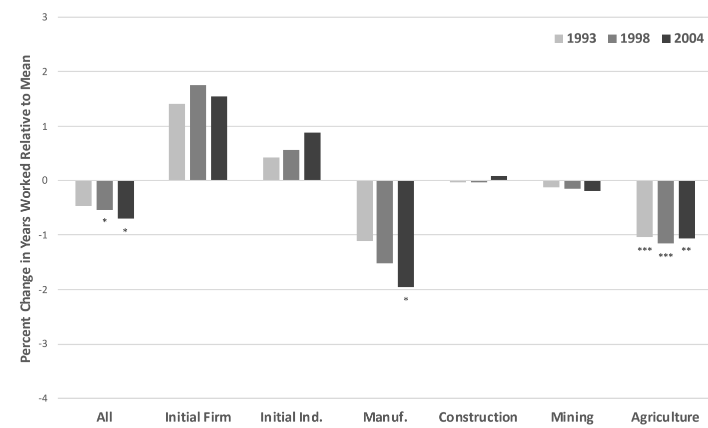
(a) Effect of Canadian Tariff Cuts - Low-Attachment Workers



(b) Effect of US Tariff Cuts - Low-Attachment Workers



(c) Effect of Canadian Tariff Cuts - High-Attachment Workers



(d) Effect of US Tariff Cuts - High-Attachment Workers

Notes: The figures present scaled estimates from regressions in Table 2 and in Tables A3 and A4 in the Online Appendix. The bars show predicted differences in years worked when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean years worked. The interquartile range for Canadian tariff cuts is 0.064 and for U.S. tariff cuts is 0.025. The unconditional mean of years worked for low-attachment workers is 11.6 and for high-attachment workers is 13.4. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

5.4 Cumulative Earnings

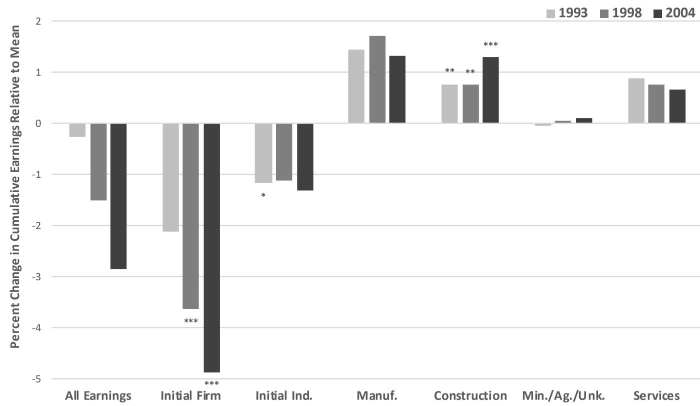
We now examine the effects of the bilateral CUSFTA tariff cuts on cumulative earnings of Canadian workers. Recall that the cumulative normalized earnings measure is defined in equation (2) as total earnings during the relevant period divided by the worker's average yearly earnings in the pre-FTA period. The mean cumulative normalized earnings during 1989-2004 is 20.19 for low-attachment workers and 14.34 for high-attachment workers. This means that low-attachment workers earned 20 times their initial yearly earnings during 1989-2004, while high-attachment workers earned 14.3 times their initial yearly earnings. This difference partially reflects the fact that low-attachment workers tended to be younger in 1988 and hence were on a steeper portion of their lifecycle earnings profile (Mincer, 1974; Lemieux, 2006). We estimate equation (1) with cumulative normalized earnings as the dependent variable, and present associated magnitudes in Figure 4.[44]

Figure 4 is constructed in the same way as Figure 3, showing differences in predicted cumulative normalized earnings for workers facing interquartile differences in tariff changes as a proportion of the unconditional average outcome, scaled to make the different time-frames comparable. As with years worked, we find earnings adjustments that intensify over time but with small and statistically insignificant effects on long run earnings for both worker types.[45] Significant earnings losses at low-attachment workers' initial firms in response to Canadian tariff cuts (Panel a) are consistent with a heightened probability of separation from the initial firm in Table 1 and reductions in years worked at the initial firm in Figure 3. This negative effect of Canadian concessions on initial-firm income is substantially offset by higher earnings in other manufacturing industries, construction, and services, consistent with workers successfully transitioning across industries and sectors to make up for earnings losses at the initial firm. Comparing the overall effects in Panel (a) of Figures 3 and 4, we see that although low-attachment workers facing larger Canadian tariff cuts steadily recover over time in terms of years worked as they transition across industries and sectors, their relative earnings fall over time. However, the effects of import competition on overall earnings remain small and indistinguishable from zero at all time horizons, such that we cannot reject full recoveries for low attachment workers. Estimates for the effect of U.S. concessions in Panel (b) are small and indistinguishable

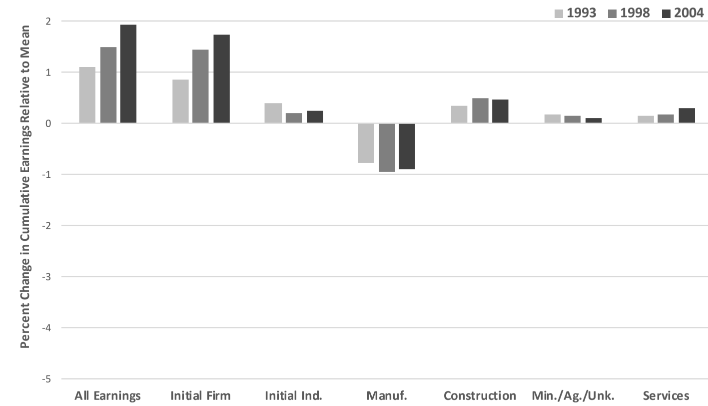
[44]The regression tables corresponding to Figure 4 appear in Online Appendix Tables A5-A7

[45]To map our regression results to this figure, consider the black bar for "All Earnings" in Panel (a) of Figure 4. The associated regression coefficient in Online Appendix Table A7 is -8.990. Multiplying by the interquartile Canadian tariff cut of 0.064 and dividing by low-attachment workers' mean cumulative normalized earnings of 20.19 yields -2.85 percent, shown in the figure.

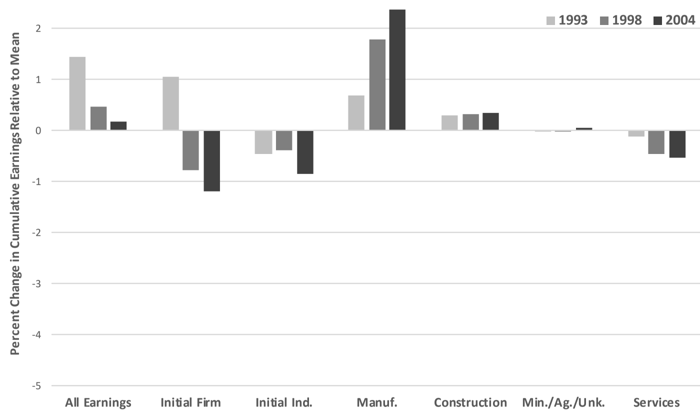
Figure 4: Evolution of Effects on Cumulative Normalized Earnings



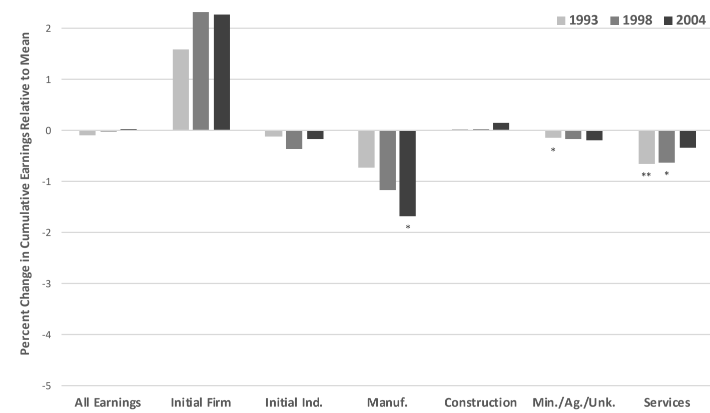
(a) Effect of Canadian Tariff Cuts - Low-Attachment Workers



(b) Effect of US Tariff Cuts - Low-Attachment Workers



(c) Effect of Canadian Tariff Cuts - High-Attachment Workers



(d) Effect of US Tariff Cuts - High-Attachment Workers

Notes: The figures present scaled estimates obtained from regressions appearing in Online Appendix Tables A5-A7. The bars show predicted differences in cumulative normalized earnings when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean cumulative normalized earnings. The interquartile range for Canadian tariff cuts is 0.064 and for U.S. tariff cuts is 0.025. The unconditional mean of cumulative normalized earnings for low-attachment workers is 20.19 and for high-attachment workers is 14.34. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

from zero.

For high-attachment workers (Panels c and d), we find little overall effect on long run earnings, although the effects on initial firm earnings have the expected signs. These small and statistically insignificant results for high-attachment workers contrast sharply with those of Autor et al. (2014), who find inter-quartile effects of the China shock on high-attachment U.S. workers' earnings that are more than an order of magnitude larger than those we find for Canadian workers.[46]

5.5 Low Income and High Income Workers

In a companion paper, Kovak and Morrow (2023) examine years worked and cumulative earnings separately by workers' initial income rather than by labor force attachment. This alternative sample split allows us to directly examine the effects of the CUSFTA on earnings inequality among workers initially employed in manufacturing. We find nearly identical impacts for low income and low attachment workers, while the effects are qualitatively similar but somewhat larger in magnitude for high income workers than for high attachment workers. Therefore the effect on earnings inequality was small, with point estimates implying a slight reduction in earnings inequality.

5.6 Understanding Our Results

In the preceding subsections, we find small and (on average) offsetting effects of Canadian and U.S. tariff cuts on the probability of permanent layoff from the worker's initial firm, on total years worked, and on cumulative earnings of low and high-attachment workers. Although low-attachment workers facing larger Canadian tariff cuts experienced meaningful reductions in time employed at their initial firm and had reduced earnings from that firm, these losses were largely offset by higher levels of income in other sectors, suggesting relatively smooth transitions between firms and industries.

These modest effects and smooth transitions stand in contrast to a large literature finding substantial and persistent consequences of job displacement, including pioneering work on mass layoffs by Jacobson et al. (1993). They also contrast with more recent

[46]An inter-quartile difference in the U.S. China shock led to an average reduction in earnings equivalent to 38 percent of initial annual earnings (Autor et al. (2014), p.1816). The same calculation using our overall earnings effect for high-attachment workers in column (1), row 3 of Online Appendix Table A7 (0.362) and the inter-quartile difference in Canadian tariff cuts (0.064) yields an average earnings reduction of only 2.3 percent of initial annual earnings. Note that both papers examine cumulative earnings over a 16-year time horizon, so the results are comparable.

research on the effects of trade on workers' labor market outcomes, including Autor et al. (2014) and Dix-Carneiro and Kovak (2017). Both papers find large and growing effects of import competition over long periods of time, suggesting slow and costly worker transitions into more favorable employment situations. Although our findings of offsetting effects of import competition and export opportunities are similar to those of (Dauth et al., 2014, 2017, 2021) in the German context, we find a stronger role for worker transitions across industries. While Canadian workers experience substantial effects of tariff cuts on employment and earnings in their initial firms and industries, shifts to other industries *fully* offset these gains and losses.[47]

To help understand these contrasting results, this subsection begins by ruling out four potential explanations for our finding of small overall effects: i) FTA tariff changes were too small to drive substantial effects, ii) U.S. and Canadian tariff changes offset *within* each industry, iii) Canada's industrial geography facilitated transitions across industries, and iv) the FTA was implemented in the midst of a strong labor market.[48] We then present findings explaining the relatively smooth labor market adjustment in Canada. First, Canadian workers moved quickly from industries facing large increases in competition to industries facing smaller shocks. Second, the bilateral nature of the FTA allowed workers subject to Canadian tariff cuts to replace lost earnings and employment by transitioning to closely related manufacturing industries benefiting from U.S. tariff cuts. Third, the CUSFTA tariff changes did not induce mass layoffs. Fourth, industry employment responded to the tariff cuts primarily by reducing the number of new hires.

Shock Size: Were the FTA tariff cuts too small to have substantial effects on Canadian workers? Figure 1 shows that U.S. import penetration in Canada grew by 40 percentage points during our outcome period of 1988-2004. This was roughly 4 times larger than the growth in Chinese import penetration in Canada during this period and the growth in Chinese import penetration in the U.S. during 1991-2011 (Autor et al., 2014, Table

[47] This stands in contrast to the German context, e.g Dauth et al. (2021) Table 3, column 1.

[48] In Appendix Table A8 we additionally find no substantial differences in manufacturing workers' demographics and educational attainment between the U.S. and Canada. While it is also possible that Canadian labor market policies facilitate smoother transitions, we find this explanation unlikely. The Canadian Labour Adjustment Benefit program provided much less generous benefits and had narrower eligibility criteria than the U.S. Trade Adjustment Assistance program and was phased out by 1988 (Lysenko and Schwartz, 2015). Other social safety net programs in Canada were generally more generous and had broader eligibility than those in the U.S. during our sample period (Blank and Hanratty, 1993; Card and Riddell, 1993). An extensive prior literature suggests that more generous benefits in Canada should lead to longer non-employment durations for displaced workers (e.g. Meyer (1990), Schmieder et al. (2016)), but we nonetheless find minimal effects on aggregate years worked in Canada.

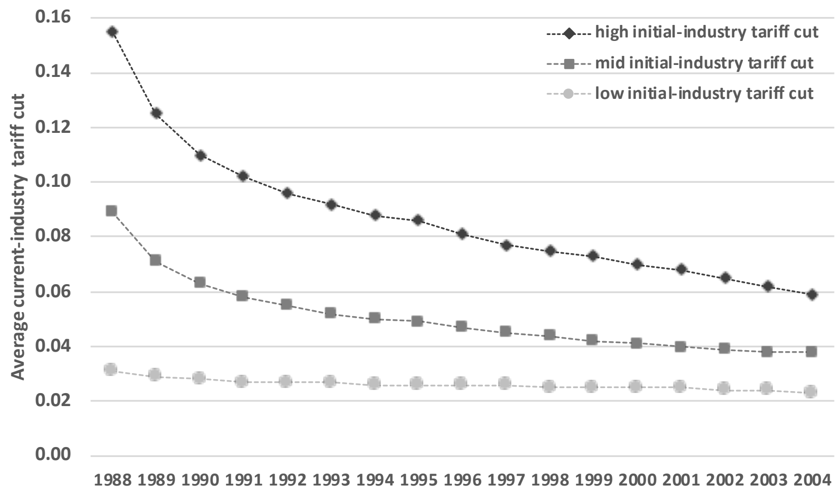
I). Moreover, Table 1 shows that the FTA tariff changes were in fact large enough to cause substantial displacement of workers. Table 4 (below) shows that Canadian tariff cuts also reduced overall industry employment growth. These findings together rule out the possibility that the FTA tariff cuts were too small to have meaningful labor market impacts.

Offsetting Canadian and U.S. Tariff Cuts Within Industries or Sectors: Perhaps the negative effects of Canadian tariff cuts were exactly offset by favorable effects of U.S. tariff cuts within industries, so that minimal worker adjustment was required. Because we include both sets of tariff cuts in all of our analyses, if industries facing larger Canadian tariff cuts nearly always faced larger U.S. tariff cuts, there would be insufficient independent variation available to separately identify the effects of each set of cuts (see footnote 32). This is not the case. While in many industries the *net* effect of Canadian and U.S. tariff cuts is to lower cumulative earnings at the *initial firm*, in nearly all industries there is no net effect on *overall* cumulative earnings (see Online Appendix A.8). Also, sections 5.3 and 5.4 document substantial worker reallocation, both among manufacturing industries and between manufacturing and other sectors. These transitions are inconsistent with perfectly offsetting shocks within industry or within sector.

Industrial Geography: When migration is costly, workers may be more likely to transition between industries if their local labor market is more industrially diverse. Because our longitudinal data do not include detailed geographic information, we cannot implement a standard local labor market analysis as in Topalova (2010), Autor et al. (2013a), or Kovak (2013). Instead, Online Appendix A.9 uses data on the pre-FTA industrial composition of local employment to compare the industrial geography of Canada to that of the U.S. We find that i) Canadians do not live in systematically more industrially diverse labor markets, ii) Canadian workers are not systematically more likely to live in larger urban areas, and iii) locations of similar size have similar industry concentrations in the two countries.[49] Moreover, Canadian industrial geography does not systematically lead to Canadian workers facing larger regional trade shocks when facing simulated industry-level tariff changes. While not definitive, these results suggest that industrial geography is not likely to explain the smoother cross-industry transitions that we observe in Canada relative to other contexts.

[49]Autor et al. (2021) find modestly larger effects of the China Shock in U.S. commuting zones with higher levels of industry employment concentration.

Figure 5: Average Tariff Cuts in Workers' Current Industries: Low-Attachment Workers



Notes: We divide manufacturing industries into terciles based on the size of the industry's Canadian tariff cut and assign workers to each tercile based on their *initial* industry of employment. The set of workers in each tercile bin remains fixed over time, and for each bin we plot the average total Canadian tariff cut faced by workers in their *current* industry of employment during the year listed on the x-axis. Non-employed individuals in a given year are omitted from that year's average, and we assign zero tariff cut to non-tradable industries. Declining profiles imply that, on average, workers transition into industries that faced smaller Canadian tariff cuts than their initial industry.

Contemporaneous Labor Market Conditions: Oreopoulos et al. (2012) and Lachowska et al. (2020) argue that the costs of job displacement depend on the macroeconomic conditions during which the displacement occurs. However, macroeconomic conditions do not appear to explain our results. The Canadian unemployment rate increased from 7.6% to 11.4% between 1989 and 1993, and then fell from 11.4% to 8.3% between 1993 and 1998.[50] Given that there was both a severe economic contraction and strong expansion during the implementation of the FTA, it does not appear that persistently strong macroeconomic conditions explain our results.

Having ruled out the preceding explanations for Canada's smooth labor market adjustment, we turn to four empirical results explaining how these relatively smooth adjustments occurred.

Speedy Transitions Away From Import Competition: Sections 5.3 and 5.4 have shown that Canadian workers whose initial industries faced larger increases in import competition shifted into other industries and sectors. Figure 5 shows that these transitions occurred quickly and that workers systematically shifted into industries facing smaller

[50] OECD (2022)

increases in import competition. The Figure divides low-attachment workers into terciles based on the size of their *initial* industry's tariff cut and plots the average tariff cut for each group of workers in their *current* industry in each subsequent year.[51] If workers had stayed in their initial industries, the profiles would have been flat. If cross-industry transitions were uncorrelated with industry tariff cuts, we would find evidence of mean reversion, in which the high tariff-cut tercile would decline while the low tariff-cut tercile would increase. Instead, the declining profiles for all three terciles indicate that workers systematically transitioned from relatively high-tariff industries to relatively low-tariff industries.[52]

U.S. Tariff Cuts in Connected Industries: Here we present evidence that worker transitions out of import-competing industries were enabled by export opportunities in other industries. As in Borusyak et al. (2022), we assume that related industries are reflected in pre-FTA worker transitions between industries, with stronger industry connections implying lower transition costs, all else equal. We therefore define an average outside-option tariff change for a worker initially in manufacturing industry j as

$$\Delta \ln(1+\tau^c_{-j}) \equiv \sum_{\iota \neq j} \varphi_{j\iota} \Delta \ln(1+\tau^c_{\iota}), \tag{4}$$

which is a weighted average of tariff changes facing other related manufacturing industries. The weights reflect the share of pre-FTA worker transitions out of j accounted for by transitions into other manufacturing industries $\iota \neq j$.[53] We generate outside-option tariff cuts for both Canadian and U.S. tariff cuts, $c \in \{\text{CAN}, \text{US}\}$, capturing the extent to which

[51] When calculating this average, we omit workers who are not employed in the relevant year and assign nontradable industries a tariff cut of zero. The results for high-attachment workers are similar and appear in Appendix Figure A13. While the ideal approach would take into account local equilibrium spillovers from tradable to nontradable industries as in Kovak (2013), our lack of detailed geographic information precludes such an analysis.

[52] Autor et al. (2014) present a related analysis showing that although U.S. workers were likely to switch firms and industries in response to increased Chinese import competition, many workers moved into jobs facing similar import competition. We replicate their analysis in Online Appendix Figure A14 and confirm the conclusions of Figure 5: Canadian workers facing import competition due to the FTA quickly transitioned into industries facing substantially less import competition. In addition, their movements were close to what one might expect if workers moved exclusively into industries that saw no direct increase in import competition.

[53] We calculate the pre-FTA transition weights using observed worker transitions between manufacturing industries from 1985 to 1986. Specifically, let $f_{j\iota}$ be the flow of workers from manufacturing industry j to manufacturing industry i, and define $\varphi_{j\iota} \equiv f_{j\iota} / \sum_{\iota' \neq j} f_{j\iota'}$, such that the weights sum to one across manufacturing industries $\iota' \neq j$.

workers in each initial industry j would face increases in import competition or export opportunities in industries previously connected to j through worker transitions.

We then add these outside option measures to our main regression equation (1) in the following specification.

$$\begin{aligned} Y_{ifjk} = \beta_0 - \beta_1 \Delta \ln(1+\tau_j^{\text{CAN}}) - \beta_2 \Delta \ln(1+\tau_j^{\text{US}}) - \beta_3 \Delta \ln(1+\tau_{-j}^{\text{CAN}}) - \beta_4 \Delta \ln(1+\tau_{-j}^{\text{US}}) \\ + \beta_5 \eta_j + \mathbf{X}_i' \beta_6 + \mathbf{X}_f' \beta_7 + \mathbf{X}_j' \beta_8 + \epsilon_{ifjk}, \end{aligned} \tag{5}$$

where η_j is the share of workers initially in industry j who transition to any other manufacturing industry in the pre-FTA period, accounting for the fact that different industries have different baseline degrees of connection to other manufacturing industries.[54] All else equal, workers facing larger increases in import competition in their outside-option industries, i.e. for whom $\Delta \ln(1+\tau_{-j}^{\text{CAN}})$ is more negative, should be less likely to transition into other manufacturing industries. Similarly, workers facing larger increases in export opportunities in their outside-option industries, i.e. for whom $\Delta \ln(1+\tau_{-j}^{\text{US}})$ is more negative, should be more likely to transition into other manufacturing industries.

Table 3 presents the predicted change in years worked for an interquartile difference in the relevant tariff cut, expressed as a share of the unconditional mean years worked (as in Figure 3).[55] Column (1) shows the effect of tariff cuts on total years worked in any job in any sector. Columns (2)-(4) additively decompose this effect into years worked in the initial industry including the initial firm, other industries in manufacturing, and other sectors, respectively, with the last combining columns (5)-(9) of Table 2 and Figure 3 for brevity. Panels A and B show the results for low- and high-attachment workers, respectively.

For low-attachment workers, direct Canadian tariff cuts in the initial industry reduce years worked in that industry by 4.9 percent and increase time working in non-manufacturing industries by 3.5 percent. Figure 3 panel (a) reminds us that this shift was primarily into services and to a lesser extent into construction. Direct U.S. tariff cuts increase years worked in the initial industry by 2.4 percent and reduce time spent elsewhere in manufacturing by 1.9 percent. Outside-option tariff cuts have the opposite signs: workers facing larger Canadian tariff cuts in connected manufacturing industries spend 2.9 percent more years in the initial industry and 2.8 percent less time in these connected manufacturing industries; U.S. tariff cuts in outside-option industries pull workers out of

[54] We also include outside-option measures for MFN tariffs and import penetration from China.

[55] Online Appendix Table A9 presents the coefficient estimates from (5).

Table 3: Years Worked (1989-2004) - Direct and Outside-Option IQR Effects (% Change)

	(1) Total	(2) Initial Ind.	(3) Manuf.	(4) Other
Panel A: Low-Attachment (n=20,600)				
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-0.740	-4.920***	0.715	3.464***
	(0.758)	(1.297)	(0.828)	(0.898)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.445	2.380***	-1.860***	-0.966
	(0.485)	(0.767)	(0.466)	(0.584)
$-\Delta\ln(1+\tau_{-j}^{\text{CAN}})$	-0.237	2.882	-2.801**	-0.319
	(1.039)	(1.802)	(1.330)	(1.291)
$-\Delta\ln(1+\tau_{-j}^{\text{US}})$	0.349	-1.285	1.087*	0.546
	(0.498)	(0.915)	(0.595)	(0.662)
R-squared	0.096	0.147	0.050	0.070
Panel B: High-Attachment (n=63,100)				
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	1.584**	-0.262	1.417	0.429
	(0.62)	(1.81)	(1.37)	(0.74)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.960**	1.243	-1.443	-0.761
	(0.39)	(1.14)	(0.93)	(0.48)
$-\Delta\ln(1+\tau_{-j}^{\text{CAN}})$	0.380	4.075*	-3.964**	0.270
	(0.92)	(2.26)	(1.41)	(1.33)
$-\Delta\ln(1+\tau_{-j}^{\text{US}})$	0.014	-2.009**	1.667**	0.356
	(0.43)	(0.98)	(0.76)	(0.66)
R-squared	0.058	0.113	0.045	0.069

Notes: The table reports estimated effects of interquartile-range tariff cuts as percent change relative to the unconditional mean for years worked. See Online Appendix Table A9 for the associated regression estimates from equation (5). The interquartile range for direct Canadian tariff cuts is 0.064, for direct U.S. tariff cuts is 0.025 , for outside-option Canadian tariff cuts is 0.021, and for outside-option U.S. tariff cuts is 0.0065 . The unconditional mean of years worked for low-attachment workers is 11.6 and for high-attachment workers is 13.4. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

the initial industry (1.3 percent fewer years) and into other manufacturing industries (1.1 percent more years).

High-attachment workers exhibit similar sign effects but with more pronounced effects of outside-option tariffs. High-attachment workers spend 4 percent fewer years in other manufacturing industries when those industries face increased import competition and 1.7 percent more years when those industries experience increased export opportunities.

Overall, the results in Table 3 document the role of U.S. tariff cuts in providing an alternative for workers facing large increases in import competition. High-attachment workers facing increased import competition shift mainly into manufacturing, particularly when outside-option industries benefit from U.S. tariff cuts. Low-attachment workers facing increased Canadian tariff cuts in their initial industries are more likely to work in construction and services, but there is evidence that they also transition into industries benefitting from U.S. tariff cuts. U.S. tariff cuts in related manufacturing industries therefore give some displaced manufacturing workers viable alternatives and help avoid a flood of workers entering the construction and service industries that might otherwise have lowered earnings and/or years worked. In this way, the bilateral nature of the FTA tariff cuts facilitated the successful transitions we observe in the Canadian context, potentially explaining the contrast with other settings.

Mass Layoffs: Mass layoffs lead to substantial and persistently negative labor market outcomes for affected workers (Jacobson et al., 1993; Couch and Placzek, 2010; Lachowska et al., 2020).[56] In Table A10 in the Online Appendix, we examine whether the CUSFTA tariff cuts altered the probability of a mass layoff at affected firms. We define mass layoffs following Jacobson et al. (1993) and run a firm-level regression of the mass-layoff indicator on Canadian and U.S. tariff changes, their interactions with the initial firm size, and the full sets of firm and industry level controls described in Section 4. In specifications with and without heterogeneous effects by firm size, we find no effect of Canadian or U.S. tariff cuts on the probability of a mass layoff; the point estimates are statistically indistinguishable from zero and have small magnitudes. This lack of mass layoffs in response to the FTA helps explain its lack of substantial long-run effects. For comparison, we report the coefficient on the industry's change in Chinese import penetration in Canada (which was included as a control in all prior analyses) and find a statistically significant increase in the probability of a mass layoff for firms in affected industries. While the CUSFTA tariff changes did not induce mass layoffs, the substantial effect of the China Shock shows that Canadian labor markets were not invulnerable to import competition shocks.

Industry Employment Growth: While the main analysis focused on workers initially employed in manufacturing, the Canadian labor market may also have adjusted through changes in employment among other workers. To examine that possibility, Table 4 studies the change in total industry employment and its components. The dependent variable in column (1) is the proportional change in total industry employment from 1988 to 2004. We then regress this growth on Canadian and U.S. tariff cuts and the full set of industry controls described in Section 4. We report the coefficient on the industry's change in Chinese import penetration for comparison. Column (1) of Table 4 shows that both Canadian tariff cuts and increased import penetration from China substantially reduced industry-level employment growth: an industry-level interquartile increase in the

[56] Although not focusing on mass layoffs, Morissette et al. (2013) and Stepner (2019) also find substantial income losses following general layoffs in the Canadian context.

Table 4: Aggregate Industry Employment Growth (1988-2004)

	(1)	(2)	(3)	(4)	(5)
	Industry	Employment Growth Components			
	Employment Growth	Manufacturing Workers	Non-Manuf. Workers	Previously Unemployed	New Entrants
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-3.767*	-0.356	-0.761	-0.285*	-2.365**
	(2.099)	(0.599)	(0.573)	(0.150)	(1.097)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.600	-0.418	-0.020	-0.083	-0.080
	(3.441)	(0.982)	(0.939)	(0.246)	(1.798)
$\Delta IPR_j^{\text{CHN}}$	-0.714**	-0.216**	-0.123	-0.045*	-0.331*
	(0.332)	(0.095)	(0.091)	(0.024)	(0.173)
R-Squared	0.409	0.350	0.322	0.390	0.473

Notes: These industry-level regressions examine the effects of Canadian and U.S. tariff cuts and increased Chinese import penetration on the proportional change in aggregate industry employment from 1989-2004, across 78 manufacturing industries (not restricting to workers initially in manufacturing as in earlier analyses). Column (1) examines overall industry employment growth, while columns (2)-(5) study the portion of industry employment growth accounted for by its additively separable components: (2): workers employed in manufacturing in 1988; (3): those employed outside manufacturing in 1988; (4): those employed between 1984 and 1987, but not in 1988 ("unemployed"); and (5) those not employed between 1984 and 1988 ("new entrants"). All specifications include the dependent variable pre-trend, calculated for 1984-1987 (results are similar without this pre-trend control), and the full set of industry-level controls described in Section 4. Standard errors clustered by 4-digit NAICS industry which is equivalent to heteroskedasticity-robust for these industry-level regressions. *** p<0.01, ** p<0.05, * p<0.1.

Canadian tariff cut (0.045) reduced employment growth by 17.0 percentage points. This is large relative to the effect of an interquartile difference in Chinese import penetration (0.139): a reduction of 9.9 percentage points.

The remaining columns additively decompose overall industry growth into the portion accounted for by incumbent workers who were already employed in manufacturing in 1988 (column 2), those who were employed outside manufacturing in 1988 (column 3), those not employed in 1988 but who were observed working in previous years (column 4), and those who entered the labor force after 1988 (column 5). While the China shock affected employment growth across various margins, the effect of Canadian tariff cuts is strongly concentrated among new entrants. This adjustment among new entrants does not appear in our main analysis because the latter focuses on individuals initially employed in manufacturing. However, this finding for entrants corroborates a pattern revealed in our main analysis: the negative effects of import competition resulting from Canadian tariff cuts are minimal among those with strong labor force attachment, and larger for low-attachment workers.

Summary: The results presented here help explain the small overall effects of the FTA on Canadian manufacturing workers. Workers facing import competition quickly transitioned from adversely affected industries to those facing smaller increases in import competition. The bilateral nature of the FTA gave import-competing workers the option of shifting into related industries with large U.S. tariff cuts. This option allowed high attachment workers to remain in manufacturing, and reduced the number of workers the service sector needed to absorb. In addition, Canadian tariff cuts did not lead to highly disruptive mass layoffs. Although Canadian tariff cuts did reduce industry employment growth, this occurred primarily among new entrants, while insulating incumbent manufacturing workers. In contrast, the China Shock in Canada increased the probability of a mass layoff and reduced employment among both incumbent workers and new entrants. This difference in effects across different shocks suggests that the Canadian labor market is not invulnerable to all trade shocks, and that labor market institutions alone are insufficient explain the relatively smooth adjustment to the FTA tariff changes documented in this paper. Instead, the results suggest that the bilateral nature of the FTA was an important feature facilitating worker transitions.

6 Firm Heterogeneity

This section returns to the issues of firm heterogeneity raised in Section 5.2 by examining heterogeneous effects of the CUSFTA tariff cuts by initial firm size.

6.1 Transitions

Table 1 showed that bilateral tariff cuts affected the probability of a worker experiencing a permanent work-shortage related separation from their initial firm. Here, we additively decompose those separation results based on the worker's subsequent employment situation. We categorize workers based on their primary job in the year following displacement, so each separated worker falls in precisely one employment transition category or unemployment. The results of this decomposition appear in Figures 6 and 7. We present magnitude calculations comparing interquartile differences in tariff cuts, following the same procedure used in Figure 3.[57] The first set of bars ("Total") is simply the change in layoff probability due to an interquartile comparison, while the remaining bars present the decomposition.[58]

Figure 6 shows the effects of Canadian tariff cuts. Results for workers initially at large firms (top panels) and those initially at small firms (bottom panels) tend to be mirror op-

[57]The associated regression results appear in Online Appendix Tables A11-A13.
[58]Results for workers at medium-sized firms appear in Online Appendix Tables A11-A13.

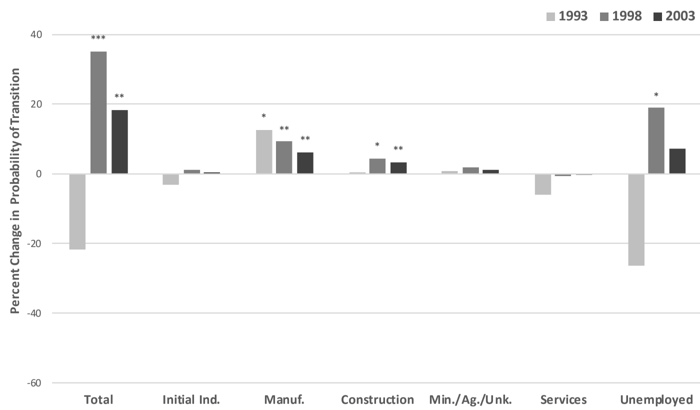
posites. Canadian tariff concessions induce a higher separation probability at large firms, but a smaller probability at small firms. Separated workers at large firms did not stay in the same industry, but moved elsewhere in manufacturing or into construction, consistent with movement into industries insulated from import competition, as documented in Figure 5. Low-attachment workers at small firms (Panel c) benefit from Canadian tariff cuts through lower layoff probabilities and fewer transitions into unemployment, with similar though muted effects for high-attachment workers (Panel d).

As mentioned in Section 5.2, displacement effects of import competition concentrated at large firm runs counter to standard firm heterogeneity models such as Melitz (2003) and Demidova and Rodríguez-Clare (2013), which predict employment losses at smaller firms. Our findings are more in line with empirical studies of the effects of increased import competition that find larger effects at large firms, perhaps justified by the niche market argument proposed by Head and Ries (1999) and formalized by Holmes and Stevens (2014) or the complementary product-cycle arguments of Eriksson et al. (2021).[59] Yet, despite this increased probability of separation from their initial employers, workers at large firms reallocated relatively smoothly into other industries and did not see statistically significant increases in unemployment at the short one-year time horizon following separation.

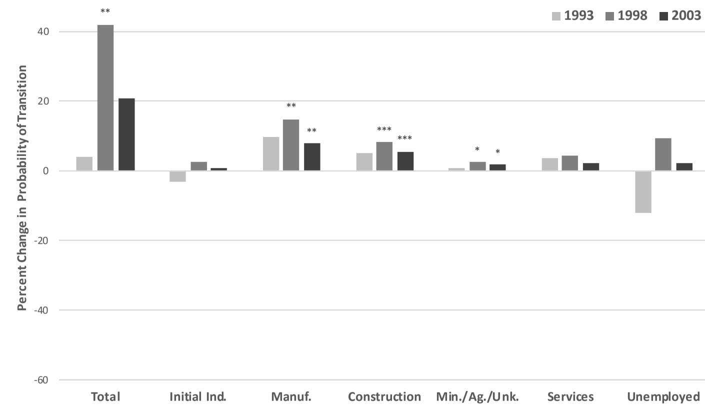
Figure 7 examines reallocations in response to U.S. concessions. U.S. tariff cuts for low-attachment workers at large Canadian firms reduced separations largely by reducing transitions into unemployment (Panel a). The opposite occurs for workers initially at small firms: there is a heightened probability of separation and transition to another firm in the same industry, into construction, or into unemployment (Panel c). This pattern is consistent with results in Trefler (2004) and Lileeva (2008) in which U.S. tariff cuts increase employment at exporters (large firms) but reduce it for non-exporters (small firms). Results for high-attachment workers are similar but less precisely estimated: increased job stability at large firms is mirrored by increased transitions to other firms within the same industry for those initially employed at small firms (Panels b and d). The effects of U.S. tariff cuts therefore conform with the predictions of models of firm heterogeneity: increased access to export markets benefits larger firms able to bear the fixed costs of exporting while potentially heightening factor market competition that harms smaller non-exporting firms (Demidova and Rodríguez-Clare, 2013).

[59] Empirical papers finding larger effects of import competition at large firms include Head and Ries (1999), Baldwin et al. (2001), Baldwin and Gu (2004), and Lileeva (2008), for CUSFTA in Canada and Autor et al. (2013b) and Pierce et al. (2020) for Chinese import competition in the U.S.

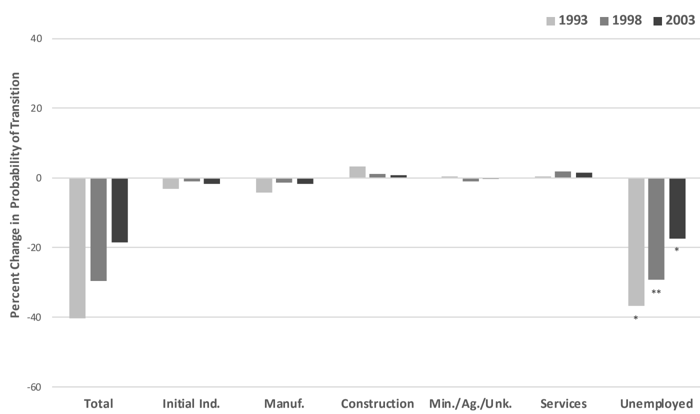
Figure 6: Effects of Canadian Tariff Cuts on Worker Transitions, by Labor-Force Attachment and Initial Firm Size



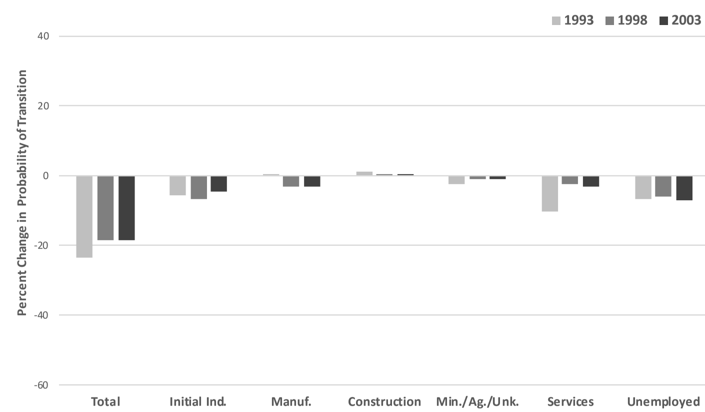
(a) Low-Attachment Workers, Large Firm



(b) High-Attachment Workers, Large Firm



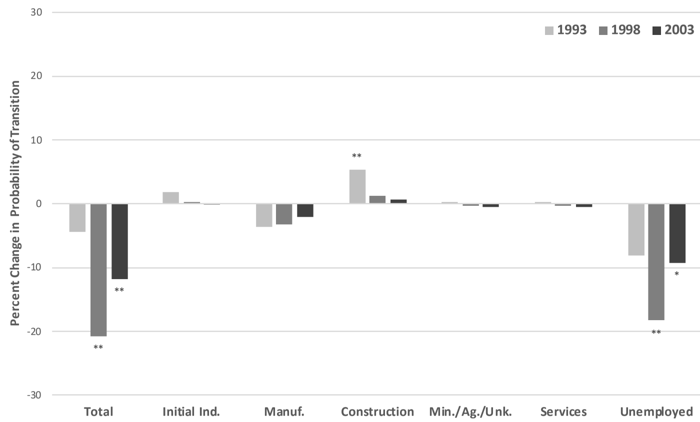
(c) Low-Attachment Workers, Small Firm



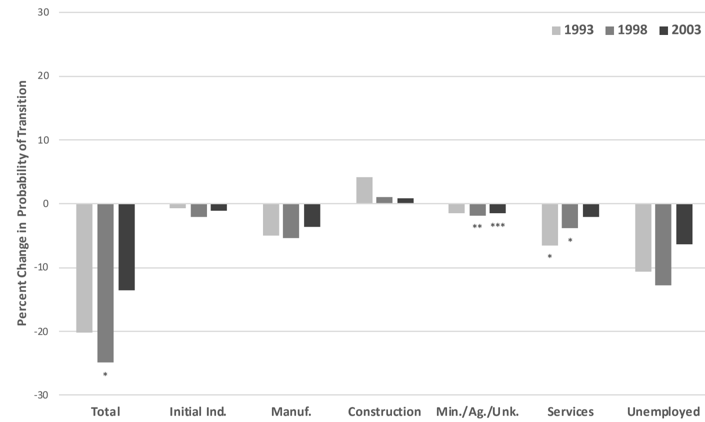
(d) High-Attachment Workers, Small Firm

Notes: The figures present scaled estimates from regressions paralleling those in Table 1. The bars labeled "Total" show predicted differences in the probability of a work-shortage related separation from the worker's initial firm from 1989 to the year associated with each bar when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean separation probability. Subsequent bars decompose the separations based on the worker's status in the year following separation. The interquartile range for Canadian tariff cuts is 0.064. The unconditional probability of a work-shortage related separation is 0.169 for low-attachment workers and 0.116 for high-attachment workers. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

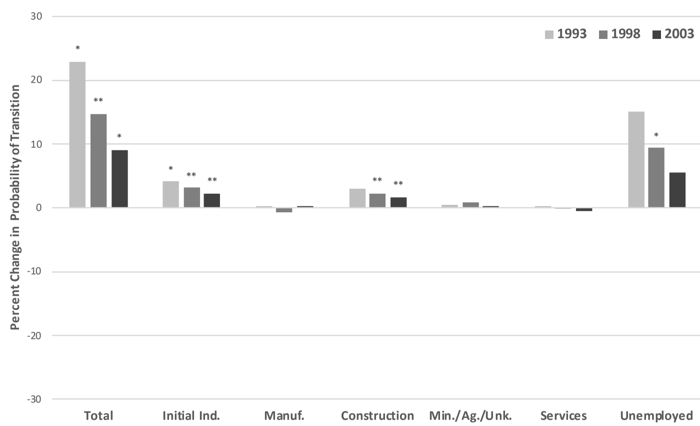
Figure 7: Effects of U.S. Tariff Cuts on Worker Transitions, by Labor-Force Attachment and Initial Firm Size



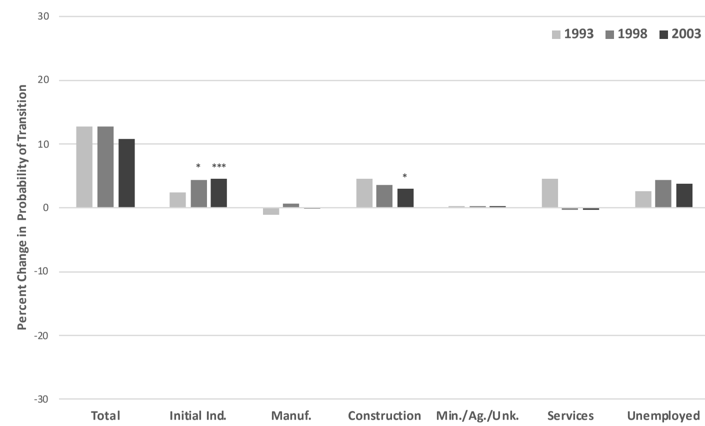
(a) Low-Attachment Workers, Large Firm



(b) High-Attachment Workers, Large Firm



(c) Low-Attachment Workers, Small Firm



(d) High-Attachment Workers, Small Firm

Notes: The figures present scaled estimates from regressions paralleling those in Table 1. The bars labeled "Total" show predicted differences in the probability of a work-shortage related separation from the worker's initial firm from 1989 to the year associated with each bar when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean separation probability. Subsequent bars decompose the separations based on the worker's status in the year following separation. The interquartile range for U.S. tariff cuts is 0.025. The unconditional probability of a work-shortage related separation is 0.169 for low-attachment workers and 0.116 for high-attachment workers. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

6.2 Earnings

Figures 8 and 9 examine effects on cumulative earnings for workers initially employed at large or small firms, using the same organization as Figures 6 and 7.[60] Up to this point, we have emphasized the quantitatively small effects of the FTA on overall worker outcomes. However, in Figures 8 and 9, we find substantial and growing overall effects of both Canadian and U.S. tariff cuts on the earnings of low-attachment workers initially employed in large firms. Figure 8, Panel (a) finds that an interquartile comparison of Canadian tariff concessions reduces long-run cumulative earnings by 7.0 percent for low-attachment workers initially employed at large firms, with losses of 11.9 percent in the worker's initial firm and initial industry (combined) and 5.1 percent recovered through increased earnings in manufacturing, construction, and services. When facing U.S. concessions (Figure 9, Panel (a)), these workers exhibit earnings gains (5.2 percent) primarily coming from increased initial-firm earnings.

In contrast, the earnings effects for low-attachment workers initially employed in small firms and for high-attachment workers irrespective of firm size are generally small and statistically insignificant. These results therefore confirm the broad message of Figure 4, that on average Canadian workers experienced relatively small effects of the CUSFTA tariff changes. However, for the minority of our sample consisting of low-attachment workers initially employed at large firms, we find substantial earnings effects. While this nontrivial effect poses an important qualifier to our baseline analysis in Section 5, recall that the effects of Canadian and U.S. tariff cuts offset each other on average, even for low-attachment workers at large firms. When this group simultaneously faces interquartile differences in Canadian and U.S. tariff cuts, the predicted difference in net cumulative earnings is small: -1.7 percent ($= 7.0 - 5.2$).[61]

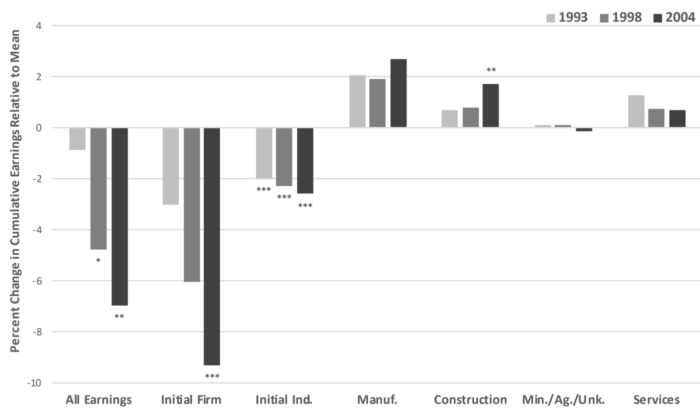
7 Conclusion

This paper uses 21 years of longitudinal worker-firm administrative data to examine how the bilateral tariff reductions legislated by the Canada-U.S. Free Trade Agreement af-

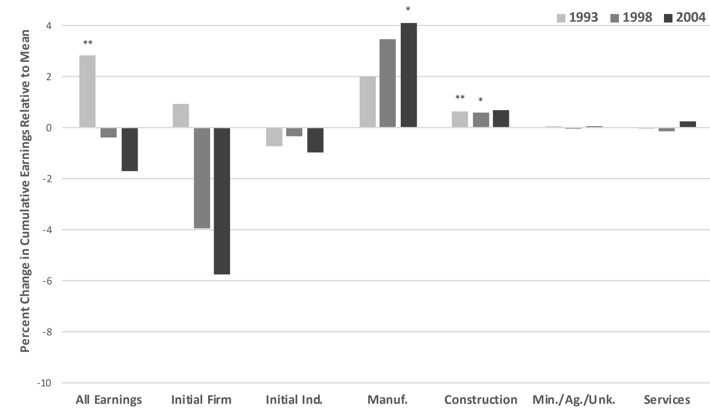
[60] Regression tables corresponding to these figures appear in Online Appendix Tables A14-A16.

[61] As discussed in Section 5.6, the predicted net effect of Canadian and U.S. cuts differs by industry. Consider low-attachment workers initially at large firms, as this group generally has the largest point estimates for each individual tariff change. For the separation probability and for cumulative earnings, we can only reject the null of zero net effect for 4 out of 78 industries, and the effects are generally small. However, for the net effect of tariff cuts on earnings at the worker's *initial* firm, we can reject the null of zero for 35 industries, all of which have negative point estimates. See Online Appendix Figures A3-A5.

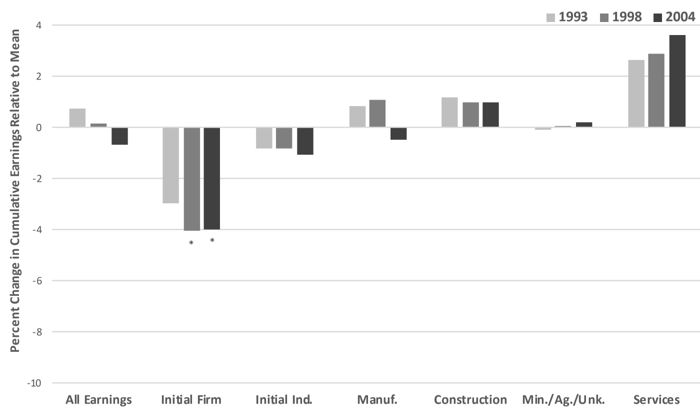
Figure 8: Effects of Canadian Tariff Cuts on Cumulative Normalized Earnings, by Labor-Force Attachment and Initial Firm Size



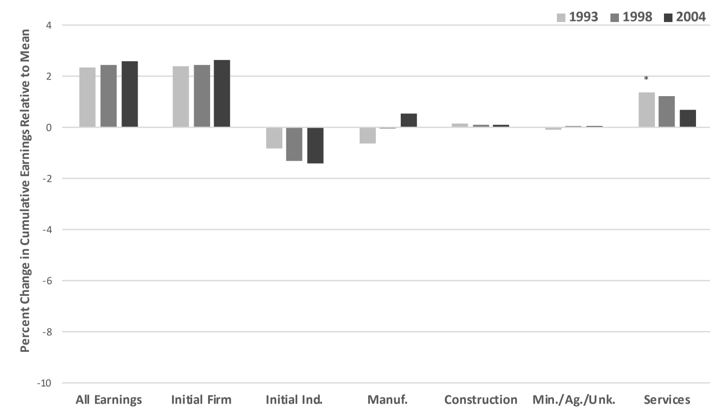
(a) Low-Attachment Workers, Large Firm



(b) High-Attachment Workers, Large Firm



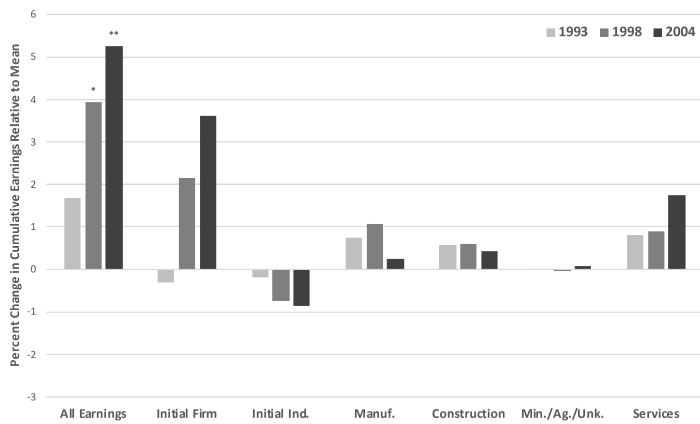
(c) Low-Attachment Workers, Small Firm



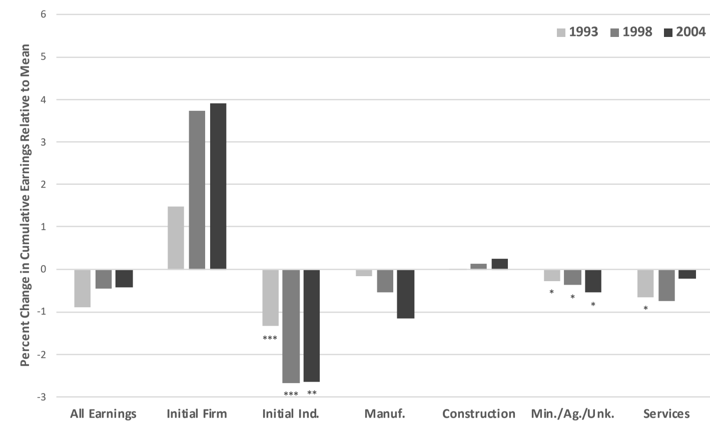
(d) High-Attachment Workers, Small Firm

Notes: The bars show predicted differences in cumulative normalized earnings when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean cumulative normalized earnings. The interquartile range for Canadian tariff cuts is 0.064. The unconditional mean of cumulative normalized earnings for low-attachment workers is 20.19 and for high-attachment workers is 14.34. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

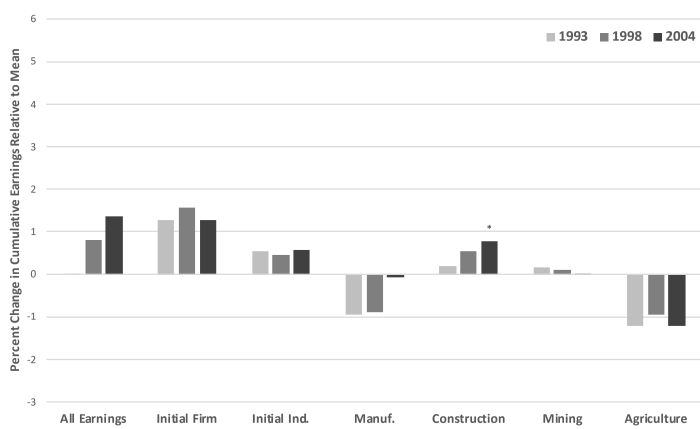
Figure 9: Effects of U.S. Tariff Cuts on Cumulative Normalized Earnings, by Labor-Force Attachment and Initial Firm Size



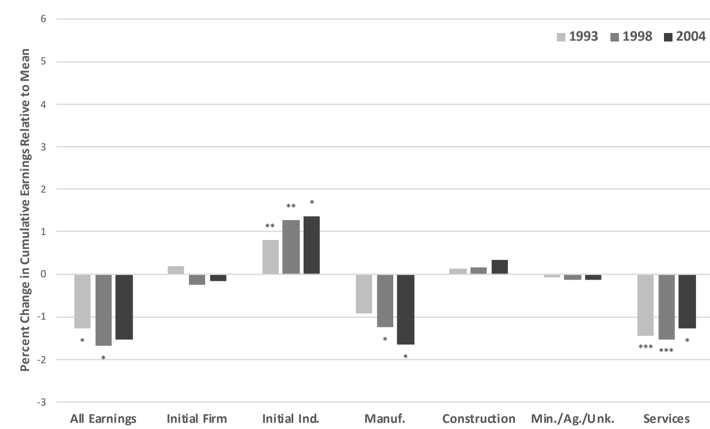
(a) Low-Attachment Workers, Large Firm



(b) High-Attachment Workers, Large Firm



(c) Low-Attachment Workers, Small Firm



(d) High-Attachment Workers, Small Firm

Notes: The bars show predicted differences in cumulative normalized earnings when facing tariff changes that differ by the interquartile range, expressed as a percent of the group's mean cumulative normalized earnings. The interquartile range for U.S. tariff cuts is 0.025. The unconditional mean of cumulative normalized earnings for low-attachment workers is 20.19 and for high-attachment workers is 14.34. To make results comparable to the 16-year 1989-2004 timeframe, the 1989-1993 values are multiplied by 16/5, and the 1989-1998 values are multiplied by 16/10. See Table 2 note for category definitions. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

fected Canadian workers. The bilateral tariff cuts had muted effects on worker outcomes. Substantial adverse effects of Canadian tariff concessions on employment and earnings at workers' initial firm of employment were generally offset by opposing effects elsewhere in the labor market, as workers transitioned into other manufacturing industries, construction, and services. Because Canadian and U.S. tariff reductions generally had opposite signs, the net effects had even smaller magnitudes on average. For example, although low-attachment workers initially employed at large firms had larger magnitude effects of each country's tariff change than did other worker groups, the net effects of the FTA were still very small.

These relatively optimistic findings contrast strikingly with the prolonged effects of import competition and mass layoffs documented in Jacobson et al. (1993), Autor et al. (2014), and Dix-Carneiro and Kovak (2017). To help reconcile this difference, we show that Canadian workers left affected industries quickly and that the bilateral nature of the FTA gave import-competing workers employment options in potential alternative manufacturing industries benefiting from larger U.S. tariff cuts. In addition, the tariff cuts primarily reduced the number of new hires in affected industries and had little effect on incumbent workers.

This collection of results allows us to reject certain explanations for the small effects of the CUSFTA. Figures 1 and 2 rule out the possibility that CUSFTA was too small to matter; it was larger than the China Shocks in Canada and the U.S. We also reject the possibility that Canadian labor markets simply respond more flexibly to all trade shocks. Tables A10 and 4 suggest this is not the case, as an interquartile difference in Chinese import penetration growth led to a 3.8 percentage point increase in the firm-level mass-layoff probability and a 9.9 percentage point slower growth in industry employment. Instead, our findings suggest that the bilateral nature of the FTA was a central feature facilitating the worker transitions that helped mitigate the negative consequences of import competition.

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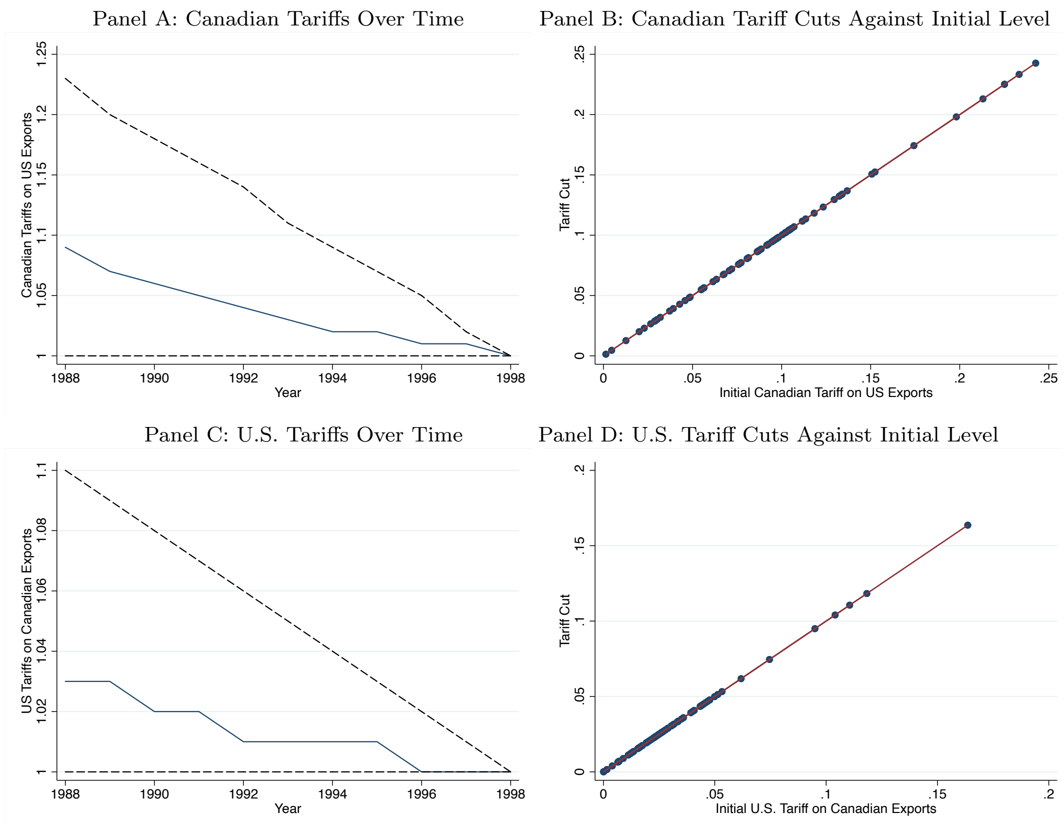
Online Appendices

(Not for publication)

A Additional Results

A.1 CUSFTA Tariff Cuts

Figure A1: CUSFTA Tariff Cuts

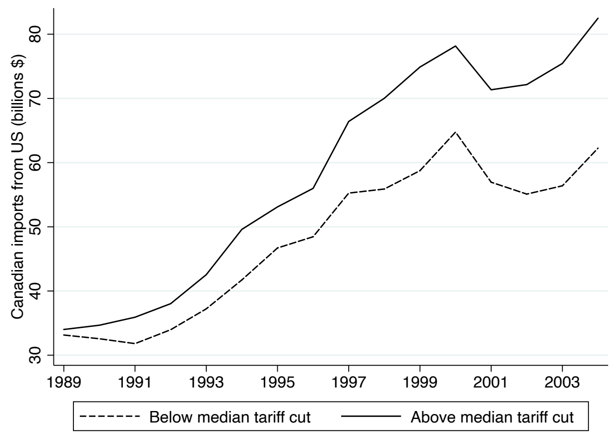


Notes: Panel A plots the unweighted average Canadian NAICS tariff plus one against U.S. exports from 1988 through 1998. Values of 1 represent no tariff. The dotted lines represent 5^{th} and 95^{th} percentiles. Panel B plots the initial 1988 tariff on the horizontal axis and the cut from 1988 to 1998 on the vertical axis. Each dot is an industry and the line is a 45 degree line. Values of zero on the horizontal axis represent no tariff. Panels C and D does the same for U.S. tariffs against Canadian exports.

A.2 Change in Trade Flows by Tariff Change

Figure A2 shows that Canadian imports from the U.S. increased more quickly for 6-digit HS products that faced larger Canadian tariff cuts than for products facing smaller tariff cuts, and that the gap between these two sets of products grew steadily over time. The solid line shows Canadian imports from the U.S. in billions of CAD for products facing above-median Canadian tariff cuts, while the dashed line shows the same measure for products facing below-median tariff cuts. While both series start with quite similar trade values in 1989, at the start of the FTA, they steadily diverge throughout our sample

Figure A2: Change in Trade Flows by Tariff Change



Notes: The y-axis plots the level of Canadian imports from the United States in billions of CAD for the years 1989-2004 (the x-axis). The solid line represents the level of imports in HS 6-digit codes whose 1988 tariff was above the median industry level. The dashed line represents imports in HS 6-digit codes whose 1988 tariff was below the median industry level.

period, with products experiencing larger tariff cuts exhibiting larger increases in trade values. We thank Teresa Fort for suggesting this figure.

A.3 Correlates of High Attachment Status

The majority of our sample is high-attachment: 63,100 high-attachment workers and 20,600 low-attachment workers (both rounded to the nearest 100 to avoid disclosure concerns). Columns (1)-(3) of Table A1 examine the features of high-attachment status, regressing an indicator for high labor force attachment on the full set of worker, firm, and industry controls. We omit the experience and tenure indicators, which are mechanically correlated with the high-attachment indicator. Columns (1) and (2) show that women and younger workers are unconditionally less likely to be high attachment. Column (3) adds the full set of controls. Workers with higher average initial wage income and lower pre-FTA wage income growth are more likely to have high attachment status. Workers at large firms are *less* likely to be high attachment, as are workers at firms with stronger pre-FTA wage growth. Workers in industries with lower average wages and lower average wage growth are more likely to be high attachment.

Table A1: Correlates of High Attachment Status

	(1)	(2)	(3)
Worker Characteristics			
Female_i	-0.189***		0.0627***
	(0.0209)		(0.00599)
Age_i		0.0776***	0.0598***
		(0.00489)	(0.00740)
Age_i^2		-0.000920***	-4.18e-05
		(6.56e-05)	(3.58e-05)
$\text{Age}_i \times \ln(\text{income}_{i,1986-1988})$			-0.00559***
			(0.000823)
$\ln(\text{income}_{i,1986-1988})$			0.636***
			(0.0286)
$\Delta_{1986-1988} \ln(\text{income}_i)$			-0.0753***
			(0.00507)
Firm Characteristics			
$\ln(\text{income}_{f,1986-1988})$			0.0199***
			(0.00356)
$\Delta_{1986-1988} \ln(\text{income}_f)$			-0.0231***
			(0.00552)
$\mathbb{1}(\text{small firm})$			0.0203**
			(0.00806)
$\mathbb{1}(\text{medium firm})$			0.0234***
			(0.00699)
Industry Characteristics			
$\ln(1+\tau^{\text{CAN}}_{j,1988})$			-0.0285
			(0.113)
$\ln(1+\tau^{\text{US}}_{j,1988})$			-0.180
			(0.141)
$\Delta_{1988-1998} \ln(1+\tau_j^{\text{CAN,MFN}})$			0.225*
			(0.122)
$\Delta_{1988-1998} \ln(1+\tau_j^{\text{US,MFN}})$			-0.0104
			(0.162)
$\Delta IPR_j^{\text{CHN}}$			-0.0133
			(0.0257)
Cyclicality_j			-0.000489
			(0.00242)
Share below median $\text{income}_{j,1988}$			-0.0256
			(0.0261)
Mean log $\text{earnings}_{j,1988}$			-0.0525*
			(0.0286)
Log capital-labor $\text{ratio}_{j,1988}$			-0.00626**
			(0.00260)
$\Delta_{1984-1988} \ln\left(\frac{emp_j}{\sum_{j'} emp_{j'}}\right)$			-0.0265
			(0.0249)
$\Delta_{1986-1988}$ Mean log earnings_j			-0.161**
			(0.0652)
Observations	83,700	83,700	83,700
R-squared	0.039	0.048	0.436

Notes: ***: $p < 0.01$, **: $0.01 \le p < 0.05$, *: $0.05 \le p < 0.1$. The dependent variable is an indicator for workers with high attachment status. Standard errors clustered at the 2007 NAICS-4 digit level are in parentheses. age_i is the age of individual i in the initial year.

A.4 Exogeneity of Trade Policy

Table A2: Exogeneity of Trade Policy

Dependent variable:	$\ln(1+\tau^{\text{CAN}}_{j,1988})$		$\ln(1+\tau^{\text{US}}_{j,1988})$	
	(1)	(2)	(3)	(4)
$\ln(1+\tau^{\text{US}}_{j,1988})$		1.010***		
		(0.166)		
$\ln(1+\tau^{\text{CAN}}_{j,1988})$				0.357***
				(0.0585)
$\Delta_{1988-1998}\ln(1+\tau_j^{\text{CAN,MFN}})$		0.626***		-0.187**
		(0.101)		(0.0719)
$\Delta_{1988-1998}\ln(1+\tau_j^{\text{US,MFN}})$		-0.0447		-0.0324
		(0.202)		(0.120)
$\Delta IPR_j^{\text{CHN}}$	0.0133	0.0372*	-0.0119	-0.0207*
	(0.0292)	(0.0200)	(0.0145)	(0.0120)
Separation prob.$_{1985-1988,j}$	-0.281	-0.0496	-0.0946	-0.0340
	(0.202)	(0.139)	(0.100)	(0.0828)
Cyclicality$_j$	0.00741*	-0.00350	0.00748***	0.00589***
	(0.00395)	(0.00298)	(0.00195)	(0.00164)
Share below median income$_{j,1988}$	-0.0668	-0.0202	-0.0237	-0.00559
	(0.0557)	(0.0384)	(0.0276)	(0.0229)
Mean log earnings$_{j,1988}$	-0.104**	-0.0390	-0.0451*	-0.0136
	(0.0468)	(0.0326)	(0.0231)	(0.0195)
Log capital-labor ratio$_{j,1988}$	-0.00388	0.00214	-0.00296	-0.00253
	(0.00522)	(0.00360)	(0.00259)	(0.00212)
$\Delta_{1984-1988}\ln\left(\frac{emp_j}{\sum_{j'}emp_{j'}}\right)$	-0.0482	0.0126	-0.0632***	-0.0456***
	(0.0392)	(0.0287)	(0.0194)	(0.0161)
$\Delta_{1986-1988}$ Mean log earnings$_j$	0.0787	0.0415	-0.0151	-0.0262
	(0.102)	(0.0695)	(0.0503)	(0.0413)
R-squared	0.313	0.699	0.398	0.619

Notes: ***: $p < 0.01$, **: $0.01 \leq p < 0.05$, *: $0.05 \leq p < 0.1$. Standard errors clustered at the 2007 NAICS-4 digit level are in parentheses. All columns estimate versions of equation (3). All variables are as described in the text. Estimation is OLS. 78 industry observations.

A.5 Years Worked Results Tables

Table A3: Years Worked (1989-1993)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta \ln(1+\tau_j^{\text{CAN}})$	-0.968***	-1.717**	-0.788*	0.495	0.316	-0.0393	0.764
	(0.292)	(0.745)	(0.417)	(0.457)	(0.276)	(0.187)	(0.464)
$-\Delta \ln(1+\tau_j^{\text{US}})$	0.427	1.197	1.804***	-2.069**	0.428	0.0264	-0.960
	(0.505)	(1.189)	(0.672)	(0.883)	(0.517)	(0.302)	(0.876)
R-squared	0.114	0.174	0.034	0.035	0.037	0.021	0.057
Panel B: High Attachment (n=63,100)							
$-\Delta \ln(1+\tau_j^{\text{CAN}})$	1.052***	0.534	-0.472	0.702	0.266	-0.0230	0.0448
	(0.383)	(0.918)	(0.381)	(0.757)	(0.168)	(0.109)	(0.272)
$-\Delta \ln(1+\tau_j^{\text{US}})$	-0.769	2.378	0.718	-1.850	-0.0417	-0.216	-1.759***
	(0.581)	(1.879)	(0.758)	(1.314)	(0.362)	(0.166)	(0.474)
R-squared	0.037	0.111	0.017	0.039	0.019	0.012	0.054

Notes: Dependent variable is the number of years worked (with nonzero earnings) during 1989-1993. Remaining notes identical to Table 2.

Table A4: Years Worked (1989-1998)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta \ln(1+\tau_j^{\text{CAN}})$	-1.194	-4.088**	-1.567*	1.837	0.868*	-0.0181	1.775*
	(0.717)	(1.560)	(0.939)	(1.108)	(0.458)	(0.408)	(0.954)
$-\Delta \ln(1+\tau_j^{\text{US}})$	-0.676	3.170	3.792**	-5.323***	0.746	0.0745	-3.136*
	(1.352)	(2.221)	(1.634)	(1.947)	(0.995)	(0.681)	(1.837)
R-squared	0.103	0.150	0.044	0.041	0.041	0.025	0.056
Panel B: High Attachment (n=63,100)							
$-\Delta \ln(1+\tau_j^{\text{CAN}})$	2.107***	-0.250	-1.149	2.950	0.640	-0.0846	0.000747
	(0.725)	(2.285)	(0.943)	(1.774)	(0.390)	(0.294)	(0.760)
$-\Delta \ln(1+\tau_j^{\text{US}})$	-1.766*	5.858	1.910	-5.125	-0.0309	-0.481	-3.897***
	(0.907)	(4.556)	(2.493)	(3.155)	(0.830)	(0.423)	(1.314)
R-squared	0.040	0.107	0.032	0.041	0.020	0.019	0.057

Notes: Dependent variable is the number of years worked (with nonzero earnings) during 1989-1998. Remaining notes identical to Table 2.

A.6 Cumulative Normalized Earnings Results Tables

Table A5: Cumulative Normalized Earnings (1989-1993)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-0.267	-2.101	-1.157*	1.409	0.750**	-0.0419	0.873
	(1.218)	(1.316)	(0.627)	(1.131)	(0.359)	(0.285)	(0.861)
$-\Delta\ln(1+\tau_j^{\text{US}})$	2.786	2.145	1.014	-1.988	0.839	0.405	0.371
	(2.043)	(2.247)	(0.922)	(1.897)	(0.702)	(0.536)	(1.678)
R-squared	0.105	0.064	0.012	0.033	0.022	0.019	0.081
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	1.014	0.733	-0.319	0.481	0.202	-0.000961	-0.0821
	(0.737)	(1.067)	(0.400)	(0.775)	(0.142)	(0.105)	(0.339)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.166	2.846	-0.228	-1.331	0.000503	-0.275*	-1.178**
	(0.889)	(1.779)	(0.748)	(1.156)	(0.296)	(0.153)	(0.466)
R-squared	0.073	0.076	0.014	0.036	0.016	0.009	0.051

Notes: Dependent variable is the sum of a worker's earnings during 1989-1993, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2). The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry. A positive (negative) coefficient means that larger tariff cuts in the worker's initial industry lead to increased (decreased) cumulative earnings. Column (1) examines total earnings from all sources, (2) earnings from the initial firm, (3) from firms other than the initial firm, but in the same initial 4-digit industry, (4) in manufacturing industries (NAICS=3xxx) other than the initial industry, (5) in construction and utilities (NAICS=22xx, 23xx), (6) in mining (NAICS=21xx), agriculture (NAICS=1xxx), or in a firm with unknown industry code, or (7) in services (NAICS≥4xxx). Because earnings in columns (2) through (7) additively decompose total earnings, the coefficients in columns (2) through (7) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Cumulative Normalized Earnings (1989-1998)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-2.980	-7.171***	-2.205	3.356	1.482**	0.0873	1.470
	(3.221)	(2.650)	(1.645)	(2.773)	(0.744)	(0.725)	(2.217)
$-\Delta\ln(1+\tau_j^{\text{US}})$	7.535	7.307	0.949	-4.838	2.509	0.735	0.873
	(5.888)	(4.506)	(2.667)	(5.057)	(1.559)	(1.218)	(5.131)
R-squared	0.108	0.059	0.014	0.029	0.022	0.024	0.100
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	0.663	-1.080	-0.535	2.480	0.455	-0.0158	-0.643
	(2.021)	(2.747)	(1.066)	(1.881)	(0.338)	(0.310)	(0.951)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-0.0593	8.274	-1.312	-4.235	0.0865	-0.616	-2.257*
	(2.469)	(5.216)	(2.773)	(3.083)	(0.710)	(0.455)	(1.294)
R-squared	0.080	0.073	0.024	0.044	0.017	0.015	0.062

Notes: Identical to the preceding table with the exception that the dependent variable is the sum of a worker's earnings during 1989-1998, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2).

Table A7: Cumulative Normalized Earnings (1989-2004)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-8.990	-15.38***	-4.188	4.167	4.049***	0.317	2.041
	(6.823)	(4.653)	(3.093)	(5.201)	(1.486)	(1.357)	(4.596)
$-\Delta\ln(1+\tau_j^{\text{US}})$	15.54	14.07	2.014	-7.345	3.699	0.783	2.319
	(12.95)	(8.530)	(5.250)	(9.793)	(2.576)	(2.067)	(10.50)
R-squared	0.134	0.048	0.017	0.037	0.026	0.022	0.116
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	0.362	-2.684	-1.927	5.286	0.790	0.102	-1.205
	(3.394)	(5.367)	(2.056)	(3.430)	(0.714)	(0.686)	(2.092)
$-\Delta\ln(1+\tau_j^{\text{US}})$	0.0234	12.97	-1.002	-9.633*	0.808	-1.129	-1.994
	(4.240)	(9.373)	(5.078)	(5.538)	(1.458)	(0.907)	(3.090)
R-squared	0.113	0.070	0.028	0.051	0.020	0.022	0.073

Notes: Identical to the preceding two tables with the exception that the dependent variable is the sum of a worker's earnings during 1989-2004, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2).

A.7 Manufacturing Workers' Demographics and Education

Table A8 shows average characteristics of manufacturing workers in the 1981 Census of Canada and the 1980 US Census of Population. The two sets of workers have very similar mean age, gender, marital status, and educational attainment. In particular, the share of workers with a high-school degree or less is remarkably similar: 68.0 percent in Canada and 70.8 in the US. This rules out substantial differences in educational attainment facilitating smoother industry transitions in Canada. The most salient difference between the two countries' manufacturing workers is that Canadian manufacturing workers are much more likely to be foreign-born, reflecting Canada's much more immigrant intensive population.

Table A8: Manufacturing Workers' Characteristics (Canada 1981, US 1980)

	Canada (1981)	US (1980)
Age	39.1	39.7
Female	0.264	0.318
Married	0.785	0.736
Foreign born	0.277	0.086
High-school or less	0.680	0.708
Some college	0.238	0.162
College or more	0.082	0.129

Notes: 1981 Census of Canada data from IPUMS International (Ruggles et al., 2024a). 1980 US Census of Population data from IPUMS USA (Ruggles et al., 2024b). Sample includes those age 22-64 who report working in manufacturing industries in the preceding week and not enrolled in school.

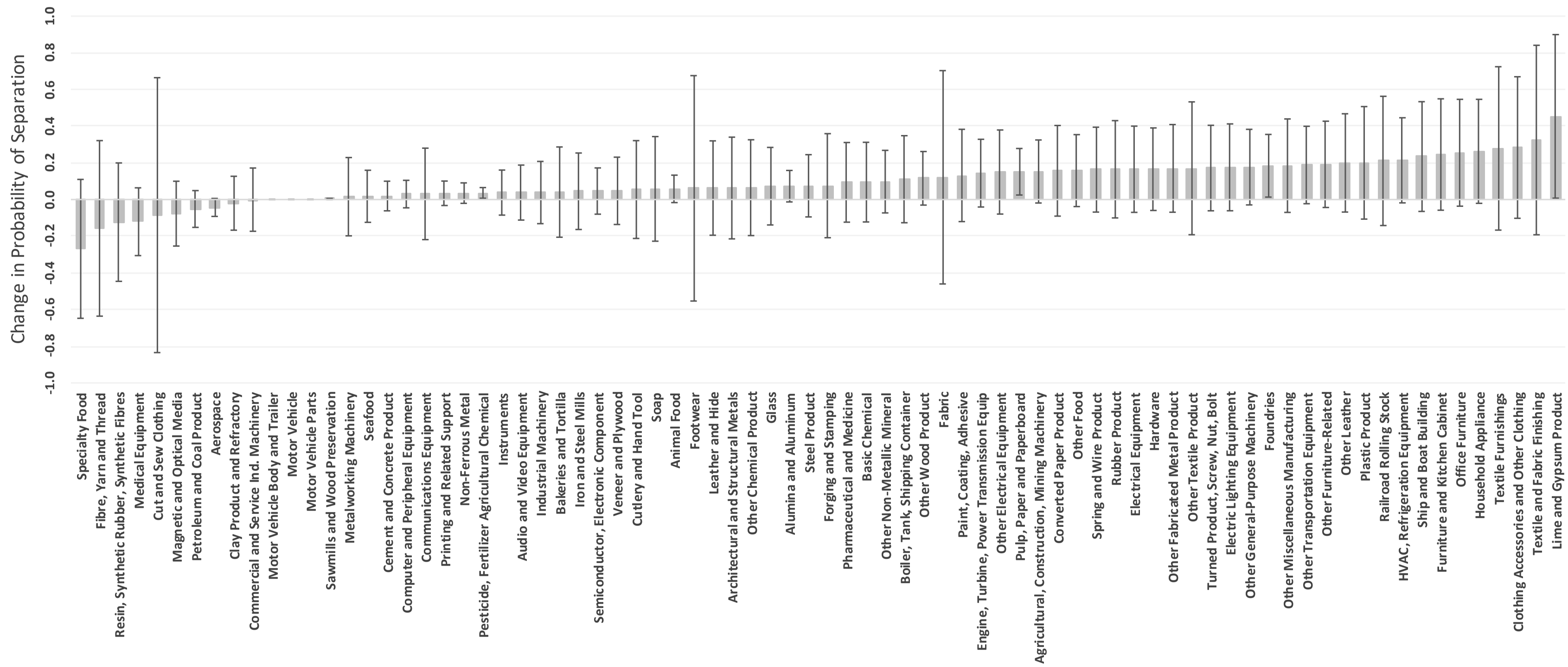
A.8 Net Effects by Industry

In Figures A3-A5, we present the net effects of Canadian and U.S. tariff cuts on the probability of experiencing a work-shortage related separation (layoff), on overall cumulative earnings, and on cumulative earnings from the initial firm, respectively. We present results for low attachment workers initially at large firms because this worker group generally exhibits the largest point estimates. The predicted effects are evaluated at the particular Canadian and U.S. tariff cuts facing each industry and divided by the average outcome for low attachment workers initially at large firms, so the predicted values are expressed as proportional differences from the average outcome. Each figure sorts industries on the x-axis from most negative to most positive net effect.

Figure A3 shows the net effects for permanent work-shortage related separations. In spite of focusing on the worker group with the largest point estimates, the majority of predicted net effects are small, with magnitudes less than 20 percent, and only 4 out of 78 manufacturing industries exhibit effects that are statistically different from zero at the 5 percent level0. The results for cumulative earnings in Figure A4 are similar. Only 3 industries exhibit point estimates with magnitudes above 10 percent, and again only 4 are statistically different from zero. These findings make clear that even though low attachment workers at large firms have nontrivial predicted effects of each individual tariff change, the net effects are relatively small because the effects of Canadian and U.S. tariff cuts generally offset each other.

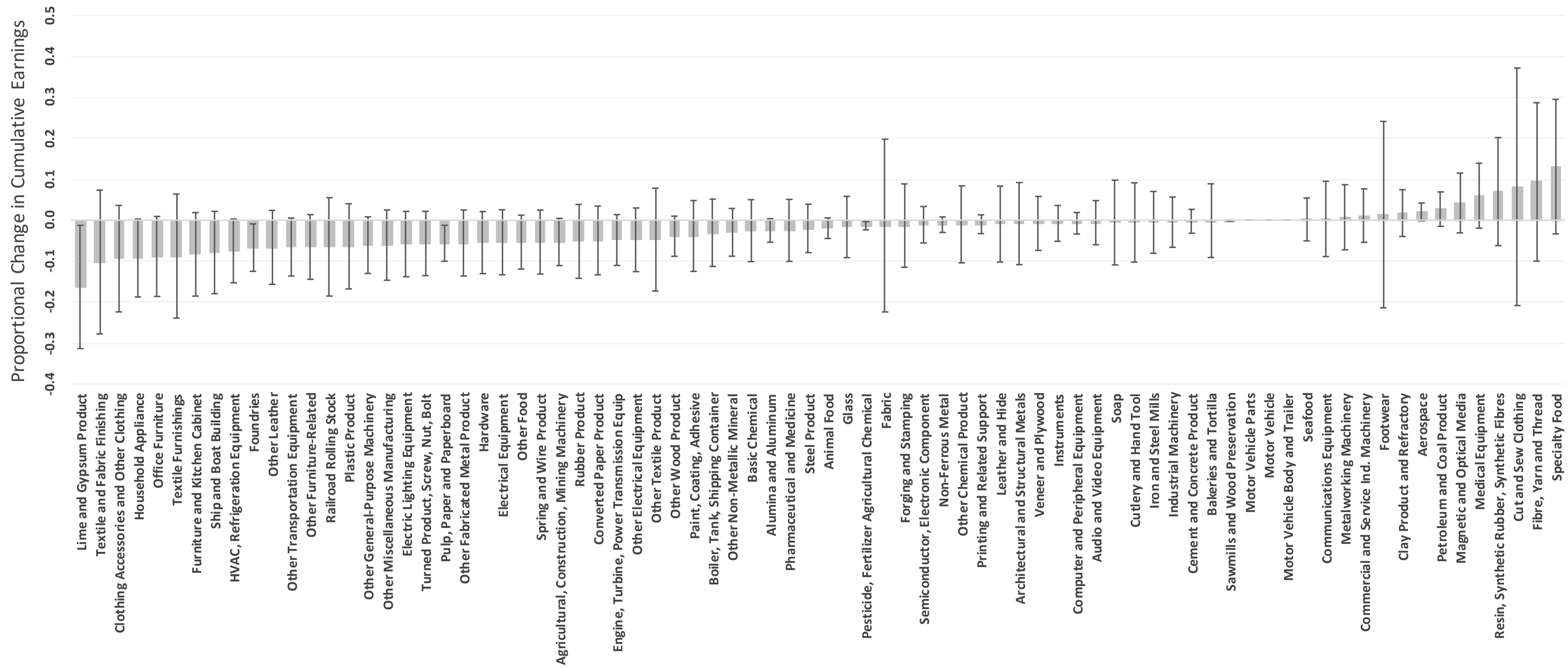
Figure A5 shows the net effects on cumulative earnings from the worker's initial firm. Consistent with the overall estimates shown in the main text, these effects are substantially larger than the overall earnings estimates, reflecting Canadian workers' ability to recover lost earnings at the initial firm by transitioning into other positions. In this case 35 industries exhibit net effects that are distinguishable from zero, all of them with negative point estimates. This is inconsistent with perfectly correlated and offsetting shocks in each sector.

Figure A3: Net Effects of Canadian and U.S. Tariff Cuts on the Probability of Separation for Low Attachment Workers Initially at Large Firms (1989-2003)



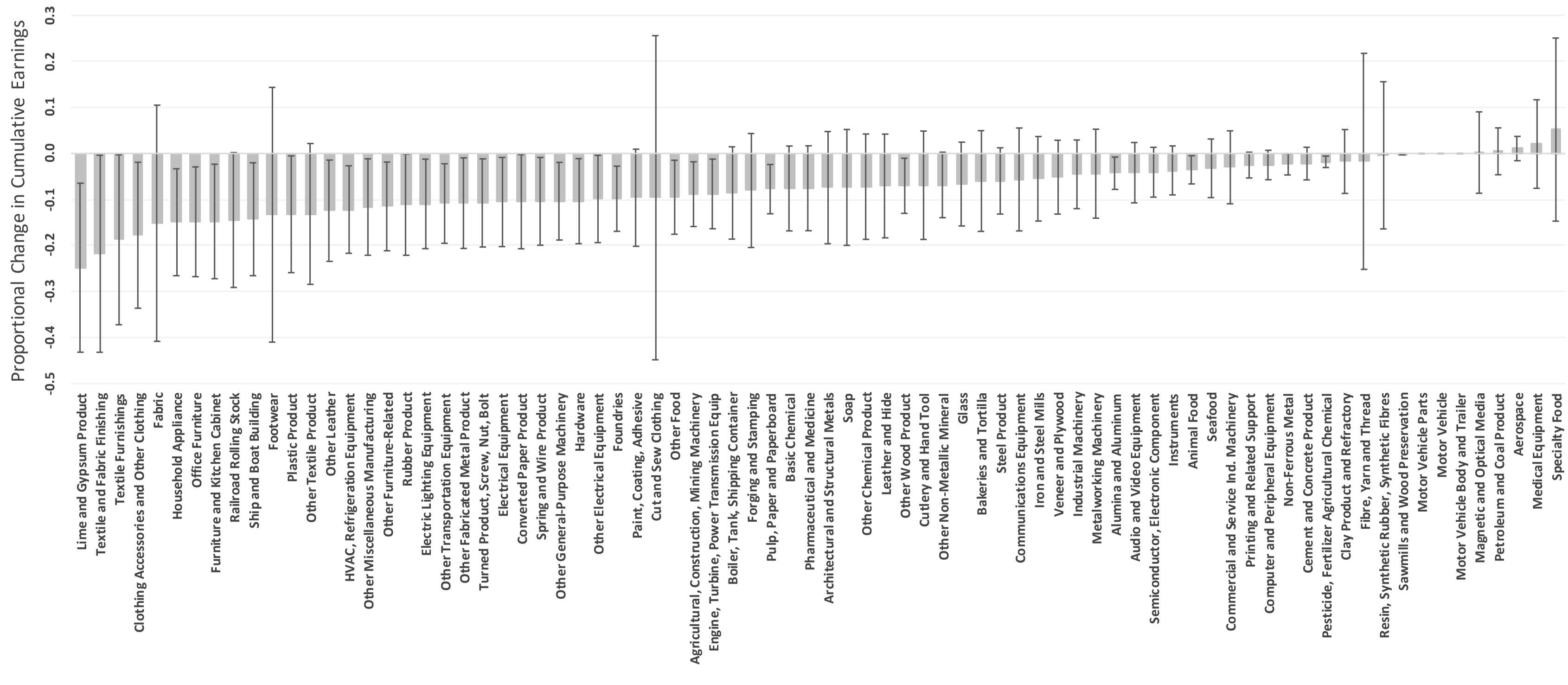
Notes: Each bar represents the predicted net effect of the Canadian and U.S. tariff cuts on the probability of experiencing a work-shortage related separation for low attachment workers initially at large firms in the industry listed on the x-axis. The predicted values are expressed relative to the worker group's unconditional average separation probability: 0.169. Industries sorted from most negative to most positive net effect estimate. Error bars reflect 95 percent confidence intervals. Out of 78 industries, 4 net effect estimates are statistically distinguishable from zero at the 5 percent level.

Figure A4: Net Effects of Canadian and U.S. Tariff Cuts on Cumulative Normalized Earnings for Low Attachment Workers Initially at Large Firms (1989-2004)



Notes: Each bar represents the predicted net effect of the Canadian and U.S. tariff cuts on cumulative normalized earnings for low attachment workers initially at large firms in the industry listed on the x-axis. The predicted values are expressed relative to the worker group's unconditional average cumulative earnings: 20.19. Industries sorted from most negative to most positive net effect estimate. Error bars reflect 95 percent confidence intervals. Out of 78 industries, 4 net effect estimates are statistically distinguishable from zero at the 5 percent level.

Figure A5: Net Effects of Canadian and U.S. Tariff Cuts on Cumulative Normalized Earnings From the Initial Firm for Low Attachment Workers Initially at Large Firms (1989-2004)



Notes: Each bar represents the predicted net effect of the Canadian and U.S. tariff cuts on cumulative normalized earnings from the initial firm for low attachment workers initially at large firms in the industry listed on the x-axis. The predicted values are expressed relative to the worker group's unconditional average cumulative earnings: 20.19. Industries sorted from most negative to most positive net effect estimate. Error bars reflect 95 percent confidence intervals. Out of 78 industries, 35 net effect estimates are statistically distinguishable from zero at the 5 percent level.

A.9 Regional Shocks and Industrial Geography

This Appendix explores what role geography plays in generating the results in this paper. Because the T2-LEAP-LWF data set from Statistics Canada includes only very coarse province-level geographic information, we are unable to observe worker outcomes by Canadian local labor market. This data limitation precludes the implementation of a local-labor-markets analysis along the lines of Topalova (2010), Kovak (2013), or Autor et al. (2013a). However, using data in the public domain, we can construct regional tariff shocks paralleling those used in these local-markets analyses in an effort to understand whether features of Canadian industrial geography may have facilitated Canadian worker adjustment to its CUSFTA tariff concessions. For example, if a large share of the Canadian population lives in cities or otherwise industrially diverse regions, then workers facing unfavorable shocks may be able to find employment in favorably affected industries without having to relocate.

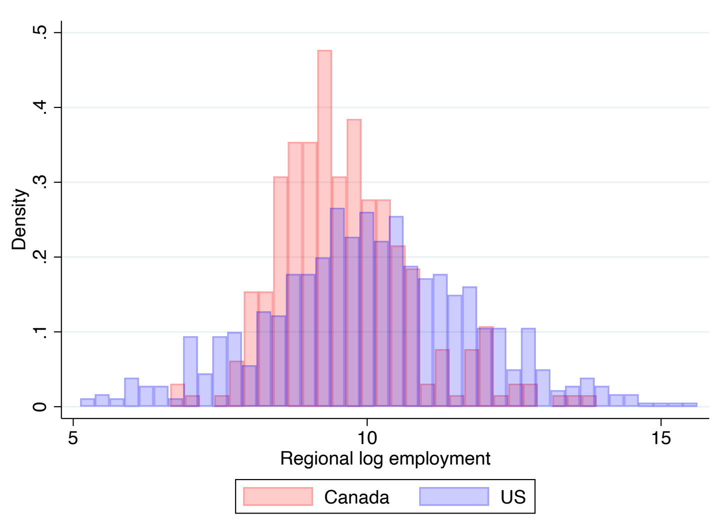
In order to assess if Canadian geography is special in some way, we require a benchmark for comparison. We choose the US as a natural comparison. Our strategy is to calculate actual regional shocks associated with the Canadian CUSFTA tariff cuts using Canadian industrial geography, and then to calculate a hypothetical set of regional shocks using the same industry tariff cuts but US industrial geography. We emphasize that this is not a counterfactual experiment but rather an attempt to examine whether and how Canadian industrial geography might have affected regional shocks.

We emphasize three findings. First, using the same set of industrial shocks, fewer Canadian regions than US regions would face large shocks. Second, we find no evidence that this is because Canadian regions are more industrially diversified. Third, we show that randomly generated industry-level shocks do not generate systematically different regional shocks in Canada and the US. Together, these findings provide little evidence in support of observable differences in industrial geography as a main driver of the relatively smooth and speedy reallocation of Canadian workers away from industries facing large increases in import competition. Rather, *this particular set* of tariff changes would have generated more large-shock regions in the US than it did in Canada, but a similar comparison should not be expected for other arbitrary industry shocks.

A.9.1 Local Labor Markets

We define Canadian local labor markets based on the Census Division classification from Statistics Canada. This definition allows us to use a custom tabulation from the 1986

Figure A6: Histograms of 1986 Employment by Canadian Census Division and US Commuting Zone



Notes: The red histogram plots log employment across Canadian Census Divisions from a special tabulation of the 1986 Canadian Census of Population generously provided by Jeff Chan. The blue histogram plots log employment across US Commuting Zones from 1986 County Business Patterns with imputed values from Eckert et al. (2020). The bars are semi-transparent, so the overlap appears purple. The extensive common support between the two distributions implies that neither country's regions are systematically more aggregated than the other's.

Canadian Census of Population reporting the industry distribution of regional employment. Jeff Chan uses these data in Chan (2019), and we thank him for generously providing this tabulation. We follow the literature by defining US local labor markets based on Commuting Zones. It is important that these two levels of geographic aggregation (Census Division vs. Commuting Zone) are comparable across the two countries. Figure A6 confirms this comparability by plotting a histogram of regional log employment in 1986 using employment data for Canadian Census Divisions from Chan (2019) and for US Commuting Zones from the 1986 County Business Patterns (CBP), with imputed values from Eckert et al. (2020).[62] The two distributions have extensive common support, with the US having both smaller and larger locations than those seen in Canada, indicating that neither country's locations are systematically more aggregated than the other's on average.

[62]We aggregate from counties to commuting zones using the concordance provided by David Dorn: `https://www.ddorn.net/data/cw_cty_czone.zip`.

A.9.2 Regional Tariff Reductions

Regional tariff reductions reflect the regional employment-weighted averages of industry-level tariff reductions. Industry i's share of 1986 employment in region r in country $c \in \{\text{CAN,US}\}$ is given by φ_{ri}^{c}. Note that φ_{ri}^{c} is the share of *all* employment in region r, including non-manufacturing and nontradable industries. For each country, we calculate two versions of the regional tariff reduction: one reflecting the average regional tariff reduction within manufacturing (M),

$$s_r^{c,\text{M}} \equiv -\sum_{i\in\text{M}} \frac{\varphi_{ri}^{c}}{\sum_{j\in\text{M}}\varphi_{rj}^{c}} \Delta \ln(1+\tau_i^{\text{CAN}}) \qquad \forall r \in c \text{ and } c \in \{\text{CAN,US}\}. \tag{6}$$

and one averaging across all industries, with zero tariff reduction outside manufacturing:

$$s_r^{c} \equiv -\sum_{i} \varphi_{ri}^{c} \mathbf{1}(i\in\text{M}) \cdot \Delta \ln(1+\tau_i^{\text{CAN}}) \qquad \forall r \in c \text{ and } c \in \{\text{CAN,US}\}. \tag{7}$$

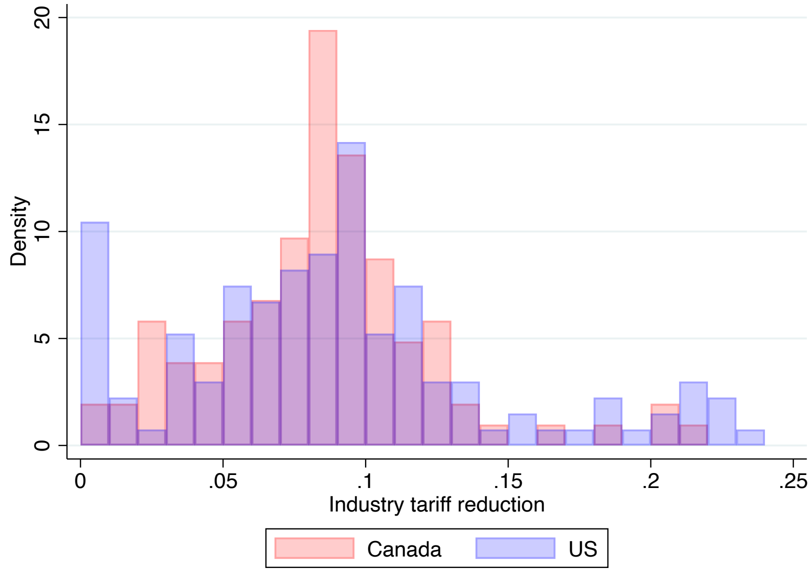
Because our focus is on industrial geography, the regional tariff reductions for both Canada and the US use the *same* vector of tariff reductions. We choose the CUSFTA tariff reductions facing US exports to Canada, i.e. τ^{CAN}. By using the same tariff changes in all of the measures, we isolate the implications of differences the industrial geography across the two countries.

To match the level of industry detail available in the Canadian Census data and the 1986 US CBP regional employment data, we use tariff changes at the 3-digit SIC level.[63] Because the Canadian and US versions of the SIC classification differ somewhat, we are concerned that shocks derived from the same HS-level data might generate different SIC-level shocks. Figure A7 assuages this concern by showing that the cross-industry distribution of tariff reductions is similar across the two versions.

Given comparable industry definitions and levels of geographic aggregation, we calculate the regional tariff reductions in (6) and (7) using the industrial geography of Canada

[63]We begin with CUSFTA tariff reductions provided by Global Affairs Canada at the 8-digit Harmonized System (HS) level. For Canada, then truncate to 6-digit HS codes, map to 5-digit NAICS-1997 codes using the concordance from Pierce and Schott (2012), and then map from 5-digit NAICS to 3-digit 1980 Canadian SIC-E codes using the Statistics Canada crosswalk available here: `https://www.statcan.gc.ca/eng/subjects/standard/concordances/concordance1997-1980`. For the US, we truncate to 6-digit HS codes and then map to 3-digit 1980 US SIC codes using the "H0 to SIC" concordance available here: `https://wits.worldbank.org/product_concordance.html`. Once we have HS codes mapped to SIC industries, we aggregate the tariff levels, weighting HS codes based on 1988 Canadian imports from the US.

Figure A7: Histograms of Tariff Reductions by US and Canadian 3-digit SIC Manufacturing Industries



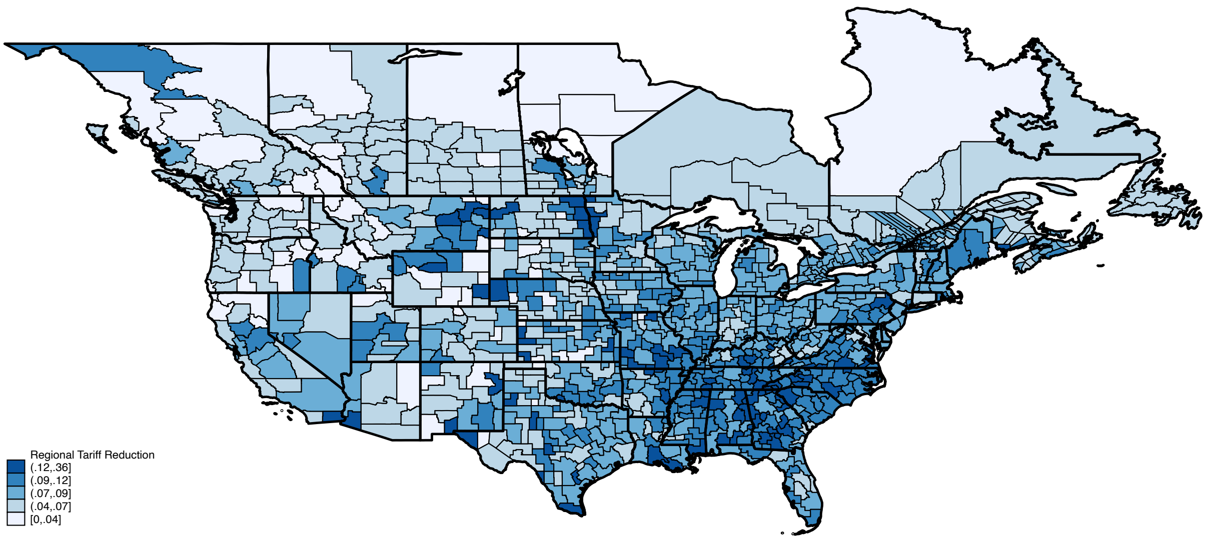
Notes: The red histogram plots tariff reductions ($\Delta \ln(1 + \tau_i^{\text{CAN}})$) across Canadian 3-digit SIC industries, while the blue histogram plots tariff reductions across US 3-digit SIC industries. The bars are semi-transparent, so the overlap appears purple. The similarity between the two distributions implies that the two SIC definitions are comparable.

($\varphi_{ri}^{\text{CAN}}$) or the US ($\varphi_{ri}^{\text{US}}$).[64] The resulting shocks appear in Figure A8. The shocks calculated using manufacturing industries only in panel (a) are of higher magnitude than those for all industries in panel (b) because the latter averages in zero tariff changes for non-manufacturing industries. In both cases, it is clear that a number of US regions would have faced larger regional tariff reductions than any of the Canadian regions. Since the tariff reductions are all based upon the vector of Canadian CUSFTA tariff cuts, the differences between Canada and the US are solely due to differences in the industrial geography of employment in each country's regions.

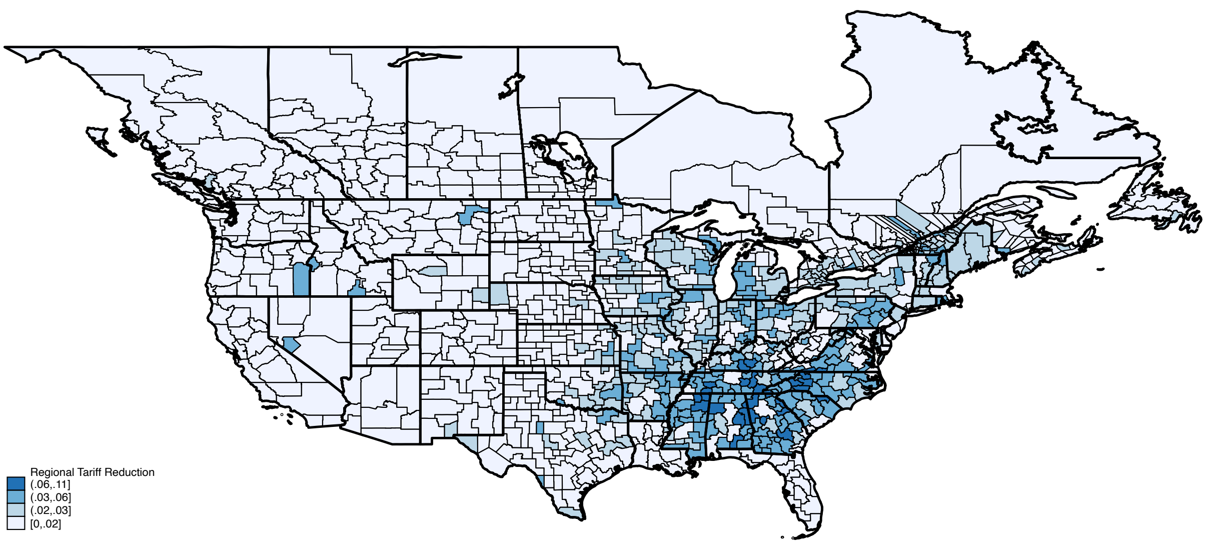
Figure A9 corroborates Figure A8's maps by plotting the distributions of regional tariff reductions across Canadian and US regions, weighted by total employment in each region. Many US regions would have faced substantially larger tariff reductions than the most heavily shocked Canadian regions. For example, for manufacturing-only regional shocks, only 1 percent of the Canadian population lives in regions facing shocks of at least 10

[64]The US County Business Patterns data report the vast majority of county employment at the 3-digit SIC or more detailed level, but a portion of employment is reported at the 2-digit SIC level. We apportion this 2-digit employment to underlying 3-digit industries based on each 3-digit industry's share of national employment within the corresponding 2-digit industry.

Figure A8: Regional Tariff Reductions



(a) Manufacturing Industries Only



(b) All Industries

Notes: Panel (a) shows regional tariff reductions calculated using only manufacturing industries as in equation (6). Panel (b) shows regional tariff reductions calculated using all industries, with those outside manufacturing facing zero tariff reduction, as in equation (7).

percent, while 11.3 percent of the US population lives in regions facing these large shocks. Similarly, for all-industry shocks, only 5 percent of Canada's population lives in regions facing shocks of at least 2.5 percent, while 19.9 percent of the US population lives in regions facing these large shocks.

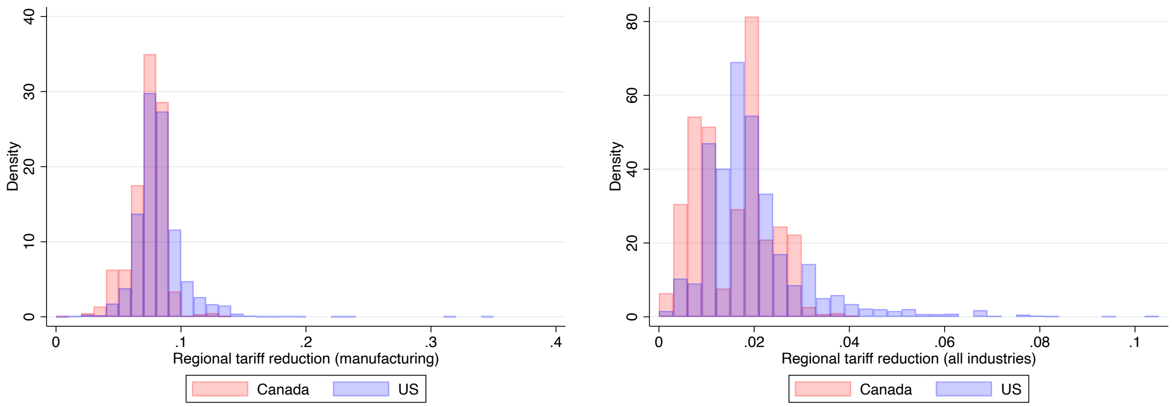
One important point to note when considering the all-industry shocks is that the US CBP data omit a number of industries in agriculture and government, which artificially inflates the US manufacturing share of employment observed in the CBP by omitting some non-manufacturing employment that would fall in the denominator of the manufacturing share. Although we have restricted the sample of Canadian industries in an attempt to cover an identical set of industries, it is possible that we nonetheless overstate the manufacturing share by more in the US than in Canada. If so, the all-industry regional tariff reductions will be systematically overstated in the US relative to Canada. In fact, although national data suggest the manufacturing share of employment is extremely similar in Canada and the US (17.1 in Canada and 17.6 in the US in 1986), our sample finds a manufacturing share of employment of 20.1 percent in Canada and 23.4 in the US.[65] This potential measurement issue will become important in interpreting the all-industry results based on the tariff simulations below. This concern does not apply to the manufacturing-only regional tariff reductions.

A.9.3 Regional Industry Concentration

A potential explanation why Canadian regions do not face particularly large tariff reductions is that they are more industrially diverse than their US counterparts. This can be because either a larger share of Canadians lives in industrially diverse cities, or because Canadian locations are more industrially diverse than US locations, conditional on size. We check this possibility directly by calculating the Herfindahl-Hirschman Index (HHI) of industry employment shares in each Canadian and US region. Figure A10 shows the distributions of HHI values across regions within each country, weighting by total regional employment. For both manufacturing industries (panel a) and all industries (panel b), the HHI distributions between Canada and the US are not systematically different. While Canada has more locations with low concentration, it also has higher density than the US in more concentrated locations. This suggests that Canadian regions are not systematically more industrially diverse than US regions and that differences in regional shocks

[65] National statistics based on the BLS International Comparisons of Annual Labor Force Statistics program, as reported by FRED.

Figure A9: Regional Tariff Reductions



(a) Manufacturing Industries Only

(b) All Industries

Notes: Panel (a) shows the within-country distributions of regional tariff reductions calculated using only manufacturing industries as in equation (6). Each distribution is weighted by total regional employment. Panel (b) shows the within-country distributions of regional tariff reductions calculated using all industries, with those outside manufacturing facing zero tariff reduction, as in equation (7).

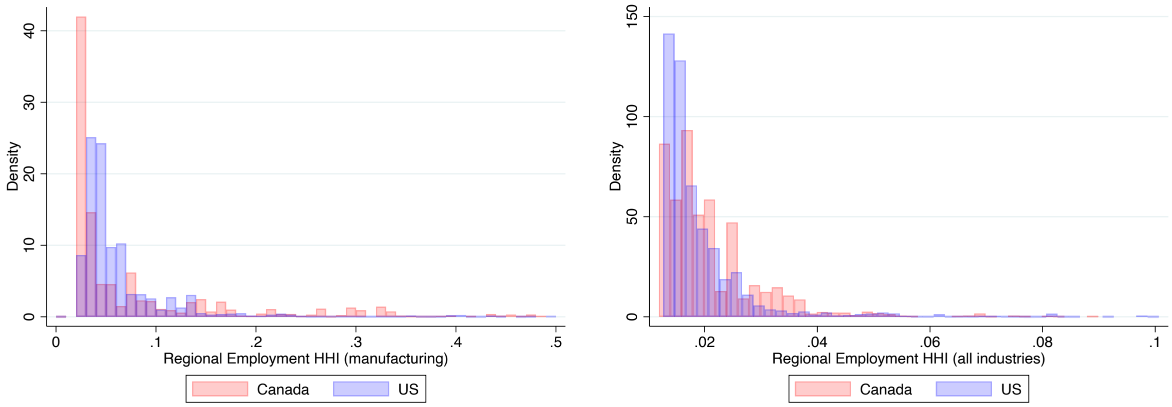
are not coming from systematic differences in regional concentration.

A.9.4 Tariff Change Simulations

Given the apparent similarity between industry concentration in Canadian and US regions, we seek to understand whether there are other systematic differences between the industrial geography of Canada and the US that might drive the apparent differences in regional shocks in Figures A8 and A9. To do so, we fit the observed distribution of Canadian CUSFTA tariff changes across manufacturing industries to a 2-parameter Weibull distribution and use this distribution to generate 1000 simulated IID tariff change vectors. We then calculate regional tariff reductions for the US and Canada using each simulated tariff change vector and the real-world industrial geography of each country. For each simulation we calculate i) the share of national population living in regions facing large shocks (10 percent for the manufacturing-only shock and 2.5 percent for the all-industry shock) and ii) the population-weighted inter-quartile range of regional tariff reductions.

Figures A11 and A12 present histograms of these statistics across the 1000 simulations to see whether systematic differences emerge across countries. Figure A11 shows the results for the manufacturing-only shocks, which are influenced only by differences in the composition of manufacturing employment across regions in each country. The distributions are extremely similar across countries for both statistics, implying that the

Figure A10: Regional Industry Concentration of Employment (HHI)



(a) Manufacturing Industries Only

(b) All Industries

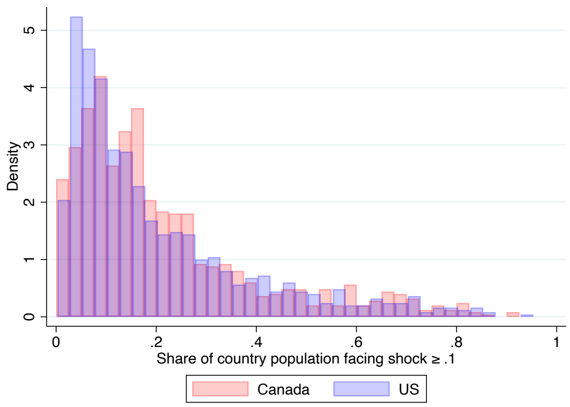
Notes: Both panels show the within-country distributions of the Herfindahl-Hirschman Index (HHI) of industry employment concentration within each country. Panel (a) shows industry concentration of employment within manufacturing, while Panel (b) shows industry concentration across all industries. To enhance readability, panel (a) restricts to HHI values of 0.5 or less and panel (b) restricts to HHI values of 0.1 or less, omitting an extremely small share of employment in both cases.

industrial geographies of manufacturing in Canada and the US yield similar regional tariff reductions across simulated industry tariff reductions.

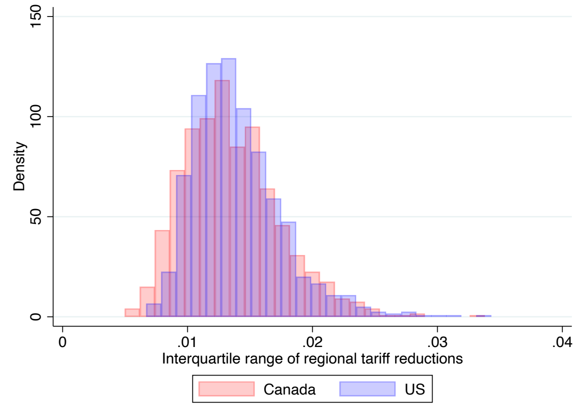
This conclusion contrasts with the larger tariff reductions facing many US regions in Figure A9 panel (a). While the particular tariff reduction vector employed in Figure A9 (the Canadian CUSFTA tariff cuts) implies large regional tariff reductions in a number of US regions, this feature is specific to that particular vector of tariff changes and not the systematic result of differences in Canadian and US industrial geography.

The results for the simulated all-industry regional tariff reductions in Figure A12 show more substantial differences, but these should be interpreted with care. In particular, the share of the population in regions facing large shocks is substantially larger across simulations in the US than in Canada. In all simulations (as in the actual tariff changes) the tariff reductions outside manufacturing are set to zero, so the difference between the all-industry and manufacturing-only results are driven by differences in the manufacturing share of employment. As mentioned above, although comprehensive national data report very similar manufacturing shares of employment in Canada and the US, the region-by-industry employment data used to construct the regional tariff reductions imply a higher manufacturing share in the US than in Canada. It is therefore likely that the differences between the US and Canada in Panel (a) of Figure A12 are driven by this data artifact. Panel (b) of Figure A12 shows that, if anything, the inter-quartile range in Canada is

Figure A11: Simulation Results - Manufacturing-Only Regional Tariff Reductions



(a) Share of Population in Regions Facing 10 Percent or Larger Tariff Reduction



(b) Population-Weighted Inter-Quartile Range of Regional Tariff Reductions

Notes: Summary statistics from manufacturing-only regional tariff reductions based on 1000 simulated vectors of industry tariff changes. Panel (a) shows the share of the relevant country's population facing regional tariff reductions of 10 percent or more. Panel (b) shows the population-weighted inter-quartile range of regional tariff reductions.

systematically larger than in the US.

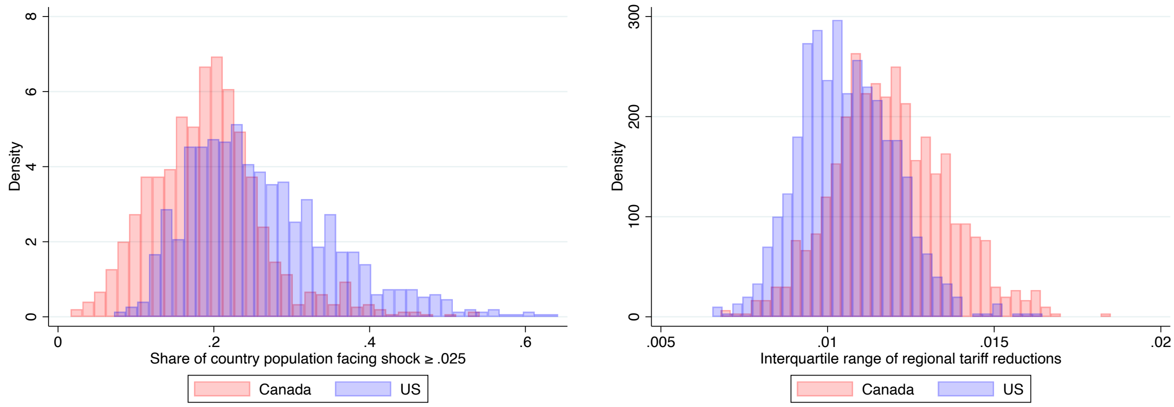
A.9.5 Regional Shocks Summary

Together, these results provide little evidence in support of the hypothesis that Canadian industrial geography accounts for the relatively smooth and speedy reallocation of workers from industries facing more import competition to more favorably affected industries. Canadian workers are not systematically more likely to live in industrially diverse regions than are workers in a natural comparison economy, the US. Nor are Canadian workers systematically less likely to face large shocks or large differences in shocks across regions when facing arbitrary tariff changes.

A.10 Evolution of Tariff-Cut Exposure

Figure IV in Autor et al. (2014) plots regression coefficients and 90% confidence intervals obtained from 32 regressions that relate the 1991-2007 trade exposure of a worker's industry to the 1991-2007 trade exposure of the worker's initial 1991 industry, compared against a similar series setting trade exposure to 0 for all firms except the worker's initial employer. Figures A14a and A14b perform an identical exercise for low- and high-attachment workers. Black diamonds correspond to coefficients from a regression of he tariff cut in

Figure A12: Simulation Results - All-Industry Regional Tariff Reductions



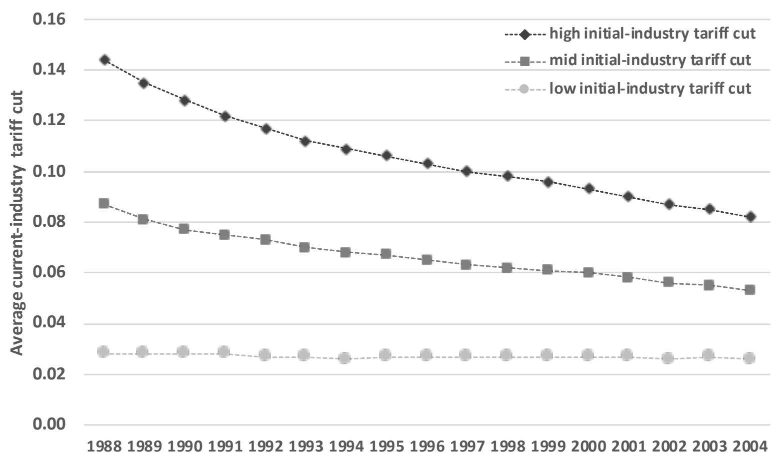
(a) Share of Population in Regions Facing 10 Percent or Larger Tariff Reduction

(b) Population-Weighted Inter-Quartile Range of Regional Tariff Reductions

Notes: Summary statistics from all-industry regional tariff reductions based on 1000 simulated vectors of industry tariff changes. Panel (a) shows the share of the relevant country's population facing regional tariff reductions of 2.5 percent or more. Panel (b) shows the population-weighted inter-quartile range of regional tariff reductions. See text for discussion of the apparent differences across Canada and the US.

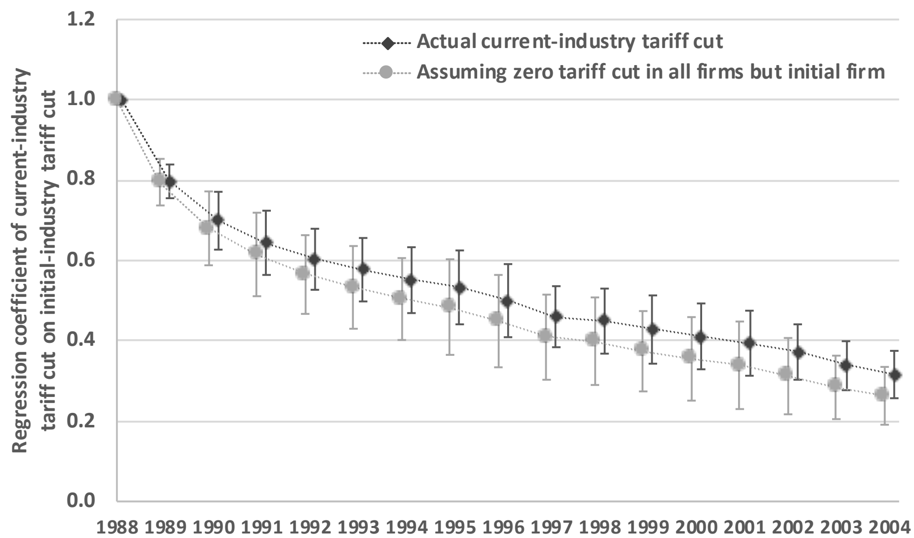
worker $i's$ initial industry of employment j $(\Delta \ln(1 + \tau^{\text{CAN}}_{j(i)}))$ on the tariff cut in the industry in which the worker is employed in year t $(\Delta \ln(1 + \tau^{\text{CAN}}_{j(i)t}))$. Confidence intervals are at the 95 percent level. Non-employed individuals in a given year are omitted from the regression in that year, and we assign zero tariff cut to non-tradable industries. Following Autor et al. (2014). The gray circles reflect an otherwise similar exercise in which we assign $\Delta \ln(1 + \tau^{\text{CAN}}_{j(i)t}) = 0$ for employment at all firms other than the worker's initial firm when running this regression. The similarity of the black and gray diamonds indicate that Canadian workers quickly moved into industries facing dramatically less import competition as a result of Canadian tariff cuts.

Figure A13: Evolution of Canadian Tariff-Cut Exposure: High Attachment Workers

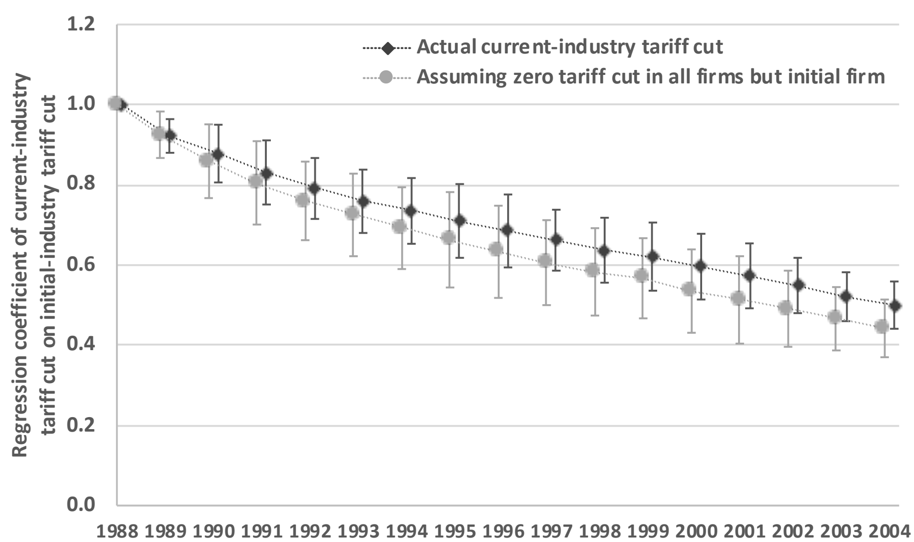


Notes: We divide manufacturing industries into terciles based on the size of the industry's Canadian tariff cut and assign workers to each tercile based on their initial industry of employment. For each initial-tariff-cut tercile, we plot the average Canadian tariff cut faced by workers in their current industry of employment during the year listed on the x-axis. Non-employed individuals in a given year are omitted from that year's average, and we assign zero tariff cut to non-tradable industries. Declining profiles imply that, on average, workers transition into industries that faced smaller Canadian tariff cuts than their initial industry.

Figure A14: Persistence of Tariff-Cut Exposure



(a) Low Attachment Workers



(b) High Attachment Workers

Notes: These figures replicate Figure IV of Autor et al. (2014). Black diamonds represents regression coefficients from regressing each worker's current industry's tariff cut in the relevant year on their initial-industry's tariff cut. Error bars are the associated 95 percent confidence intervals. Non-employed individuals in a given year are omitted from the regression in that year, and we assign zero tariff cut to non-tradable industries. The gray circles reflect an otherwise similar exercise in which all firms other than the worker's initial firm are assigned zero tariff cut. The similarity of the black and gray series indicate that Canadian workers quickly moved into industries facing less import competition as a result of Canadian tariff cuts.

A.11 Connected Industry Tariff Cut Analysis Estimates

In Section 5.6, we study the effects of tariff cuts in workers' outside-option industries using the regression specification in equation (5). In Table A9 we present the regression estimates, which we use to calculate the effects of inter-quartile range tariff cuts in Table 3 in the main text.

Table A9: Years Worked (1989-2004) - Direct and Outside-Option Tariff Cuts - Regression Estimates

	(1) Total	(2) Initial Ind.	(3) Manuf.	(4) Other
Panel A: Low-Attachment (n=20,600)				
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	-1.342	-8.921***	1.297	6.282***
	(1.375)	(2.352)	(1.501)	(1.628)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-2.068	11.05***	-8.635***	-4.483
	(2.250)	(3.559)	(2.161)	(2.709)
$-\Delta\ln(1+\tau_{-j}^{\text{CAN}})$	-1.334	16.22	-15.76**	-1.796
	(5.849)	(10.14)	(7.482)	(7.263)
$-\Delta\ln(1+\tau_{-j}^{\text{US}})$	6.241	-23.01	19.47*	9.782
	(8.922)	(16.38)	(10.65)	(11.85)
R-squared	0.096	0.147	0.050	0.070
Panel B: High-Attachment (n=63,100)				
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	3.316**	-0.549	2.967	0.898
	(1.304)	(3.782)	(2.877)	(1.555)
$-\Delta\ln(1+\tau_j^{\text{US}})$	-5.146**	6.664	-7.733	-4.077
	(2.090)	(6.095)	(4.973)	(2.568)
$-\Delta\ln(1+\tau_{-j}^{\text{CAN}})$	2.471	26.48*	-25.76***	1.757
	(5.994)	(14.71)	(9.194)	(8.667)
$-\Delta\ln(1+\tau_{-j}^{\text{US}})$	0.298	-41.54**	34.47**	7.371
	(8.853)	(20.35)	(15.69)	(13.59)
R-squared	0.058	0.113	0.045	0.069

Notes: The table reports regression estimates from the specification in equation (5). These estimates are used to create the inter-quartile range effects reported in Table 3 in the main text. Stars indicate statistical significance based on standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

A.12 Mass Layoffs

In Table A10, we examine whether the CUSFTA tariff cuts altered the probability of a mass layoff at affected firms. Following Jacobson et al. (1993) we create a sample of manufacturing firms that employed at least fifty workers in 1988 and employed workers in our sample in each year between 1984 and 1988 (inclusive). A firm has a mass layoff if its employment fell below 70 percent of its pre-FTA (1984-88) peak in any year between 1989 and 2004. The results are similar using definitions based on firm exit or year-to-year employment declines. Unlike Head and Ries (1999) and Trefler (2004), we observe firms and not plants so that there may have still been mass layoff events at the plant level that were too small to register at the firm level.

We run a firm-level regression of the mass-layoff indicator on Canadian and U.S. tariff changes, their interactions with the initial firm size, and the full sets of firm and industry level controls described in Section 4. Column (1) of Table A10 shows that larger Canadian tariff cuts did not significantly increase the probability of a mass layoff, nor did larger U.S. tariff cuts reduce that probability. In fact, the point estimates for the U.S. have the opposite sign of what one would expect. All of the estimated tariff effects are statistically indistinguishable from zero and have small magnitudes. For example, firms whose Canadian tariff cuts differed by the industry-level interquartile range of 0.045 have predicted mass layoff probabilities that differ by 2.7 percentage points. This point estimate is very imprecisely estimated and is small in comparison to the mean mass-layoff probability of 72 percent. This baseline probability is large due to our long sample period and because we measure mass layoffs as having occurred at the firm level in any year over 1989-2004. The share of *workers* initially employed in manufacturing experiencing a mass layoff during 1989-1994 was much smaller, at 37 percent, and much closer to figures in the literature for similar time frames such as Jacobson et al. (1993). In contrast, increased Chinese import penetration drove a statistically significant increase in the probability of a mass layoff for firms in affected industries. The industry-level interquartile range for Chinese import penetration is 0.139, implying a 3.8 percentage point larger mass layoff probability for firms facing larger China shocks. These results continue to hold when we allow the tariff-cut effects to vary by firm size in column (2). While the CUSFTA tariff changes did not induce mass layoffs, the substantial effect of the China Shock on mass layoffs shows that Canadian labor markets were not invulnerable to trade shocks. Given how disruptive mass layoffs are to workers' employment outcomes, the lack of mass layoffs in response to the FTA helps explain its lack of substantial long-run effects on other labor market outcomes.

A.13 Worker Transitions by Initial Firm Size Results Tables

Table A10: Mass Layoffs (1989-2004)

	(1)	(2)
$-\Delta\ln(1+\tau_j^{\text{CAN}})$	0.611	
	(0.626)	
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$		0.831
		(0.724)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$		0.515
		(0.777)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$		0.354
		(1.319)
$-\Delta\ln(1+\tau_j^{\text{US}})$	0.0178	
	(0.775)	
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$		0.0422
		(1.006)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$		0.187
		(0.904)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$		-3.520
		(2.254)
$\Delta IPR_j^{\text{CHN}}$	0.277***	0.267***
	(0.0888)	(0.0909)
R-squared	0.051	0.055

Notes: These firm-level regressions examine the effects of Canadian and U.S. tariff cuts and increased Chinese import penetration on mass layoffs across 2,400 firms. The dependent variable is an indicator for having a mass layoff, defined as having at least one year in 1989-2004 in which employment falls below 70 percent of the firm's 1984-1988 peak employment (results robust to definitions based on year-to-year employment changes or firm exit). Column (1) examines overall effects, while column (2) presents the results of tariff cuts separately by firm size in 1988 (small=1-99, medium=100-999, large=1000+). All specifications include the full set of firm-level and industry-level controls described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A11: Worker Transitions, by Labor-Force Attachment and Initial Firm Size (1989-1993)

	(1) Total	(2) Initial Ind.	(3) Manuf.	(4) Constr.	(5) Min./Ag./Unk.	(6) Services	(7) Unemp.
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	-0.333	-0.0249	-0.0359	0.0270	0.00258	0.00152	-0.304*
	(0.249)	(0.0312)	(0.0591)	(0.0249)	(0.0327)	(0.0734)	(0.175)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	0.491**	0.00626	0.0695	-0.00258	-0.00963	0.0740*	0.354***
	(0.192)	(0.0246)	(0.0681)	(0.0289)	(0.0233)	(0.0427)	(0.111)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	-0.179	-0.0266	0.105*	0.00220	0.00650	-0.0498	-0.216
	(0.278)	(0.0376)	(0.0581)	(0.0291)	(0.0182)	(0.0499)	(0.199)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	0.484*	0.0865*	0.00187	0.0613	0.00999	0.00355	0.320
	(0.252)	(0.0446)	(0.0841)	(0.0397)	(0.0379)	(0.0865)	(0.199)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	-0.629**	0.0375	-0.116	0.0972**	0.0511	-0.0872	-0.612***
	(0.294)	(0.0450)	(0.0870)	(0.0470)	(0.0372)	(0.0734)	(0.192)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	-0.0926	0.0367	-0.0781	0.113**	0.00136	0.00537	-0.171
	(0.307)	(0.0431)	(0.109)	(0.0506)	(0.0368)	(0.0871)	(0.255)
R-squared	0.043	0.006	0.006	0.011	0.007	0.006	0.051
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	-0.134	-0.0308	0.00149	0.00689	-0.0144	-0.0584	-0.0385
	(0.189)	(0.0430)	(0.0645)	(0.0229)	(0.0174)	(0.0486)	(0.0897)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	0.133	-0.00298	0.0224	0.0186	-0.0176	0.00632	0.106
	(0.134)	(0.0225)	(0.0473)	(0.0180)	(0.0139)	(0.0267)	(0.0816)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	0.0233	-0.0169	0.0545	0.0285	0.00512	0.0204	-0.0683
	(0.196)	(0.0365)	(0.0577)	(0.0265)	(0.0122)	(0.0271)	(0.107)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	0.186	0.0347	-0.0156	0.0650	0.00140	0.0645	0.0363
	(0.224)	(0.0523)	(0.0703)	(0.0464)	(0.0186)	(0.0651)	(0.126)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	-0.213	0.0248	-0.0849	0.0272	0.0170	-0.0659	-0.131
	(0.205)	(0.0431)	(0.0610)	(0.0308)	(0.0212)	(0.0399)	(0.122)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	-0.294	-0.0117	-0.0717	0.0612	-0.0225	-0.0945*	-0.155
	(0.333)	(0.0316)	(0.111)	(0.0512)	(0.0164)	(0.0496)	(0.194)
R-squared	0.025	0.008	0.005	0.008	0.003	0.005	0.018

Notes: Dependent variable in column (1) is an indicator for experiencing a permanent work-shortage based separation from the worker's initial firm during 1989-1993. The subsequent columns additively decompose this separation indicator based upon the worker's employment status in the year following separation. The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Because the transition indicators in columns (2) through (9) additively decompose the overall separation indicator, the coefficients in columns (2) through (9) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A12: Worker Transitions, by Labor-Force Attachment and Initial Firm Size (1989-1998)

	(1) Total	(2) Initial Ind.	(3) Manuf.	(4) Constr.	(5) Min./Ag./Unk.	(6) Services	(7) Unemp.
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	-0.486	-0.0183	-0.0211	0.0186	-0.0136	0.0338	-0.485**
	(0.304)	(0.0435)	(0.0629)	(0.0270)	(0.0320)	(0.0668)	(0.223)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	0.343	-0.0148	0.0667	0.0196	-0.0141	0.0345	0.251**
	(0.220)	(0.0316)	(0.0748)	(0.0278)	(0.0243)	(0.0557)	(0.119)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	0.582***	0.0223	0.155**	0.0730*	0.0309	-0.0128	0.314*
	(0.207)	(0.0504)	(0.0692)	(0.0402)	(0.0191)	(0.0590)	(0.182)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	0.624**	0.133**	-0.0277	0.0962**	0.0355	-0.00958	0.397*
	(0.295)	(0.0587)	(0.0832)	(0.0468)	(0.0385)	(0.0752)	(0.234)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	-0.574*	0.137**	-0.134*	0.0927*	0.0579	-0.0262	-0.701***
	(0.297)	(0.0657)	(0.0804)	(0.0524)	(0.0397)	(0.0965)	(0.194)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	-0.879**	0.00764	-0.140	0.0541	-0.0150	-0.0131	-0.773**
	(0.349)	(0.0754)	(0.135)	(0.0669)	(0.0323)	(0.0987)	(0.355)
R-squared	0.064	0.009	0.006	0.013	0.009	0.006	0.077
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	-0.210	-0.0739	-0.0364	0.00712	-0.0121	-0.0266	-0.0686
	(0.259)	(0.0519)	(0.0784)	(0.0285)	(0.0196)	(0.0593)	(0.122)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	0.132	-0.00838	0.0417	0.0188	-0.0186	0.0206	0.0781
	(0.206)	(0.0285)	(0.0658)	(0.0241)	(0.0170)	(0.0430)	(0.107)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	0.477**	0.0277	0.169**	0.0926***	0.0293*	0.0512	0.107
	(0.233)	(0.0466)	(0.0701)	(0.0302)	(0.0167)	(0.0439)	(0.153)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	0.371	0.128*	0.0203	0.101	0.00479	-0.00715	0.124
	(0.309)	(0.0652)	(0.0857)	(0.0614)	(0.0205)	(0.0797)	(0.157)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	-0.204	0.0883	-0.0879	0.0565	0.0362	-0.113*	-0.184
	(0.291)	(0.0606)	(0.0816)	(0.0448)	(0.0252)	(0.0608)	(0.159)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	-0.725*	-0.0623	-0.154	0.0276	-0.0539**	-0.112*	-0.371
	(0.425)	(0.0653)	(0.123)	(0.0641)	(0.0208)	(0.0602)	(0.233)
R-squared	0.036	0.015	0.006	0.012	0.004	0.005	0.028

Notes: Dependent variable in column (1) is an indicator for experiencing a permanent work-shortage based separation from the worker's initial firm during 1989-1998. The subsequent columns additively decompose this separation indicator based upon the worker's employment status in the year following separation. The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Because the transition indicators in columns (2) through (9) additively decompose the overall separation indicator, the coefficients in columns (2) through (9) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A13: Worker Transitions, by Labor-Force Attachment and Initial Firm Size (1989-2003)

	(1) Total	(2) Initial Ind.	(3) Manuf.	(4) Constr.	(5) Min./Ag./Unk.	(6) Services	(7) Unemp.
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$	-0.485	-0.0425	-0.0439	0.0240	-0.00410	0.0377	-0.456*
	(0.329)	(0.0464)	(0.0705)	(0.0285)	(0.0344)	(0.0697)	(0.233)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$	0.241	-0.0229	0.0324	0.0128	-0.0128	0.0343	0.197*
	(0.203)	(0.0318)	(0.0732)	(0.0324)	(0.0239)	(0.0604)	(0.111)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$	0.489**	0.0159	0.167**	0.0907**	0.0311	-0.00552	0.190
	(0.200)	(0.0486)	(0.0691)	(0.0446)	(0.0199)	(0.0651)	(0.168)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$	0.617*	0.152**	0.00622	0.110**	0.0146	-0.0410	0.376
	(0.316)	(0.0633)	(0.0928)	(0.0533)	(0.0417)	(0.0762)	(0.243)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$	-0.489*	0.151**	-0.0843	0.124*	0.0452	-0.0565	-0.669***
	(0.290)	(0.0652)	(0.0832)	(0.0664)	(0.0376)	(0.102)	(0.209)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$	-0.796**	-0.00180	-0.147	0.0429	-0.0364	-0.0304	-0.623*
	(0.355)	(0.0720)	(0.137)	(0.0766)	(0.0358)	(0.126)	(0.319)
R-squared	0.070	0.010	0.007	0.015	0.010	0.007	0.083
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$	-0.335	-0.0813	-0.0592	0.00443	-0.0188	-0.0542	-0.126
	(0.292)	(0.0582)	(0.0853)	(0.0340)	(0.0220)	(0.0763)	(0.138)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$	-0.0365	-0.0395	-0.00883	0.0112	-0.0163	0.000200	0.0167
	(0.216)	(0.0330)	(0.0638)	(0.0312)	(0.0176)	(0.0503)	(0.117)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$	0.378	0.0178	0.142**	0.102***	0.0323*	0.0433	0.0405
	(0.277)	(0.0487)	(0.0704)	(0.0342)	(0.0183)	(0.0503)	(0.176)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$	0.502	0.208***	-0.00527	0.135*	0.00541	-0.0161	0.175
	(0.346)	(0.0759)	(0.0933)	(0.0777)	(0.0220)	(0.0910)	(0.174)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$	0.0591	0.138**	-0.0588	0.0937	0.0296	-0.0566	-0.0873
	(0.345)	(0.0659)	(0.0986)	(0.0674)	(0.0252)	(0.0719)	(0.178)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$	-0.635	-0.0493	-0.166	0.0428	-0.0729***	-0.0945	-0.295
	(0.440)	(0.0670)	(0.122)	(0.0784)	(0.0236)	(0.0741)	(0.232)
R-squared	0.038	0.015	0.006	0.014	0.004	0.006	0.030

Notes: Dependent variable in column (1) is an indicator for experiencing a permanent work-shortage based separation from the worker's initial firm during 1989-2004. The subsequent columns additively decompose this separation indicator based upon the worker's employment status in the year following separation. The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Because the transition indicators in columns (2) through (9) additively decompose the overall separation indicator, the coefficients in columns (2) through (9) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

A.14 Cumulative Normalized Earnings by Initial Firm Size Results Tables

Table A14: Cumulative Normalized Earnings, by Labor-Force Attachment and Initial Firm Size (1989-1993)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	0.724	-2.918	-0.825	0.796	1.175	-0.0831	2.579
	(2.836)	(2.499)	(0.870)	(1.563)	(0.882)	(0.474)	(1.836)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	-1.695	-2.511	-0.748	1.690	0.594	-0.182	-0.538
	(3.043)	(3.017)	(0.893)	(1.244)	(0.692)	(0.282)	(1.669)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	-0.876	-2.985	-1.964***	2.016	0.692	0.106	1.258
	(2.575)	(4.032)	(0.631)	(2.042)	(0.642)	(0.400)	(1.154)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	0.0362	3.206	1.384	-2.416	0.514	0.411	-3.063
	(3.755)	(3.273)	(1.181)	(2.010)	(0.977)	(0.725)	(2.718)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	3.667	0.356	0.848	-3.633	1.281	0.742*	4.073*
	(3.992)	(3.889)	(1.338)	(2.370)	(1.244)	(0.430)	(2.258)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	4.236	-0.760	-0.483	1.872	1.472	0.0694	2.066
	(5.895)	(7.390)	(1.104)	(3.191)	(1.102)	(0.706)	(2.617)
R-squared	0.105	0.065	0.013	0.034	0.022	0.019	0.082
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{small firm})$	1.655	1.665	-0.587	-0.438	0.112	-0.0652	0.968*
	(1.264)	(1.410)	(0.521)	(0.778)	(0.274)	(0.154)	(0.551)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{medium firm})$	-0.813	-0.0216	-0.403	0.272	0.0886	-0.0534	-0.695
	(1.073)	(1.624)	(0.392)	(0.691)	(0.149)	(0.127)	(0.611)
$-\Delta\ln(1+\tau_j^{\text{CAN}})*\mathbb{1}(\text{large firm})$	1.976**	0.645	-0.517	1.403	0.447**	0.0397	-0.0426
	(0.924)	(2.271)	(0.457)	(1.404)	(0.189)	(0.146)	(0.610)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{small firm})$	-2.294*	0.340	1.471**	-1.627	0.231	-0.121	-2.589***
	(1.360)	(1.843)	(0.708)	(1.007)	(0.531)	(0.207)	(0.792)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{medium firm})$	1.881	2.771	0.590	-1.901*	0.270	-0.141	0.293
	(1.440)	(2.151)	(0.634)	(1.123)	(0.262)	(0.156)	(0.780)
$-\Delta\ln(1+\tau_j^{\text{US}})*\mathbb{1}(\text{large firm})$	-1.613	2.676	-2.383***	-0.281	0.0394	-0.494*	-1.172*
	(1.955)	(4.782)	(0.792)	(2.649)	(0.282)	(0.278)	(0.680)
R-squared	0.074	0.078	0.018	0.038	0.017	0.010	0.051

Notes: Dependent variable is the sum of a worker's earnings during 1989-1993, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2). The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Column (1) examines total earnings from all sources, (2) earnings from the initial firm, (3) from firms other than the initial firm, but in the same initial 4-digit industry, (4) in manufacturing industries (NAICS=3xxx) other than the initial industry, (5) in construction and utilities (NAICS=22xx, 23xx), (6) in mining (NAICS=21xx), agriculture (NAICS=1xxx), or from a firm with unknown industry code, and (7) in services (NAICS≥4xxx). Because earnings in columns (2) through (7) additively decompose total earnings, the coefficients in columns (2) through (7) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A15: Cumulative Normalized Earnings, by Labor-Force Attachment and Initial Firm Size (1989-1998)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(small firm)	0.267	-8.025*	-1.591	2.162	1.923	0.0949	5.702
	(5.900)	(4.352)	(2.277)	(4.395)	(1.505)	(0.968)	(4.129)
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(medium firm)	0.368	-5.454	-0.534	6.010*	1.245	-0.400	-0.499
	(7.384)	(5.859)	(1.966)	(3.299)	(1.468)	(0.660)	(4.687)
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(large firm)	-9.418*	-11.89	-4.516***	3.746	1.566	0.229	1.452
	(4.823)	(7.468)	(1.510)	(4.483)	(1.367)	(1.071)	(3.221)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(small firm)	4.096	7.889	2.234	-4.471	2.711	0.512	-4.780
	(8.465)	(6.331)	(2.911)	(5.311)	(2.025)	(1.401)	(6.772)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(medium firm)	1.376	-1.042	0.444	-9.729	2.872	1.475*	7.357
	(10.40)	(7.009)	(3.239)	(6.196)	(2.722)	(0.853)	(6.875)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(large firm)	19.82*	10.86	-3.739	5.379	3.088	-0.231	4.458
	(11.87)	(15.79)	(2.473)	(7.447)	(2.662)	(2.006)	(6.906)
R-squared	0.108	0.060	0.015	0.029	0.022	0.024	0.100
Panel B: High Attachment (n=63,100)							
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(small firm)	3.394	3.411	-1.833	-0.0156	0.138	0.0189	1.675
	(2.884)	(3.789)	(1.640)	(2.136)	(0.615)	(0.385)	(1.485)
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(medium firm)	-0.643	0.701	-1.162	1.946	0.521	-0.173	-2.478
	(2.503)	(4.375)	(1.035)	(1.929)	(0.349)	(0.308)	(1.865)
$-\Delta \ln(1+\tau_j^{CAN}) * \mathbb{1}$(large firm)	-0.570	-5.514	-0.473	4.865	0.806*	-0.0632	-0.191
	(2.261)	(4.939)	(1.194)	(3.307)	(0.418)	(0.495)	(1.799)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(small firm)	-6.062*	-0.869	4.586**	-4.477*	0.626	-0.452	-5.476***
	(3.344)	(4.917)	(2.284)	(2.614)	(1.227)	(0.488)	(2.015)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(medium firm)	1.607	2.892	2.748	-5.812*	0.281	-0.201	1.700
	(3.691)	(5.957)	(2.029)	(3.017)	(0.676)	(0.439)	(2.313)
$-\Delta \ln(1+\tau_j^{US}) * \mathbb{1}$(large firm)	-1.660	13.36	-9.556***	-1.939	0.472	-1.356*	-2.635
	(4.278)	(12.03)	(3.297)	(6.368)	(0.675)	(0.806)	(1.826)
R-squared	0.081	0.075	0.033	0.046	0.018	0.016	0.062

Notes: Dependent variable is the sum of a worker's earnings during 1989-1998, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2). The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta \ln(1+\tau_j^{CAN})$) or facing Canadian exports to the U.S. ($-\Delta \ln(1+\tau_j^{US})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Column (1) examines total earnings from all sources, (2) earnings from the initial firm, (3) from firms other than the initial firm, but in the same initial 4-digit industry, (4) in manufacturing industries (NAICS=3xxx) other than the initial industry, (5) in construction and utilities (NAICS=22xx, 23xx), (6) in mining (NAICS=21xx), agriculture (NAICS=1xxx), or from a firm with unknown industry code, and (7) in services (NAICS$\geq$4xxx). Because earnings in columns (2) through (7) additively decompose total earnings, the coefficients in columns (2) through (7) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A16: Cumulative Normalized Earnings, by Labor-Force Attachment and Initial Firm Size (1989-2004)

	(1) Total	(2) Initial Firm	(3) Initial Ind.	(4) Manuf.	(5) Constr.	(6) Min./Ag./Unk.	(7) Services
Panel A: Low Attachment (n=20,600)							
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$	-2.173	-12.57*	-3.304	-1.544	3.152	0.648	11.45
	(10.73)	(6.763)	(4.456)	(8.453)	(2.843)	(1.871)	(8.423)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$	0.0251	-8.676	-1.295	8.235	3.875**	0.0330	-2.147
	(13.23)	(9.460)	(3.916)	(6.342)	(1.776)	(1.222)	(9.724)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$	-21.95**	-29.33***	-8.180***	8.479	5.436**	-0.527	2.175
	(8.379)	(10.21)	(3.013)	(7.855)	(2.294)	(2.019)	(6.734)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$	10.90	10.26	4.651	-0.684	6.393*	0.0568	-9.776
	(17.76)	(10.68)	(5.537)	(12.34)	(3.728)	(2.452)	(13.30)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$	3.608	-1.820	1.165	-14.87	2.817	0.803	15.51
	(19.42)	(11.65)	(6.547)	(11.39)	(3.462)	(1.548)	(14.59)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$	42.33**	29.24	-6.906	2.059	3.421	0.516	14.00
	(19.47)	(23.56)	(4.763)	(13.38)	(4.813)	(3.346)	(13.15)
R-squared	0.134	0.050	0.018	0.037	0.027	0.022	0.116
Panel B: High Attachment (n=63,100)							
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{small firm})$	5.807	5.952	-3.201	1.252	0.176	0.146	1.483
	(4.716)	(6.717)	(3.279)	(4.205)	(1.220)	(0.708)	(3.105)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{medium firm})$	0.0154	2.972	-3.154	4.134	0.793	-0.338	-4.392
	(4.062)	(8.019)	(2.157)	(3.761)	(0.692)	(0.529)	(3.861)
$-\Delta\ln(1+\tau_j^{\text{CAN}}) * \mathbb{1}(\text{large firm})$	-3.864	-12.87	-2.216	9.190*	1.482	0.0464	0.508
	(3.933)	(8.217)	(2.129)	(5.401)	(0.936)	(1.225)	(2.903)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{small firm})$	-8.728	-0.917	7.823*	-9.536*	1.936	-0.686	-7.348*
	(5.682)	(8.703)	(4.472)	(4.902)	(2.369)	(0.887)	(4.250)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{medium firm})$	1.151	2.356	6.571	-12.19**	1.215	-0.129	3.328
	(5.753)	(10.68)	(4.122)	(5.786)	(1.436)	(0.779)	(5.006)
$-\Delta\ln(1+\tau_j^{\text{US}}) * \mathbb{1}(\text{large firm})$	-2.465	22.37	-15.10**	-6.675	1.365	-3.153*	-1.273
	(6.516)	(20.00)	(6.016)	(10.97)	(1.378)	(1.663)	(3.585)
R-squared	0.114	0.072	0.036	0.052	0.020	0.022	0.073

Notes: Dependent variable is the sum of a worker's earnings during 1989-2004, divided by the worker's average yearly earnings in 1986-1988 (omitting years with zero earnings), defined in equation (2). The independent variables of interest are the 1988-1998 tariff cuts facing U.S. exports to Canada ($-\Delta\ln(1+\tau_j^{\text{CAN}})$) or facing Canadian exports to the U.S. ($-\Delta\ln(1+\tau_j^{\text{US}})$) in the worker's initial industry, interacted with initial firm size (small=1-99, medium-100-999, large=1000+). Column (1) examines total earnings from all sources, (2) earnings from the initial firm, (3) from firms other than the initial firm, but in the same initial 4-digit industry, (4) in manufacturing industries (NAICS=3xxx) other than the initial industry, (5) in construction and utilities (NAICS=22xx, 23xx), (6) in mining (NAICS=21xx), agriculture (NAICS=1xxx), or from a firm with unknown industry code, and (7) in services (NAICS≥4xxx). Because earnings in columns (2) through (7) additively decompose total earnings, the coefficients in columns (2) through (7) sum to the overall effect in column (1). All specifications include extensive worker, initial firm, and initial industry controls, described in Section 4. Standard errors clustered by 4-digit NAICS industry. *** p<0.01, ** p<0.05, * p<0.1.