The Impact of Internal Trade Liberalizations on Plant Productivity and Markups

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Abstract

I estimate the effects of two Canadian internal trade liberalizations on plant-level productivity, markups, and exports. In particular, I examine the New West Partnership and Trade Agreement (NWPTA) and the Trade and Cooperation Agreement (TCA), both of which sought to reduce or remove prohibitive, technical and administrative barriers to trade across provinces. Employing a control function approach, I use Canadian manufacturing data to estimate plant-level total factor productivity and markups for 2004-2012. Then, using difference-in-differences methods, I find that the NWPTA increased the likelihood that a plant exports interprovincially, increased the share of output that plants sell to other provinces, increased plant-level total factor productivity but had no significant impact on plant-level markups. The agreement raised the average plant's productivity by 1.97 percent across all post-treatment years. In contrast, the TCA had no significant impact on plant-level productivity or export behavior, but was associated with a a small increase in markups. The NWPTA has shown significant positive effects on plant performance compared to the TCA, which has significant implications for the design of internal trade agreements. Specifically, the NWPTA's negative-list approach, in contrast to the TCA's positive-list, resulted in broader coverage. Moreover, the NWPTA achieved greater progress in mutually recognizing worker certifications and business registration, as well as in harmonizing business standards between provinces, making it a more effective agreement overall.

Keywords: Inter-regional trade barriers; Trade agreements; Productivity; Markups; Canada

JEL: F13; F14; L11; L38

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1 Introduction

Trade barriers are most commonly thought to exist between countries, but empirical evidence suggests that *within* countries, non-tariff barriers to trade can be large, and vary considerably across regions and industries. Significant internal border effects have been identified across many different countries, including the US (Wolf, 2000; Millimet and Osang, 2007; Coughlin and Novy, 2013), China (Ma and Tang, 2020), Japan (Wrona, 2018), Germany (Nitsch and Wolf, 2013), Spain (Gallego and Llano, 2014; Llano-Verduras et al., 2021), and Canada (Anderson and Yotov, 2010; Agnosteva et al., 2019; Alvarez et al., 2019; Lapham and Teeter, 2023).[1] These internal barriers present hurdles to domestic trade across provinces or states within a country. For example, significant compliance costs can be incurred by firms due to regulatory differences, labor mobility can be hindered by occupational licensing and recognition differences, and regional laws may outright prohibit the trade of specific goods and services.

For Canada, these barriers have been estimated to cost the Canadian economy between $50-$130 billion each year in lost trade opportunities (Albrecht and Tombe, 2016). Further estimates suggest that full liberalization of internal trade within Canada could increase Canadian GDP per capita by 4 percent (Alvarez et al., 2019). Policy makers within Canada have recognized this issue and have made several attempts to create legislation with the goal of breaking down these barriers. These internal Canadian trade agreements offer a unique perspective on how the reduction and harmonization of largely technical and administrative barriers can have productive efficiency and cost enhancing effects.

In this paper, I estimate the impact that Canadian interprovincial trade liberalizations had on plant productivity, markups, and exports. I use plant-level data from the Canadian Annual Survey of Manufactures linked to the General Index of Financial Information (ASM-GIFI) covering the period 2004-2012. Plant-level data from the ASM-GIFI contains the necessary variables needed to estimate productivity and markups, but also crucially includes interprovincial and international export data, which are used to control for market structure differences according to export-status.

Trade liberalizations may result in significant productivity gains for firms, higher wages and increased labor mobility for workers, along with lower prices and more choices for consumers. Theoretical predictions suggest that lowering trade frictions will cause a selection effect as the most productive firms enter export markets while the least productive firms exit (Melitz, 2003; Bernard et al., 2003; Melitz and Ottaviano, 2008). Market share reallocations among surviving firms also contributes to productivity growth together with any

[1] Alternatively, these are sometimes described as *home bias* effects within provinces or states.

productivity enhancing learning that occurs through trade exposure for new exporters. Empirical findings accord with these theoretical predictions, confirming productivity gains from liberalized trade (Pavcnik, 2002; Van Biesebroeck, 2006; De Loecker, 2007). Trade reforms may also reduce markups by lowering input prices and/or increasing competition, resulting in cost savings to consumers. Thus, the elimination of trade barriers may help facilitate economic growth and increased consumer welfare through these selection, reallocation, learning and pro-competitive channels.

The estimation strategy I use to obtain consistent estimates of productivity builds upon the framework in Ackerberg et al. (2015), with adjustments proposed by De Loecker (2007) to account for demand shifters related to trade. Markups are estimated using the methodology developed in De Loecker and Warzynski (2012). With productivity and markup estimates, I can identify the impact of interprovincial trade agreements on those variables by utilizing variation across treated and untreated provinces through a difference-in-differences (DiD) design. To correct for bias that may arise due to staggered timing of when provinces join these agreements or the difference in treatment intensity over time as measures in trade agreements have a period of phasing-in before taking full effect, I employ the DiD_ℓ methodology of De Chaisemartin and d'Haultfoeuille (2020).

My results indicate that the New West Partnership Trade Agreement (NWPTA), increased the likelihood that plants exported interprovincially, increased the share of output that plants sell to other provinces, increased plant-level total factor productivity (TFP) but had no impact on plant-level markups. Specifically, after a short period of phasing in, the agreement was associated with a 2.03 to 2.83 percent increase in TFP, with an average impact of 1.97 percent across all post-treatment periods. Conversely, the Trade and Cooperation Agreement (TCA) between Ontario and Quebec had no significant impact on plant-level productivity or export behavior, but was associated with a 1.97 to 2.51 percent increase in plant-level markups.

This paper is most closely related to the literature on intra-national barriers to trade and their implications for economic outcomes, which is not as extensive as the literature on international barriers. Tombe and Zhu (2019) found that internal trade and migration cost reductions within China accounted for 28 percent of China's aggregate labor productivity growth between 2000 and 2005, while the reduction in international trade costs accounted for only 8 percent of this growth. Bryan and Morten (2019) estimated aggregate productivity gains in Indonesia from the reduction of internal labor migration barriers and documented a 22 percent increase in labor productivity from removing all barriers. Morten and Oliveira (2024) examined the impact of infrastructure development in Brazil and found that highway improvement increased welfare by 2.8 percent, 76 percent of which was due to reduced trade costs and 24 percent to reduced migration costs.

Donaldson (2018) examined the implications of a vast railwork expansion from colonial India and found that it decreased trade costs and interregional price gaps, increased interregional and international trade, and increased real income levels.

In a Canadian context, Agnosteva et al. (2019) assayed regional frictions between provinces and found large intra-national trade costs that vary across provinces. Similarly, Lapham and Teeter (2023) found that geographic dispersion in internal trade frictions are greater for sellers than buyers and vary considerably across sectors. Albrecht and Tombe (2016) quantified the consequences of internal trade costs in Canada by using a multi-sector trade model and found that in a counterfactual scenario where such costs were eliminated, productivity gains average more than 50 percent but vary substantially across industries. Alvarez et al. (2019) found that 43 percent of total trade frictions came from non-geographic trade barriers in Canada, with the average non-geographic barrier being the tariff equivalent of 21 percent in 2015.

A related literature focuses on the impact of trade liberalizations on economic outcomes. Trade barriers and market regulations have the potential to reduce aggregate productivity in a country if they favor less productive firms (Hsieh and Klenow, 2009). Such policies may allow weaker firms to compete in sectors in which they may have otherwise not existed or in which they would be forced to exit in the absence of such barriers or regulations. Pavcnik (2002) empirically investigated the effects of liberalized trade on plant productivity in Chile, finding evidence of aggregate gains of 25.4 and 31.9 percent in the export-oriented and import-competing sectors as a result of resources being shifted from less to more productive firms.

A second mechanism that may contribute to a positive correlation between exporting and productivity is the learning-by-exporting hypothesis, where exporting improves the productivity of firms through exposure to new trade related knowledge and expertise over time. De Loecker (2007) disentangled the correlation between export status and productivity, finding that export entrants became on average 8.8 percent more productive once they start exporting. Atkin et al. (2017) conducted a randomized controlled trial on rug manufacturing in Egypt that accounted for changes in markups, product mix and product quality typically missing from plant-level survey data, and found that the opportunity to export raises the overall performance (profits) of firms by 16 to 26 percent for treatment firms relative to control firms.

Trade reforms also have the potential to reduce markups. Often, a trade liberalization induces more elastic demand for all firms, causing surviving firms to respond by lowering their markups. Prices fall due to the combined effect of higher average productivity and lower markups (Melitz and Redding, 2014). De Loecker et al. (2016) examined how prices, markups and marginal costs respond to a trade liberalization with data from

India. They found that a trade liberalization lowered factory-gate prices, thus had a pro-competitive effect through lowered prices passed on to consumers, although not at a pace that matched the decline in marginal costs. Garcia-Marin and Voigtländer (2019) documented that following their entry into export markets, firms experienced significant reductions in marginal costs, while maintaining stable markups. Consequently, productivity gains after export entry were largely passed on to customers through lower output prices.

Trefler (2004) and Lileeva and Trefler (2010) showed that the overall effect of the Canada-US Free Trade Agreement was a 13.8 percent increase in manufacturing productivity, with 8.4 percent attributed to selection/reallocation channels and 5.4 percent arising from within-plant growth. Baldwin and Gu (2004) documented the extent to which trade liberalizations caused more Canadian plants to enter export markets and that this export-market participation was associated with higher labor productivity growth as a result of increases in plant specialisation, learning by exporting, and exposure to international competition. Studies examining the impacts of interprovincial agreements have found that they are associated with a reduction in trade barriers (Alvarez et al., 2019) and have increased aggregate trade in goods and services for some industries, but not others (Lapham and Teeter, 2023).

The remainder of the paper is organized as follows. In Section 2, I provide a brief overview of the frictions that exist between Canadian provincial borders and the internal trade agreements designed to address them. In Section 3, I describe the methodology used to recover productivity and markup parameters along with the DiD estimators used to analyze the impact of these agreements on those parameters. In Section 4, I describe my dataset. Section 5 presents the results of the empirical analysis and Section 6 concludes.

2 Canadian Internal Trade

2.1 Interprovincial Trade Flows

Interprovincial trade in Canada represents around one-fifth of the country's annual gross domestic product.[2] As a share of total out-of-province exports, interprovincial trade in Canada is also large. Figure 1 shows that across provinces, interprovincial trade made up between 30 to 50 percent of all exports and varied substantially over the period 1992-2018. Accordingly, efforts to lower trade frictions between provinces would cover a significant portion of the Canadian economy.

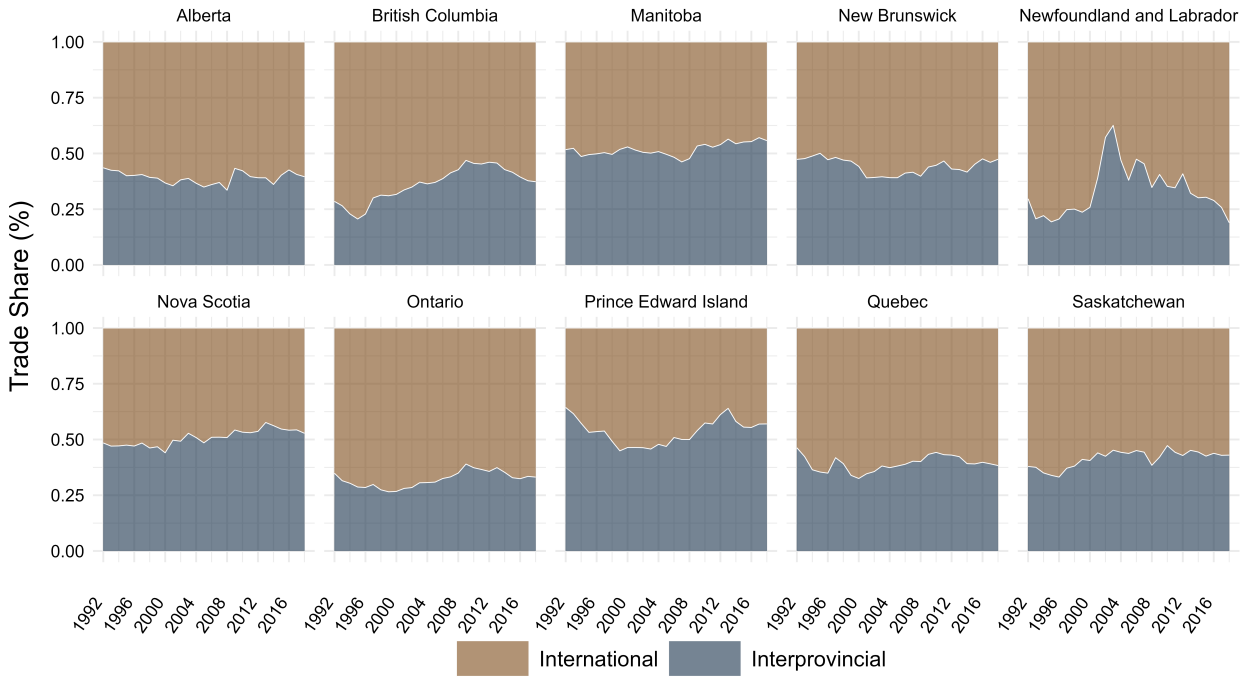
Western Canada (Alberta, British Columbia, Manitoba and Saskatchewan) accounts for close to 40 percent of Canada's real gross domestic product, a disproportionately large amount compared to its share of

[2] https://www.cfta-alec.ca/canadian-free-trade-agreement/

Canada's population.[3] Figure 2 depicts that the share these provinces hold of Canada's interprovincial and international exports grew from 25 percent in 1992 to 40 and 35 percent by 2018 respectively. As illustrated in Figures A1 and A3, Western Canada is deeply connected economically as over half of their interprovincial trade is with each other.

Comparatively, the share that Ontario and Quebec hold of Canada's interprovincial and international exports has declined over this period. Economically, these two provinces are large, representing close to 60 percent of Canada's gross domestic product. Figure A2 illustrates that the level of economic integration between Ontario and Quebec is unbalanced, as 35 percent of interprovincial exports from Ontario were bound for Quebec, but nearly 62.5 percent of exports from Quebec were bound for Ontario. Additionally, Figure A4 depicts a declining trend in the amount of imports these provinces receive from each other. Correspondingly, approaching trade frictions at the sub-national level has the potential to allow policy makers to tailor legislation representative of these deep levels of economic integration.

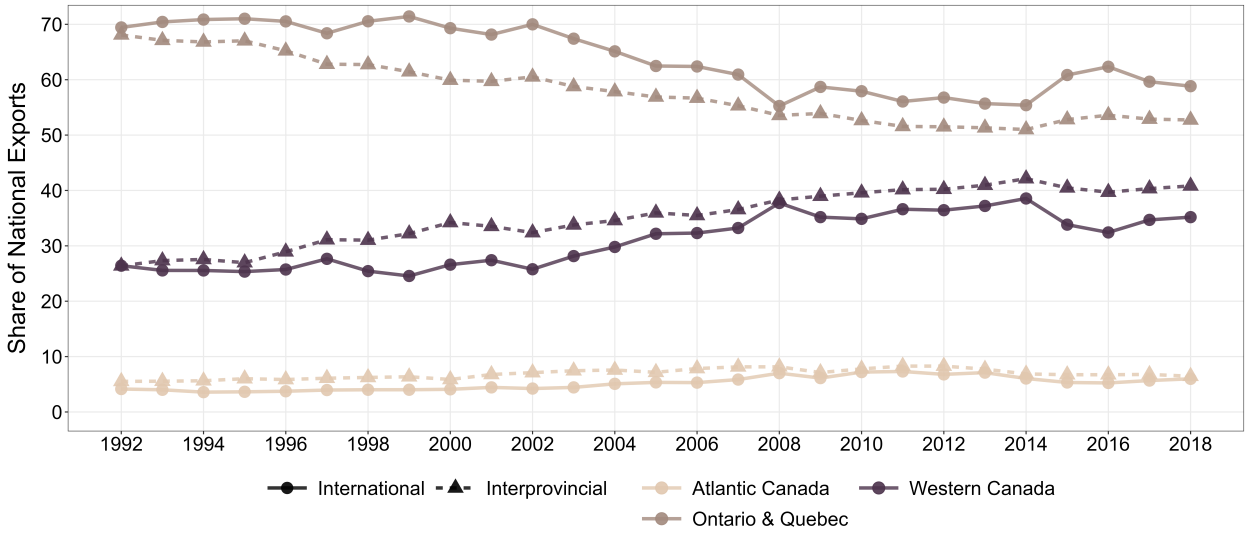
Figure 1: Provincial Aggregate Goods and Services Export Shares, 1992-2018



Note: This figure depicts the share of exported goods and services to interprovincial and international destinations from the ten Canadian provinces. Canada's Territories have been excluded from the calculations.
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

[3] Statistics Canada Table 36-10-0402-01

Figure 2: Canadian Aggregate Goods and Services Export Shares, 1992-2018



Note: This figure depicts the share of total interprovincial and international Canadian exported goods and services from Western Canada (Alberta, British Columbia, Manitoba, and Saskatchewan), Ontario & Quebec, and Atlantic Canada (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador). Canada's Territories have been excluded from the calculations.
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

2.2 Interprovincial Trade Frictions

Within Canada, Section 121 of the *Constitution Act, 1867*, withholds that goods and services must be admitted *free* into each of the other Provinces (i.e. customs duties are not permitted).[4] However, interprovincial trade barriers restricting the flow of goods, services and labor can still be found in all sectors of the economy. Aside from natural barriers to trade, such as the costs involved in moving goods across the country, Table 1 categorizes three types of internal trade barriers as identified by the Canadian Federation of Independent Business. These barriers range from explicitly preventing internal trade to making trade more difficult, and while individually they may appear small, together these market inefficiencies have the potential to significantly reduce the economy's growth potential and competitiveness.

One of the most commonly cited prohibitive barriers to trade in Canada concerns restrictions on moving alcohol across provincial borders. New Brunswick's *Liquor Control Act* made headlines when the Supreme Court of Canada upheld that the Act did not infringe upon Section 121 of the *Constitution Act, 1867* in R. v. Comeau.[5] In Quebec, Newfoundland and Labrador, and Nova Scotia, live snow crabs must be processed within the province before export, and softwood lumber in Quebec, British Columbia and New Brunswick follows similar restrictions. Federally licensed meat processing facilities are authorized for interprovincial and international trade, whereas provincially registered facilities are limited to intra-provincial sales.

[4] *Constitution Act*, 1867, 30 & 31 Vict, c 3, s 121.
[5] R. *v.* Comeau, 2018 SCC 15, [2018] 1 S.C.R. 342.

Table 1: Internal Barriers to Trade

	Description	Examples
Prohibitive Barriers	Laws that explicitly prevent trade	Inability to ship alcoholic beverages directly to consumers
Technical Barriers	Sector-specific regulations that differ across provinces/territories	Transportation standards Food packaging and labelling Professional certifications
Administrative Barriers	Paperwork requirements in different provinces/territories	Business registration Permits Licensing

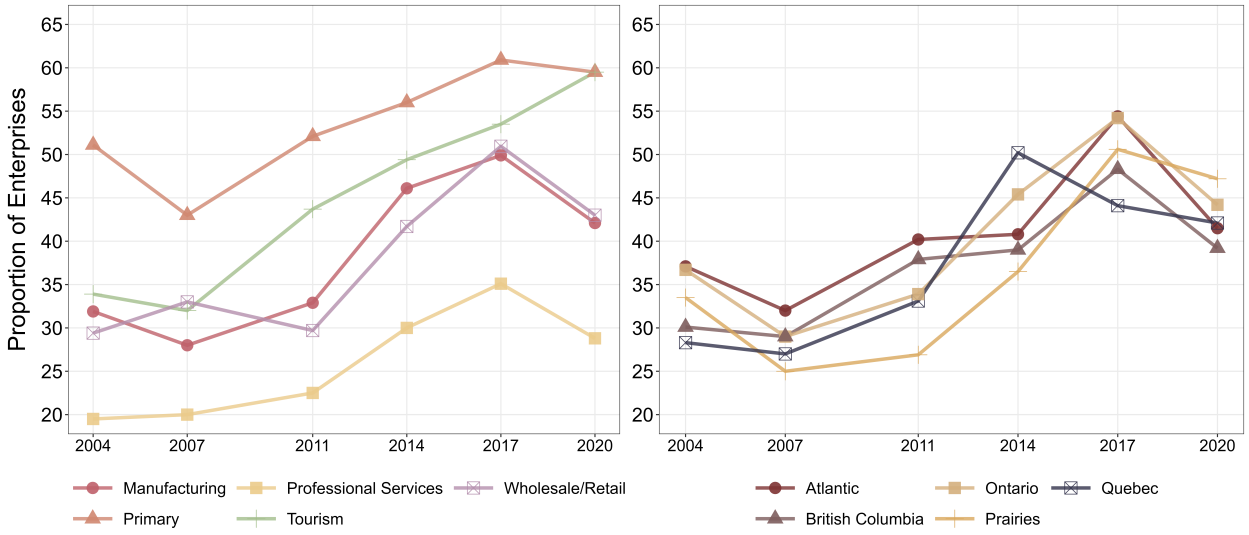
Technical barriers to trade offer the same challenges to producers when trying to establish demand for their products in a national domestic market. Quebec's *Regulation Respecting Dairy Product Substitutes* prohibited the sale in Quebec of margarine colored the same pale yellow hue as butter until its repeal in 2008 after a dispute with the Western provinces. In British Columbia, only certain types of trucks can be driven at night, while in neighboring Alberta these same trucks can only be driven during the day, which leaves a small window under which they can cross that provincial border. Trucking companies may also need to cover the cost of making different sets of tires to meet different weight requirements set in each province.

In the *Canadian Survey on Business Conditions (2023)*, administrative barriers such as extensive waiting times for candidates to become certified or licensed was cited the most frequently (35.5 percent) amongst businesses considering hiring individuals from another province, with health care and social assistance (56.9 percent) being the most likely to report this obstacle. Other noteworthy examples include the costs associated with hiring out-of-province workers, the level of effort required to verify individual's certifications, and paperwork requirements that need to be filled out.

Amongst small and medium enterprises, these internal barriers consistently rank highly on cited obstacles to business growth in the *Survey on Financing and Growth of Small and Medium Enterprises*. Figure 3 shows that these barriers are felt most by businesses in the primary sector, which comprises industries that harvest and extract raw materials. Restrictions in the agricultural sector are prevalent in Canada and most markedly include supply-managed goods, such as poultry, eggs and dairy along with a variety of different food-packaging, labelling and inspection requirements (Macmillan and Grady, 2007). Additionally, regulatory measures adopted in British Columbia[6], Ontario[7] and Quebec[8] provide effective control in all

[6] *Natural Products Marketing (BC) Act, RSBC 1996, c 330*.
[7] *Farm Products Marketing Act, R.S.O. 1990, c. F.9*.
[8] *Act Respecting the Marketing of Agricultural, Food and Fish Products, R.S.Q., c. M-35.1*.

Figure 3: Government Regulations Reported as an Obstacle to Businesses, 2004-2020



Note: This figure depicts the proportion of respondents from small and medium sized enterprises in Canada who answered "Government regulations (please specify)" to the question "Which of the following are obstacles to the growth of your business?" across different industries (left panel) and regions (right panel).
Source: Survey on Financing and Growth of Small and Medium Enterprises.

respects to the marketing of these products within their respective jurisdiction, which includes the prohibiting of marketing in whole or in part. Since the survey question was first asked in 2004, government regulations have been increasingly reported as an obstacle over time across all regions and industries in Canada.

2.3 Interprovincial Trade Agreements

To address these internal barriers to trade, the federal and provincial governments established the Agreement on Internal Trade (AIT) on July 1, 1995. This agreement created general rules governing trade-related policies between provinces, relying largely on a positive-list approach, which meant that measures that restricted or impaired the movement of goods, services, and labor were subject to the agreement only if they were specifically included within the agreement. In addition, the agreement prevented the adoption of any new measures that restricted trade. Areas that the AIT made notable progress in reducing barriers include labor mobility, government procurement, and investment. The dispute resolution mechanism included in the agreement provided resolutions to fourteen cases throughout the duration of the AIT.[9]

The AIT was a good starting point for reducing trade barriers between provinces, but had several shortcomings. The agreement did not address regulatory harmonization, it failed to provide adequate provisions to reduce barriers in the agricultural sector, it completely omitted a chapter on the energy sector, it did not

[9]One case where the provisions in the AIT were upheld was the striking down of subsidies provided in Alberta to craft brewers originating only from Western provinces who signed a separate sub-national trade agreement in 2016. A full list of these cases can be found at: https://www.cfta-alec.ca/dispute-resolution/ait-dispute-resolution-archive/

sufficiently address trade in services, its dispute resolution mechanism imposed penalties based off limited population-based criteria, and its positive-list approach limited coverage.

The shortcomings of the AIT prompted negotiations in December 2014 between provincial and federal governments to improve the agreement, resulting in the Canadian Free Trade Agreement (CFTA) which came into force on July 1, 2017. A defining aspect of this new agreement was the incorporation of a negative-list approach, which applies the rules of the agreement to all areas of economic activity unless otherwise excepted. The agreement now covers most of the service economy, which has outpaced growth in trade for goods since 1994 and accounts for 70 percent of Canada's GDP. Coverage of the agreement was extended to the energy sector, it includes a stronger dispute settlement provision by doubling the maximum monetary penalty, and addresses regulatory harmonization by allowing for a dynamic process that first identifies barriers and then puts forward negotiations towards a reconciliation agreement between parties. To date, this has resulted in thirteen reconciliation agreements covering either a specific sector or all industries broadly.[10]

Many improvements in the CFTA were made with precedent established in prior agreements formulated between provinces trying to accelerate the national effort of breaking down internal trade barriers at a regional level. Table 2 shows a selection of some of these agreements that fall within my study period and their respective parties.[11] The TILMA/NWPTA agreement is the most ambitious trade agreement that has been drafted at the provincial level. Improving on the AIT, it features a negative-list approach to measures that restrict trade, mutual recognition of standards between parties, lower government procurement thresholds, opens energy markets to producers and distributors between provinces, eliminates local-presence requirements to do business and expands dispute settlement provisions (Macmillan and Grady, 2007). Presently, NWPTA signatory provinces hold the fewest barrier exceptions across all provinces in the CFTA, likely due to the progress made through their sub-national efforts.

Although less ambitious than the NWPTA, the TCA was signed between Ontario and Quebec in 2009 and offered a limited expansion of the AIT, but continued to rely heavily on a positive list approach. A key improvement of the TCA was made in labor mobility between the two provinces through mutual recognition of certifications and permits covering most professions along with a more stringent dispute settlement mechanism. In addition, significant efforts were made to lower barriers in the financial services sector.

[10] One example is the *Weight Allowances for Wide Base Single Tires Agreement, 2018* which harmonizes differences in provincial weight limits for wide base single tires that were identified as a barrier for the trucking industry. A full list of these reconciliation agreements can be found at: https://rct-tccr.ca/agreement-category/reconciliation-agreements/.

[11] An extended list of Canada's sub-national agreements can be found at: https://www.cfta-alec.ca/trade-enhancement-agreements/. I have omitted most as they either pertain to the Canadian Territories, pertain exclusively to the construction sector, or were merely pledges to increase intergovernmental cooperation.

Table 2: Canadian Interprovincial Trade Agreements

	Parties to the Agreement	Date of Entry Into Force	Date of Latest Amendment
Canadian Free Trade Agreement (CFTA)	National	July 1, 2017	January 16, 2024
Agreement on Internal Trade (AIT)	National	July 1, 1995	February 18, 2015
New West Partnership Trade Agreement (NWPTA)	British Columbia Alberta Saskatchewan Manitoba (2017)	July 1, 2010	May 26, 2022
Trade, Investment and labor Mobility Agreement (TILMA)	British Columbia Alberta	April 1, 2007	March 30, 2009
Trade and Cooperation Agreement (TCA)	Ontario Quebec	September 11, 2009	September 1, 2016

3 Estimation Methodology

3.1 Estimating Plant-Level Productivity and Markups

My estimation strategy for obtaining estimates of productivity builds upon the control function framework of Ackerberg et al. (2015) (ACF) with adjustments from De Loecker (2007) to control for demand shifters related to trade. This approach allows for the control of simultaneity bias that arises when estimating production functions due to profit-maximizing firms knowing their productivity when they choose their inputs that are unobserved to a researcher. It also allows for productivity to move with variation associated with a trade liberalization in an internally consistent manner. Markups are then estimated following the methodology of De Loecker and Warzynski (2012).

The ACF method involves a two stage procedure to estimate the parameters of a production function. The first stage assumes that all firms within a sector share the same technology, making it possible to estimate a Cobb-Douglas production function in logs:[12]

$$y_{it} = \beta_0 + \beta_v v_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it}, \tag{1}$$

where y_{it} is value added or output for plant i in period t, v_{it} is a vector of variable inputs such as labor, materials and energy, k_{it} is capital inputs, ω_{it} captures productivity shocks that are potentially observed or predictable by firms when they make input decisions and ϵ_{it} is a standard i.i.d error term capturing

[12]In Section 5, I adopt a translog production function to allow for more flexibility in the combination of inputs.

unanticipated production shocks and measurement error.

This method assumes that productivity is a function of the firm's flexible inputs and capital, which are strictly monotonic and increasing in ω_{it} and thus can be inverted to produce: $\omega_{it} = d_t^{-1}(v_{it}, k_{it}, z_{it})$. Here, z_{it} represents a vector of demand-side shifters, which includes firm's interprovincial and international export status as per the methodology adopted in De Loecker (2007). This feature of the model creates an environment of imperfect competition that captures producer level differences from the demand shifters in z_{it} that otherwise cannot differentially impact demand across producers under the standard setup of perfect competition (De Loecker and Syverson, 2021).

This function can then be substituted into the production function:

$$y_{it} = \beta_0 + \beta_v v_{it} + \beta_k k_{it} + d_t^{-1}(v_{it}, k_{it}, z_{it}) + \epsilon_{it} = \phi_t(v_{it}, k_{it}, z_{it}) + \epsilon_{it}, \tag{2}$$

where $\phi_{it}(.)$ is a composite term that captures predicted output and subsumes the first 3 terms of equation (2), thus providing a way to control for unobserved productivity ω_{it}. The purpose of this first stage is to strip predicted output from measurement error (De Loecker and Syverson, 2021). This results in the first stage moment condition for producing an estimate $\hat{\phi}_t(v_{it}, k_{it}, z_{it})$:

$$E[\epsilon_{it} \,|\, I_{it}] = E[y_{it} - \phi_t(v_{it}, k_{it}, z_{it}) \,|\, I_{it}] = 0. \tag{3}$$

In the second stage, the method assumes that productivity evolves according to a first-order Markov process (i.e. $\omega_{it} = g(\omega_{it-1}, ES_{it-1}) + \xi_{it}$) and firms accumulate capital according to $k_{it} = (1-\delta)k_{it-1} + i_{it-1}$, where investment i_{it-1} is chosen in period $t-1$. Here, ES_{it-1} is a vector containing lagged interprovincial and international export status, allowing for plants to endogenize the production process to account for potential export related learning effects. Omission of these variables from the productivity process leads to biased coefficients if productivity depends on past export experience, invalidating the productivity analysis (De Loecker, 2007).[13]

The production function parameters are estimated using the following conditional moment, where ϕ_{t-1} is

[13]Other variables may be considered to include in this process, such as R&D expenditures (Doraszelski and Jaumandreu, 2018) or policy variables such as tariffs (Brandt et al., 2017), quotas (De Loecker, 2011), and trade agreements. In the analysis presented in Section 5, I have not included the relevant trade agreements into the producers' productivity processes but note that the main results do not change when they are included.

replaced by its estimate from the first stage:

$$E[\xi_{it}+\epsilon_{it} \mid I_{it-1}] = E[y_{it}-\beta_0-\beta_v v_{it}-\beta_k k_{it}-g(\hat{\phi}_{t-1}(v_{it-1}, k_{it-1}, z_{it-1}, d_{it-1})-\beta_0-\beta_v v_{it-1}-\beta_k k_{it-1}) \mid I_{it-1}] = 0. \tag{4}$$

After obtaining consistent estimates of the production function, total factor productivity is then given by:

$$TFP_{it} = y_{it} - \hat{\beta}_v v_{it} - \hat{\beta}_k k_{it}, \tag{5}$$

where $\hat{\beta}_v$, $\hat{\beta}_k$ denote the estimates for the variable and capital inputs respectively.

After obtaining consistent estimates of the variable inputs, plant-level markups can then be estimated following the methodology of De Loecker and Warzynski (2012). Plant-level markups derived from the cost-minimization first-order condition are given by:

$$\mu_{it} = \frac{\theta_{it}^L}{\alpha_{it}^L}, \tag{6}$$

where μ_{it} is the markup, θ_{it}^L is the output elasticity of labor obtained from equation (5), and $\alpha_{it}^L = \frac{w_{it}L_{it}}{P_{it}Y_{it}}$ is the labor share of total output directly calculated from the data. According to equation (6), the markup is identified as the difference between a plant's labor output elasticity and its revenue share.[14]

3.2 Estimating the Impact of the Interprovincial Trade Agreements

This section discusses the econometric design for estimating the effect of the New West Partnership and Trade Agreement (NWPTA) and Trade and Cooperation Agreement (TCA) on a plant's total factor productivity, markups, export status and export intensity. I employ difference-in-differences estimators to compare plants within provinces that signed interprovincial trade agreements with plants in the rest of Canada where such agreements were not instituted.[15] I start by using the two-way fixed effects (TWFE) regression specification and follow up with the DiD$_\ell$ estimator proposed by De Chaisemartin and d'Haultfoeuille (2022a) to address issues of heterogeneous treatment dates and/or heterogeneous treatment intensities over time. Standard errors are clustered at the NAICS 4-digit industry level.[16]

[14] Labor is assumed to be a static input, but the methodology does allow for it to be a dynamic input due to adjustment costs such as hiring and firing costs. If there are adjustment costs, the computed markup will capture this additional component. For this reason, I have not used capital to calculate the markup as it likely contains these adjustment costs.

[15] NWPTA provinces include British Columbia and Alberta in 2007 (formerly named TILMA) and Saskatchewan in 2010. Manitoba joined in 2017, but this lies outside the study period. TCA provinces include Ontario and Quebec in 2009.

[16] Ideally, I would cluster at the treatment level (Bertrand et al., 2004), which corresponds to the province level. However, this approach raises concerns due to the limited number of clusters, as there are only ten provinces. The province-industry level was also considered, but clustering at too fine a level can lead to over-rejection (MacKinnon et al., 2023). Nonetheless, my results are similar when clustering at the province-industry level, and for some outcomes, at the province level.

3.2.1 Dynamic TWFE Methodology

The TWFE model exploits variation in timing of when interprovincial trade agreements came into force across different provinces over time. Explicitly, I estimate the following equation:

$$Y_{ipt} = \alpha_i + \gamma_t + \sum_{\tau=-q}^{-2} \beta_\tau RTA_{p\tau} + \sum_{\tau=0}^{m} \beta_\tau RTA_{p\tau} + \epsilon_{ipt}, \tag{7}$$

where Y_{ipt} is an outcome variable for plant i in province p at time t; (i) total factor productivity and markups, which are estimated from the methodologies described in the previous section, and (ii) export status and export intensity which are directly constructed from the data. In addition, α_i are plant fixed effects that capture time-invariant plant heterogeneity, while γ_t are year fixed effects controlling for common shocks to all plants in a given year.

Here, $RTA_{p\tau}$ is an indicator equal to 1 if the plant in province p is subject to the terms of an interprovincial trade agreement which came into force in period τ. Treatment occurs in year 0, and I have included q leads or anticipatory effects and m lags or post-treatment effects. The omitted category is $\tau = -1$, the year prior to the agreement. The lead terms are used to test for strict exogeneity, which satisfies the parallel trends assumption between treatment and control groups if they are statistically zero when the treatment is not endogenous. They also capture any anticipatory effects as trade agreements are ordinarily announced before they come into force which may cause firms to adjust prior to their implementation (Moser and Rose, 2014; Egger and Yotov, 2022). The lagged terms allow for phasing-in of the agreements and capture the possibility that the effects of those agreements change dynamically over time. Baier and Bergstrand (2007) note that virtually every trade agreement is phased-in typically over ten years, thus additional lagged terms up to five periods have been added. The coefficients of interest are β_τ.

3.2.2 DiD$_\ell$ Methodology

Recent research has shown that the TWFE estimator may be biased in designs with variation in the timing of treatment, treatment switching, or nonbinary treatments. In such a case, TWFE estimators are unbiased only if parallel trends hold and the treatment effect is constant between groups and over time (De Chaisemartin and d'Haultfoeuille, 2022b).[17] When there is heterogeneity of treatment effects over time, the TWFE estimate may correspond with a potentially non-convex weighted average of parameters that sum to 1 but may be negative (De Chaisemartin and d'Haultfoeuille, 2020; Goodman-Bacon, 2021).

[17] See De Chaisemartin and d'Haultfoeuille (2022b) and Roth et al. (2023) for surveys on the recent literature documenting and proposing estimators robust to heterogeneous treatment effects.

In this context, the NWPTA was signed by provinces in different periods and it is also possible that provisions contained within the agreement may benefit sectors more heavily concentrated in one province than others. Since British Columbia and Alberta entered the agreement in 2007, they may be used as a "control" group for Saskatchewan which entered in 2010, thus the earlier treated groups can be given negative weights for the later treated group, leading to the possibility of biased estimates.

To address the issue of negative weights from the staggered adoption of treatment across groups or from possible heterogeneity of the treatment effect over time, I adopt the DiD_ℓ estimator from De Chaisemartin and d'Haultfoeuille (2022a). When the design in this context is binary and staggered, such as for the NWPTA, the DiD_ℓ is equivalent to the event-study parameters of Callaway and Sant'Anna (2021) using not-yet treated as controls. Intuitively, in a staggered design, groups are aggregated into cohorts based off when they first started receiving the treatment to identify average treatment effects by comparing the expected change in outcome for a cohort treated in period t with those not-yet treated. In a non-staggered design, such as for the TCA, the DiD_ℓ estimator is able to control for heterogeneous treatment intensity over time by comparing a group's actual outcome to a counterfactual "status quo" outcome it would have obtained if its treatment had remained equal to its period-one value (De Chaisemartin and d'Haultfoeuille, 2022b).

4 Data

I use a link of two Statistics Canada's confidential data sets for this analysis, the Annual Survey of Manufactures (ASM) and General Index of Financial Information (GIFI) over the period 2004-2012.[18] The ASM is a survey of Canadian manufacturing industries which I use to obtain principal industrial statistics including output, employment, intermediate materials and international/interprovincial shipments. The GIFI contains an extensive list of financial statement items from which I obtain information on capital stock, measured as the stock of tangible assets. Since the ASM collects data at the plant-level while the GIFI collects data at the firm-level, I use a plant's output share within a firm to allocate capital stock down to the plant-level.

I restrict my data set to plants that report positive and non-missing data on all variables used in the analysis. I impose no restrictions on the number of employees contained within a plant, so a plant may be comprised of a single employee. I further restrict my data to include only Canada's ten provinces, so I ignore Canada's three territories. To adjust for factor quality differences in labor, I use the producer's total wage bill rather than the total number of employees. This measure is preferable because market wages are

[18] This dataset covers the period from 2000-2012, however, changes occurred starting in 2004 which caused commodity data to not be readily compared to previous periods. More information on the ASM can be found here https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getInstanceList&Id=16101.

more likely to reflect variations in workers' contributions to production (De Loecker and Syverson, 2021). I convert my variables from current dollars to 2012 constant dollars using industry-specific deflators from Statistics Canada's Productivity Accounts. After cleaning the data as described, over the period 2004-2012, the ASM-GIFI contains 57 130 plants, covering ten provinces, and 86(21) NAICS 4-digit(3-digit) industries.

5 Estimation Results

5.1 Estimated Total Factor Productivity and Markups

Figure 4 presents summary statistics for estimated average total factor productivity and markups for the Canadian manufacturing sector following Equations (5) and (6) for provinces under the NWPTA and the rest of Canada. I observe over the period 2004-2012 that TFP marginally declined for both groups. Prior to the NWPTA policy in 2007, trends in TFP are observed to be parallel but after the policy the trends diverge. In the same period, markups increased substantially for the average plant from about 35 percent over marginal cost in 2004 to nearly 70 percent by 2012, with no notable differences between groups.[19] The positive correlation observed in the trends for productivity and markups is consistent with theoretical predictions (Bernard et al., 2003; Melitz and Ottaviano, 2008) and empirical findings in the literature (De Loecker and Warzynski, 2012).

The trend for Canadian TFP is not surprising, as the slowdown in productivity growth for advanced economies during this period has been well documented (Syverson, 2017) and has even decelerated for some sectors around the Great Recession (Cardarelli and Lusinyan, 2015; Fernald, 2015). My results contrast with Yamazaki (2022) who used the same data and a similar estimation methodology but reported an overall increasing trend in average manufacturing TFP for Canada.[20]

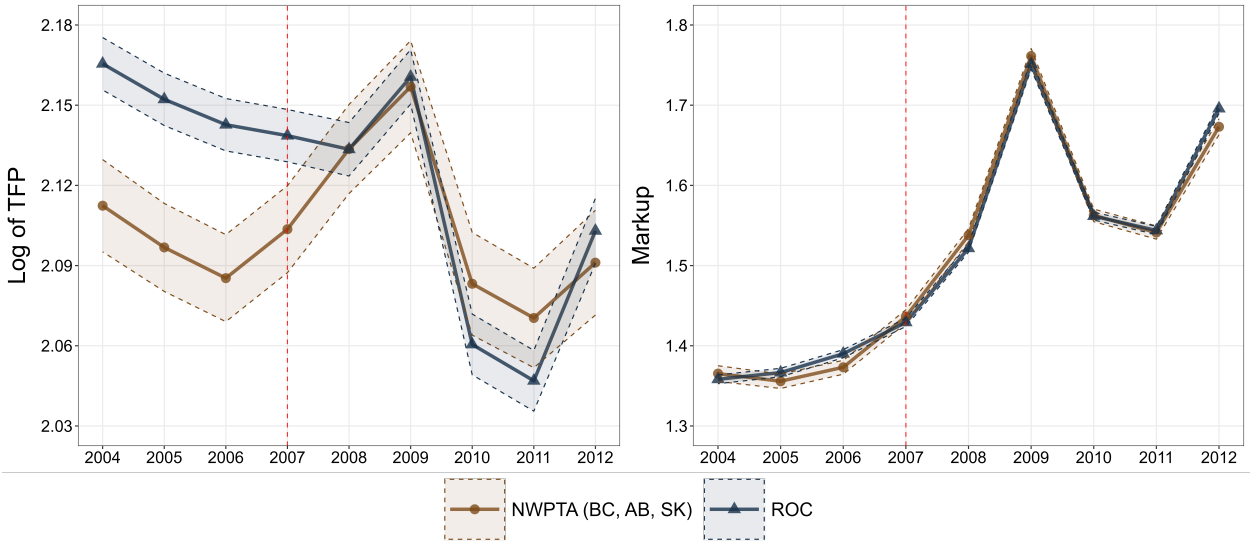
The increase in average markups over this period is consistent with trends documented in the literature using the same methodology (De Loecker and Eeckhout, 2018; De Loecker et al., 2020; Díez et al., 2021), however there are some differences worth noting. First, while the trend is similar, there are differences in the actual level of markups. My results are closest to the levels reported in De Loecker and Eeckhout (2018) and De Loecker et al. (2020), while Díez et al. (2021) report lower levels and a more moderate increase in markups over time. Second, there are differences in the set of countries or time period considered.[21] Finally,

[19] These figures present the results with the assumption of a translog production function. Figure A5 presents the estimated average markup when a Cobb-Douglas production function is assumed. My results indicate that a Cobb-Douglas production function provides markup estimates that are much higher than a translog production function.

[20] Yamazaki (2022) also reported a sharp increase during the Great Recession, which is surprising. Discrepancies may largely be due to sample size differences as Yamazaki considered 237,333 plant-year observations, while I use 311,602 observations.

[21] Díez et al. (2021) examine global trends using data on 19(27) countries for the period 2000-2015(2004-2013) and do not

Figure 4: Average Total Factor Productivity, Markups by Province Groupings, 2004-2012



Note: In both panels, provinces are grouped into either the NWPTA in beige (comprised of the British Columbia, Alberta and Saskatchewan) or the rest of Canada (ROC) in blue. The left panel reports the log of the mean (translog) TFP while the right panel reports the mean markup for each grouping and their 95% confidence intervals. The dashed red line marks the date when the NWPTA entered into force in 2007 between British Columbia and Alberta (formerly named TILMA).

this paper only has data for the manufacturing sector, while others have data that allows them to pool many sectors together or look at them separately, where slight differences are reported in the manufacturing sector.[22]

5.2 Effects of the NWPTA

In this section I analyze the impact of the NWPTA on plant-level productivity, markups and exports distinct from the TCA, which I analyze in Section 5.3. Among sub-national internal trade agreements in Canada, the NWPTA has the greatest coverage across sectors and addresses the largest variety of barriers. I first examine the impact of the NWPTA on productivity and markups, and then investigate the mechanisms that may have driven this impact by analyzing the post-treatment export decisions of plants.

5.2.1 Total Factor Productivity and Markups

There are multiple channels through which a trade liberalization may improve a plant's productivity and impact markups. A trade liberalization may increase competition in markets or remove protective regulations,

include Canada in their analysis, De Loecker and Eeckhout (2018) cover 134 countries for the period 1980-2016, and De Loecker et al. (2020) cover the United States spanning the period 1950-2016.

[22] Díez et al. (2021) report a flat average markup over time for manufacturing, rather than a moderately increasing average markup when all sectors are aggregated together. De Loecker and Eeckhout (2018) aggregate all sectors together so manufacturing is not directly comparable. The disaggregated manufacturing results from De Loecker et al. (2020) are similar to mine for NAICS industries 31-32 (food and wood manufacturing), but lower levels are reported for NAICS 33 (metal manufacturing).

causing the least productive plants to exit. It follows that a plant may become more productive as market shares are reallocated away from exiting plants towards them. Plants may also become more efficient as they enter export markets and gain new knowledge and expertise through a learning-by-exporting channel.

The potential impact of a trade liberalization on markups is more nuanced, as there are counteracting mechanisms that can drive markups in both directions. Higher productivity plants benefit from having a cost advantage over their competitors, thus may charge a higher markup. However, increased import competition shifts up residual demand price elasticities for all firms, inducing a downward shift in the distribution of markups with the expectation that the average markup across firms is reduced (Melitz and Ottaviano, 2008).

Table 3 presents the TWFE and DiD_ℓ estimates that pool all of the post-agreement years together using Equation (7). The TWFE estimates suggest that the NWPTA is associated with an average increase in plant-level productivity of 1.97 percent and an average reduction in plant-level markups of 1.63 percent across all post-agreement years. The DiD_ℓ estimate of the NWPTA on productivity remains positive and significant, although at a reduced magnitude compared to the TWFE estimate. However, no impact of the NWPTA on markups is observed with the DiD_ℓ estimator, which may be indicative of bias resulting from heterogeneous treatment effects.

Figure 5 shows the results from the event study analysis. The pre-treatment effects for the NWPTA on productivity suggest that prior to the implementation of the agreement, productivity was similar between the two groups and not statistically significant. Post-treatment, the effect of the NWPTA on productivity takes one period to phase-in, with an estimated 2.83 percent increase in period 1 (year 2) that levels out to 2.03 percent by period 5 (year 6). For markups, there is no observable significant effect of the agreement. I also present the dynamic DiD_ℓ estimates in Appendix Figure A6 which are robust to potential heterogeneous treatment effects. The qualitative results continue to hold under this alternative estimator, but the magnitude of the NWPTA on productivity changes to a 2.1 percentage increase in year 2 to 3.14 percent by year 5, with an insignificant impact ending in year 6.

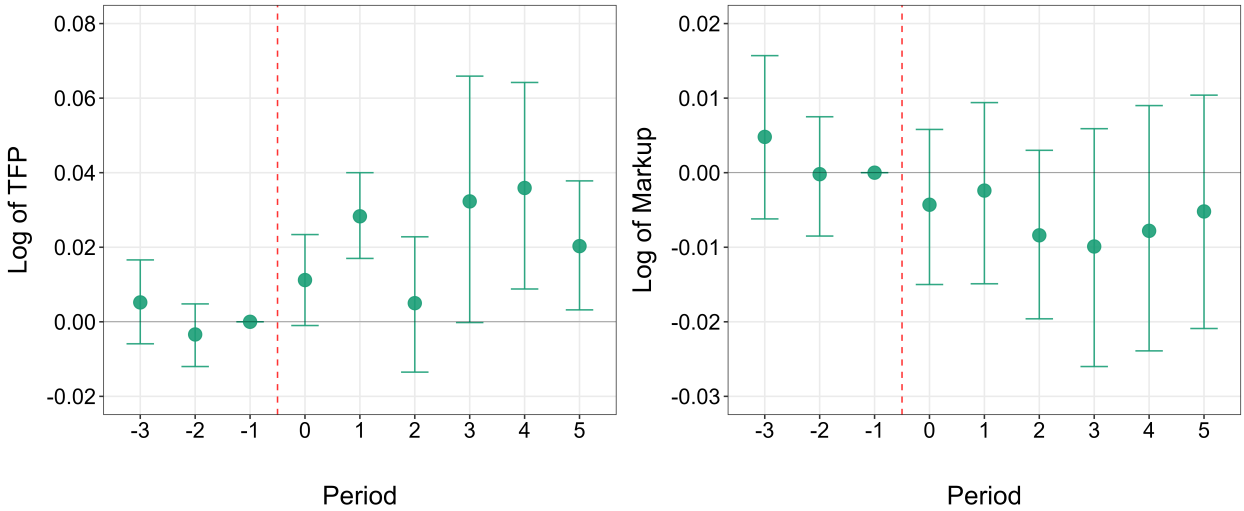
Taken together, the association of the NWPTA with increased plant-level productivity and either reduced or unchanged markups is suggestive that the agreement was effective, and that the benefits of increased competition outweighed any potential for higher markups due to cost advantages. These results are indicative that an internal trade liberalization can have effects on productivity and markups similar to those of an international trade liberalization.

Table 3: Pooled TWFE and DiD$_\ell$ Estimates of the NWPTA on TFP and Markups

Dependent Variable:	Log of TFP		Log of Markup	
	(TWFE)	(DiD$_\ell$)	(TWFE)	(DiD$_\ell$)
NWPTA	0.0197**	0.0101**	-0.0163*	-0.0021
	(0.0093)	(0.0048)	(0.0096)	(0.0060)
Controls				
Plant FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
R^2				
Observations	311602	311602	311602	311602

Note: This table shows the TWFE and DiD$_\ell$ estimates that pool all post-agreement years together from Equation (7). Total factor productivity (TFP) is from the estimation of equation (5) while markup is from the estimation of equation (6). Standard errors are clustered at the NAICS 4-digit industry level and are given in parentheses. Significance levels: ***: 0.01, **: 0.05, *: 0.1.

Figure 5: Dynamic Effects of the NWPTA on TFP and Markups



Note: These figures report TWFE coefficients and their 90% wild cluster bootstrap confidence intervals from the estimation of equation (7) for the outcomes of log total factor productivity (left panel) and log markups (right panel) for 2004-2012. The coefficients represent the change in outcomes for provinces subject to the NWPTA relative to other provinces. The NWPTA was signed in 2007 (formerly named TILMA), so I show the three years before and five years after signing.

5.2.2 Exports

The previous section established that the NWPTA had a significant impact on plant-level productivity, but had no impact on markups. In this section, I examine potential mechanisms through which trade liberalizations may affect a plant's productivity and markups. Specifically, I investigate whether the agreement was associated with an increased likelihood of a plant exporting interprovincially or internationally. Theoretical models predict a selection effect as more productive firms enter into export markets following a trade liberalization while the least productive firms exit (Bernard et al., 2003; Melitz and Ottaviano, 2008). I also investigate whether the agreement caused an increase in a plant's interprovincial or international export intensity, measured as the share of total output that is sold to other provinces or countries. Reducing interprovincial trade barriers is expected to increase the likelihood of shipping to other provinces and the amount sold, but may have similar effects in international markets due to potential spillover effects.

Table 4 presents the TWFE and DiD_ℓ estimates as a summary of the effects across all post-agreement years. When averaged over all periods, the NWPTA is shown to have a significant effect on export status and intensity. The estimates suggest that the agreement is associated with an average increase in the likelihood that a plant exports interprovincially by 2.46 percentage points, along with an average increase in interprovincial export intensity by 1.87 percentage points. The DiD_ℓ estimates hold for interprovincial export status and intensity at an increased magnitude.

The event study analysis of these results is presented in Figure 6. I estimate a 3.62 percentage point increase in the likelihood that a plant exports interprovincially immediately post-treatment under the NWPTA agreement that levels out to a 2.79 percentage point increase by the last period of study (year 6). Internationally, the effect of the NWPTA agreement is flat. For both types of export status, the pre-treatment coefficients are jointly statistically insignificant suggesting that export status was similar between the two groups. For export intensity, the share of total output that plants sold interprovincially increased by 1.74 to 3.19 percentage points, while there was no effect for the share of total output sold internationally. Pre-treatment coefficients are jointly statistically insignificant.

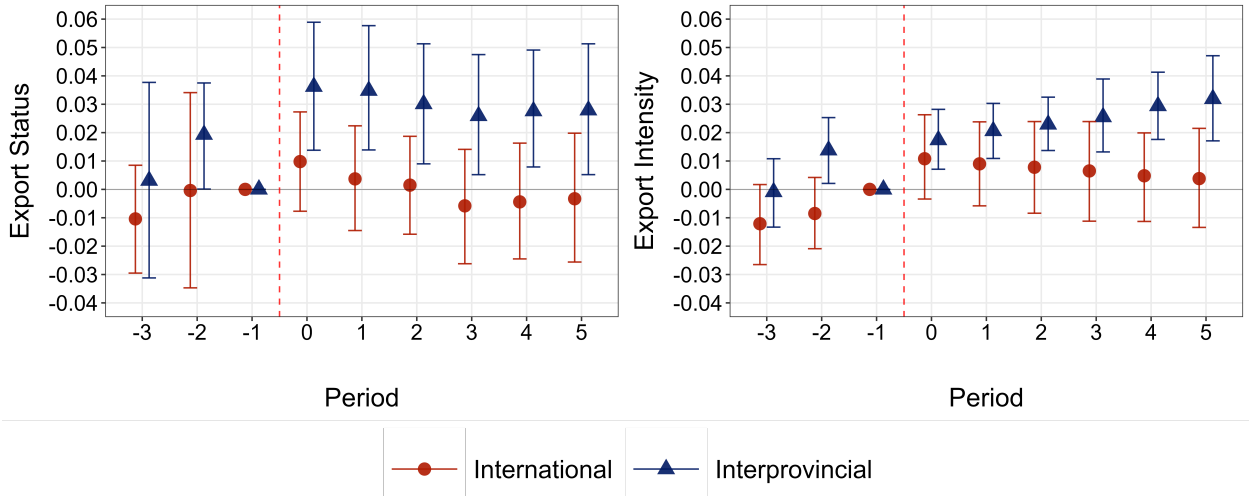
In summary, the association of the NWPTA with an increased likelihood of being an interprovincial exporter and an increase in the amount of goods sold to other provinces is suggestive that the agreement was effective at reducing interprovincial barriers to trade. Paired with the results in the previous section, these results may provide support for the learning-by-exporting hypothesis, where export exposure causes an improvement in the production process of plants.

Table 4: Pooled TWFE and DiD_ℓ Estimates of the NWPTA on Export Status and Intensity

Dependent Variable:	Export Status		Export Intensity	
	Interprovincial	International	Interprovincial	International
Panel A TWFE				
NWPTA	0.0246**	0.0053	0.0187**	0.0144*
	(0.0118)	(0.0122)	(0.0071)	(0.0085)
Panel B DiD_ℓ				
NWPTA	0.0368**	0.0065	0.0326**	0.0084
	(0.0141)	(0.0112)	(0.0049)	(0.0091)
Controls				
Plant FE	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
R^2				
Observations	311602	311602	311602	311602

Note: This table shows the TWFE and DiD_ℓ estimates that pool all post-agreement years together from equation (7). Export status is an indicator for whether a plant exports interprovincially or internationally while export intensity is measured as the share of total output that is sold to other provinces or countries. Standard errors are clustered at the NAICS 4-digit industry level and are given in parentheses. Significance levels: ***: 0.01, **: 0.05, *: 0.1.

Figure 6: Dynamic Effects of the NWPTA on Export Status and Export Intensity



Note: These figures report TWFE coefficients and their 90% wild cluster bootstrap confidence intervals from the estimation of Equation (7) for the outcomes of interprovincial (in blue) and international (in red) export status (left panel) and export intensity (right panel) for 2004-2012. The coefficients represent the change in outcomes for provinces subject to the NWPTA relative to other provinces. The NWPTA was signed in 2007 (formerly named TILMA), so I show the three years before and five years after signing.

5.3 Effects of the TCA

The previous section provided evidence that the NWPTA had a positive impact on productivity and exports in the manufacturing sector. In this section, I examine the Trade and Co-operation Agreement (TCA) signed between Ontario and Quebec in 2009. In contrast to the NWPTA, the TCA maintained a positive-list approach, which restricted its coverage in removing and preventing new barriers to trade. Additionally, coverage of the manufacturing sector was primarily limited to broad improvements in labor mobility. Consequently, examining the impacts of the TCA provides a useful check of the prior analysis, as the provisions in the agreement create an expectation of minimal impact on the same set of economic outcomes.

Table A1 presents the results from the pooled TWFE and DiD_ℓ estimators. The TWFE estimates suggest that the TCA was associated with a decrease in plant-level productivity by 2.39 percent along with an increase in markups by 2.26 percent. The DiD_ℓ differ, as the estimate for productivity is no longer statistically significant with a point estimate close to zero while the estimate for markups has remained significant but decreased in magnitude. The TWFE estimates are not associated with any change in the export status or intensity of goods sold interprovincially or abroad. However, the DiD_ℓ are associated with a slight increase of 0.7 and 0.9 percentage points in the likelihood that a plant exports interprovincially and internationally respectively.

Figures A7 and A8 present the results from the event study analysis for the TWFE and DiD_ℓ estimators. The TWFE results suggest that the TCA was not associated with any significant change in plant-level productivity or export intensity, but is associated with an increase in plant-level markups between 1.97 in year 1 to 1.79 percent by year 4. The TCA is associated with an increased likelihood of being an interprovincial exporter by between 1.26 to 1.57 percentage points and international exporter by between approximately 0.73 to 1.66 percentage points. However, some of the pre-treatment effects are significant, suggesting that interprovincial export status was not similar between the two groups prior to the implementation of the agreement. The DiD_ℓ estimates accord with the TWFE results, but at reduced magnitudes.

Summarizing, the results provide some evidence for the prior expectation that the TCA would have minimal impacts on economic outcomes in the manufacturing sector due to the characteristics of the agreement. Across both estimators, there is only consistent evidence that the agreement resulted in an increase in plant-level markups. In comparison, the NWPTA was seen to be associated with a significant increase in plant-level productivity, the likelihood of exporting interprovincially, and level of output sold to other provinces.

5.4 Comparison of the NWPTA and TCA

This paper does not directly empirically test the mechanisms specific to the NWPTA in comparison to the TCA. However, in this section I compare some of the notable differences between the two agreements that could potentially explain the results from the previous sections.[23]

A very important difference between the NWPTA and other sub-national agreements, including the TCA, is the negative-list approach that allows for a broader coverage for reducing and removing barriers to trade, investment and labor mobility. This approach allows for new and existing barriers to be subject to the terms in the agreement, unless otherwise excepted, whereas the largely positive-list approach adopted in the TCA requires that specific barriers be identified and written within the agreement. Consequently, the TCA primarily addressed only labor mobility, financial services, transportation services, public procurement and dispute resolution.

Mutual recognition of worker certifications and business registration, along with reconciling regulatory differences between provinces, is crucial for reducing internal trade barriers. The TCA enabled workers certified in an occupation in one province to be qualified in the other, removed residency requirements for workers, and formed a labor mobility committee to take steps towards reconciling differences while still maintaining occupational standards. In addition, the TCA restated a commitment between the Parties to reconcile measures in transportation services laid out in the AIT. In comparison, the NWPTA contained the same stipulations for worker certifications and residency but reconciled business registration and removed the requirement to establish an enterprise in another province to conduct business.

The AIT established a general framework to ensure equal access to procurement for all Canadian suppliers with a goal to reduce costs and increase transparency above certain threshold dollar amounts. The NWPTA further lowered these thresholds between signatory parties to the lowest values in the country.[24] In contrast, the TCA largely maintained the provisions from the AIT.

The dispute resolution mechanism in the TCA increased the maximum penalty from $5 to $10 million and expanded the criteria to meet this maximum that went beyond the sole measure in the AIT of using the population of the respective province (Kukucha, 2015). The NWPTA maintained the $5 million maximum penalty, but also expanded on the criteria needed to meet the different penalty tiers.[25] The NWPTA also

[23] For a more detailed comparison of internal trade agreements within Canada, see Kukucha (2015).

[24] For example, the AIT holds that departments, ministries, and similar agencies require open and non-discriminatory access where the procurement value is $25,000 for goods, $100,000 for services and construction, while the NWPTA lowered these to $10,000 for goods, $75,000 for services and $100,000 for construction.

[25] For instance, the AIT would allow for a maximum penalty of $250,000 when the population is below 550,000 (Newfoundland and Labrador, Prince Edward Island and the Territories fall below this) and $5,000,000 when the population exceeds 1,500,000,

established shorter timelines, with the consultative process lasting for thirty days compared to the 120 day minimum of the AIT (and by extension, the TCA).

More generally, the TCA did not include many measures to lower barriers in the manufacturing sector which my data exclusively covers. It has also been observed that Ontario and Quebec exhibit the lowest exporting and importing frictions in Canada (Agnosteva et al., 2019; Lapham and Teeter, 2023) which may further dampen the observed impact of the TCA if there were less relative initial frictions compared to the Western provinces. In the future, research that utilizes employer-employee linked data may provide further insights on the effectiveness of the labor mobility provisions within these agreements.

6 Conclusion

This paper investigated the links between internal trade liberalizations and plant-level productivity, markups and exporting behavior. To analyze these links, I leverage Canadian manufacturing data to estimate plant-level total factor productivity and markups for ten Canadian provinces between the years 2004 and 2012. Crucially, this data includes plant-level interprovincial and international shipments, which allows me to incorporate the presence of learning effects into the productivity process. Canada is a particularly interesting case to study because the literature has identified large and varied internal barriers across Canada's provinces. Consequently, Canadian policy makers have ratified several interprovincial trade agreement to reduce or remove these barriers to trade, investment and labor mobility. Evidence suggesting that these internal trade agreements have successfully reduced barriers indicates that they could serve as valuable guidelines for policy makers.

I found that the NWPTA was associated with an increased likelihood that a plant exports interprovincially, an increase in the share of output that a plant sells to other provinces, an increase in plant-level productivity but had no significant impact on markups. Conversely, the TCA did not affect a plant's export behavior or increase plant-level productivity, but may have increased markups. The NWPTA achieved greater progress in mutually recognizing worker certifications and business registration, as well as in harmonizing business standards between provinces than the TCA. Crucially, the NWPTA was a more in-depth agreement, and adopted a negative-list approach that provided far greater coverage than the largely positive-list approach adopted in the TCA. In practice, both approaches can achieve similar levels of liberalization, but these results suggest that policymakers should adopt the negative-list approach to reduce internal trade barriers, as long as the exceptions listed are kept to a minimum.

while the NWPTA established criteria including economic injury and other relevant factors.

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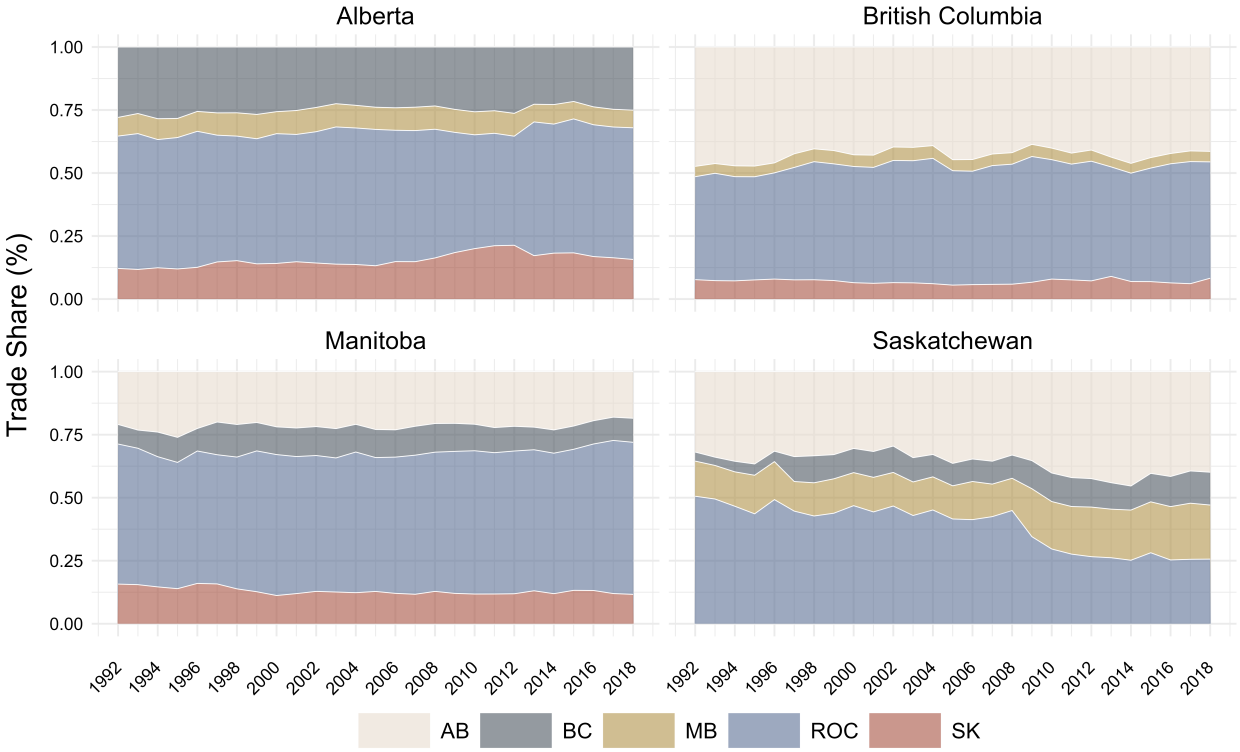
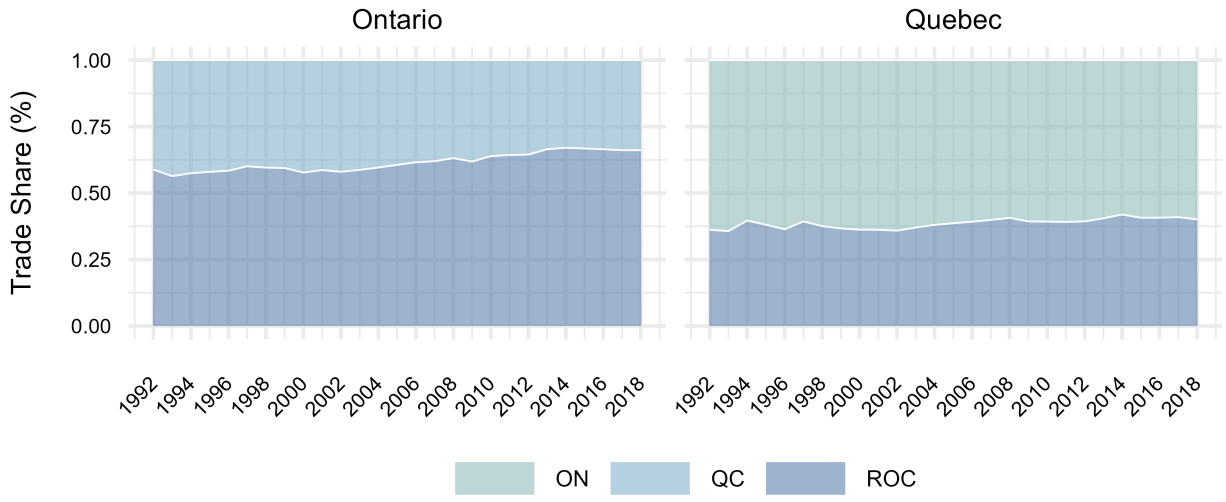
7 Appendix

Figure A1: Aggregate Goods and Services Interprovincial Exports, 1992-2018



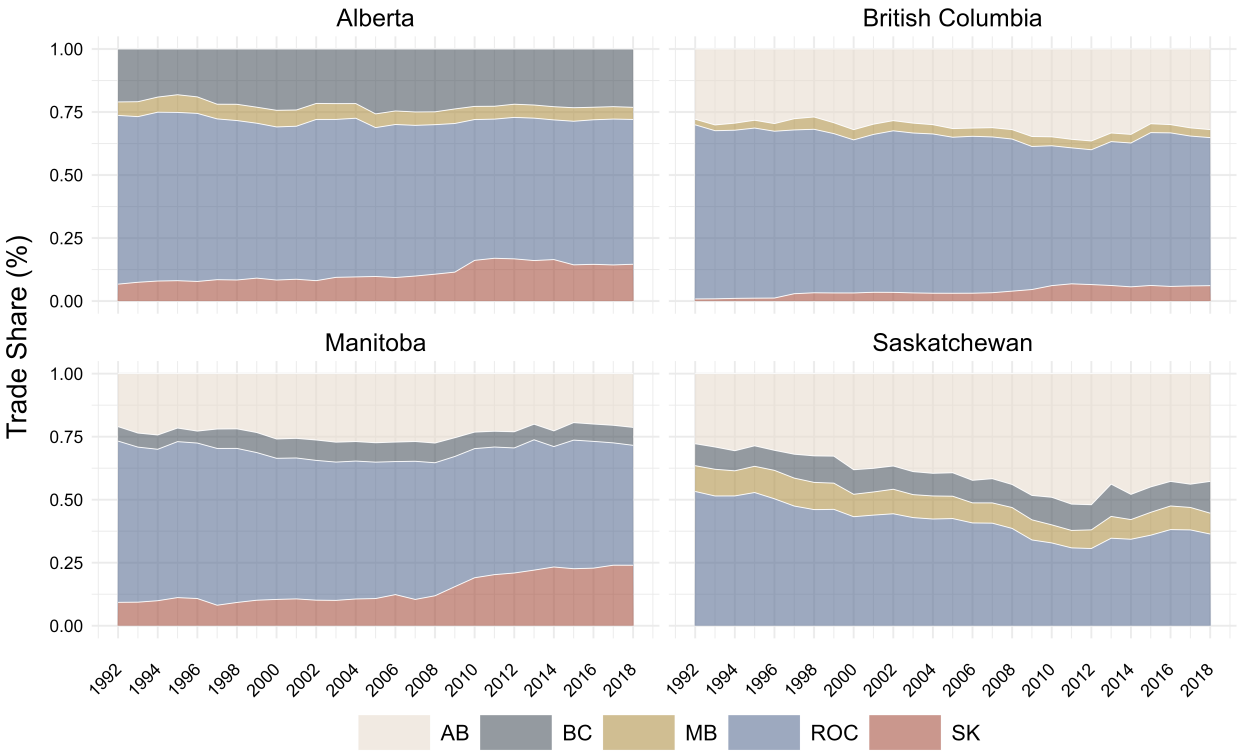
Note: This figure depicts the share of total interprovincial exported goods and services from the four Western provinces — Alberta (AB), British Columbia (BC), Manitoba (MB), and Saskatchewan (SK) — to each other and the rest of Canada (ROC).
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

Figure A2: Aggregate Goods and Services Interprovincial Exports, 1992-2018



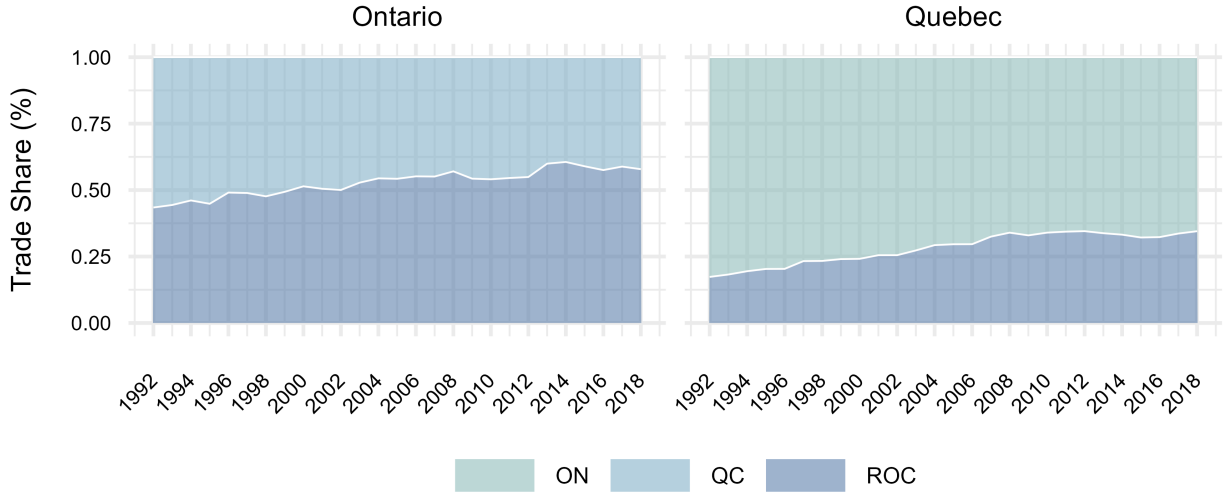
Note: This figure depicts the share of total interprovincial exported goods and services of Ontario (ON) and Quebec (QC) to each other and the rest of Canada (ROC).
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

Figure A3: Aggregate Goods and Services Interprovincial Imports, 1992-2018



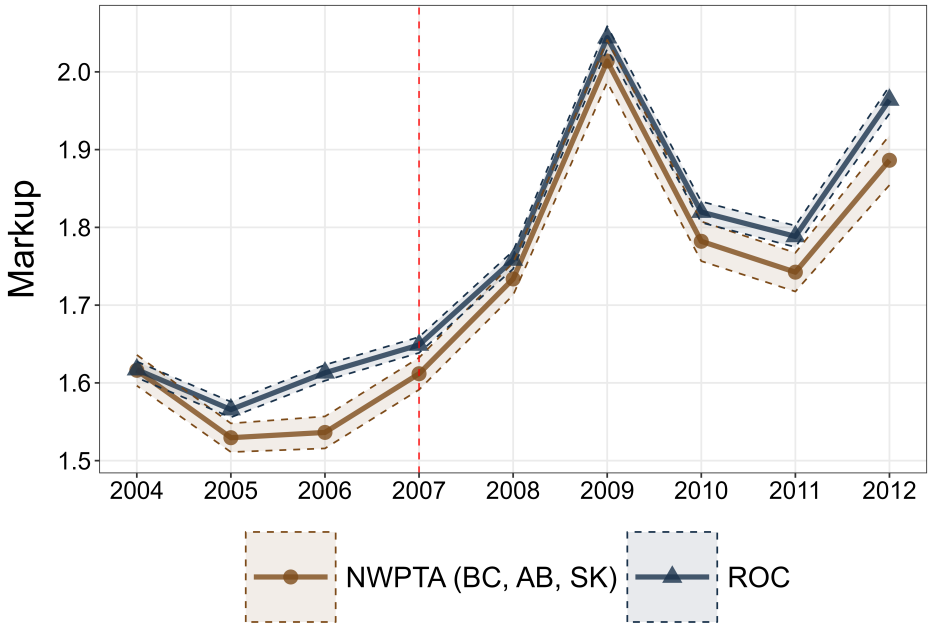
Note: This figure depicts the share of total interprovincial imported goods and services from the four Western provinces — Alberta (AB), British Columbia (BC), Manitoba (MB), and Saskatchewan (SK) — from each other and the rest of Canada (ROC).
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

Figure A4: Aggregate Goods and Services Interprovincial Imports, 1992-2018



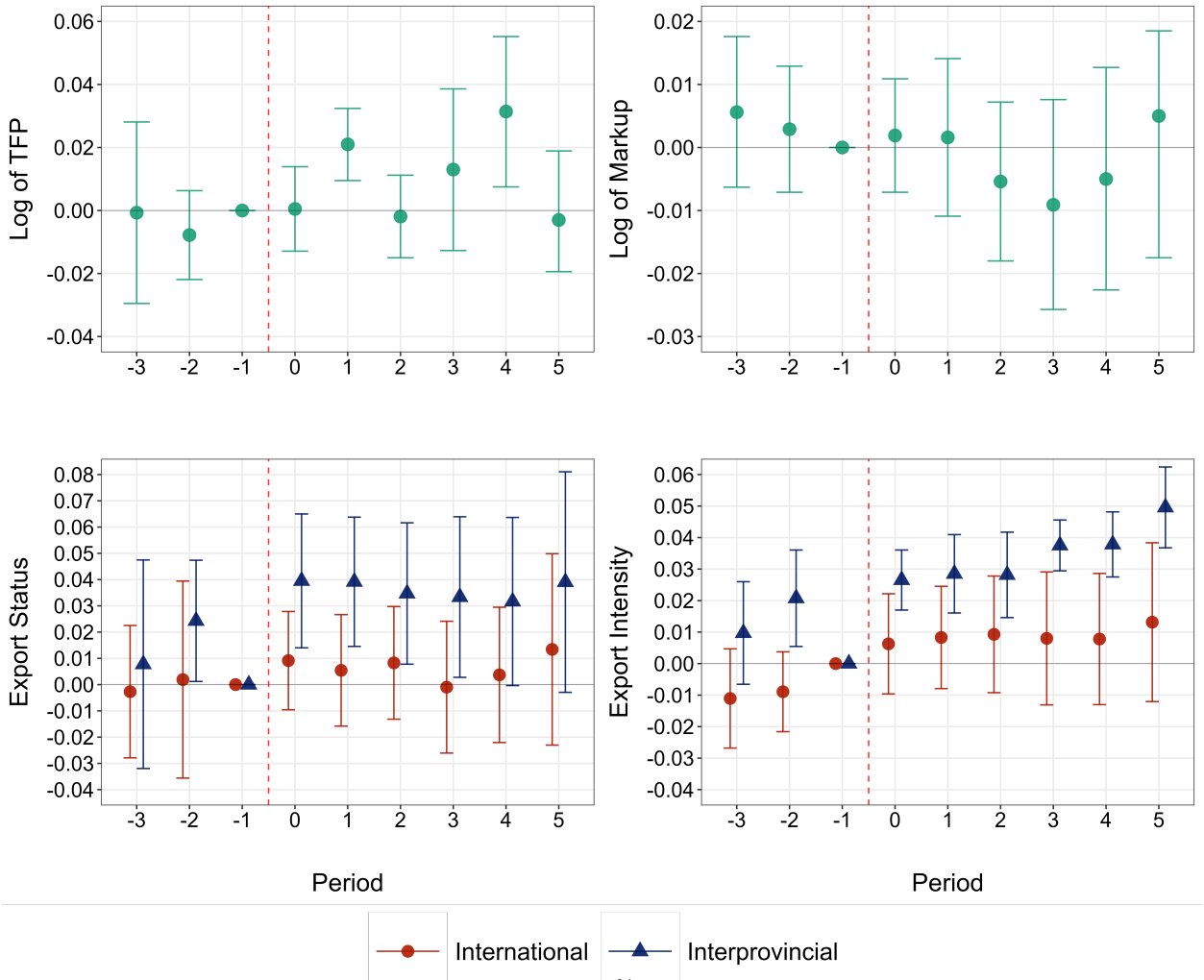
Note: This figure depicts the share of total interprovincial imported goods and services of Ontario (ON) and Quebec (QC) from each other and the rest of Canada (ROC).
Source: Author's calculations from Statistics Canada Tables 12-10-0085-01, 12-10-0086-01, and 12-10-0088-01.

Figure A5: Average Cobb-Douglas Markups by Province Groupings, 2004-2012



Note: This figure reports the log of the mean Cobb-Douglas markup by province groupings. In beige are the NWPTA provinces (British Columbia, Alberta, and Saskatchewan) while in blue is the rest of Canada (ROC).

Figure A6: Dynamic Effects of the NWPTA on TFP, Markups, Export Status and Export Intensity (DiD_ℓ)



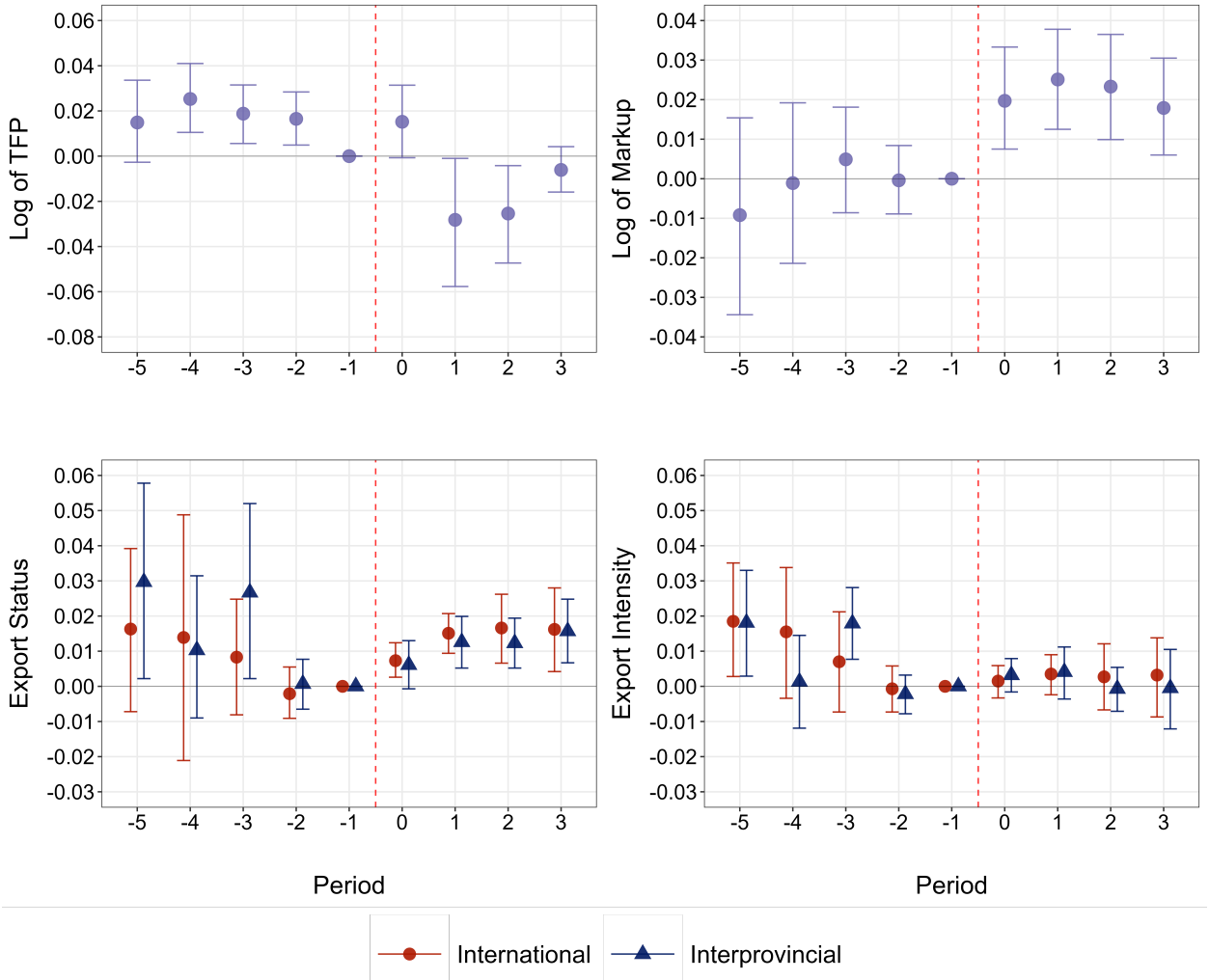
Note: These figures report DiD_ℓ coefficients and their 95% wild cluster bootstrap confidence intervals from the estimation of Equation (7) for the outcomes of log TFP (top left panel), log markups (top right panel), export status (bottom left panel) and export intensity (bottom right panel) for 2004-2012. The coefficients represent the change in outcomes for provinces subject to the NWPTA relative to other provinces. The NWPTA was signed in 2007 (formerly named TILMA), so I show the three years before and five years after signing.

Table A1: Pooled TWFE and DiD$_\ell$ Estimates of the TCA on TFP, Markups, Export Status and Intensity

Dependent Variable:	TFP	Markup	Export Status		Export Intensity	
			Interprovincial	International	Interprovincial	International
Panel A TWFE						
TCA	-0.0239**	0.0226*	-0.0009	0.0070	-0.0043	-0.0044
	(0.0103)	(0.0128)	(0.0057)	(0.0068)	(0.0056)	(0.0062)
Panel B DiD$_\ell$						
TCA	-0.0075	0.0188**	0.0069**	0.0093**	-0.0001	0.0011
	(0.0064)	(0.0068)	(0.0034)	(0.0034)	(0.0036)	(0.0035)
Controls						
Plant FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
R^2	0.9359	0.7203	0.7081	0.7315	0.6647	0.6547
Observations	311602	311602	311602	311602	311602	311602

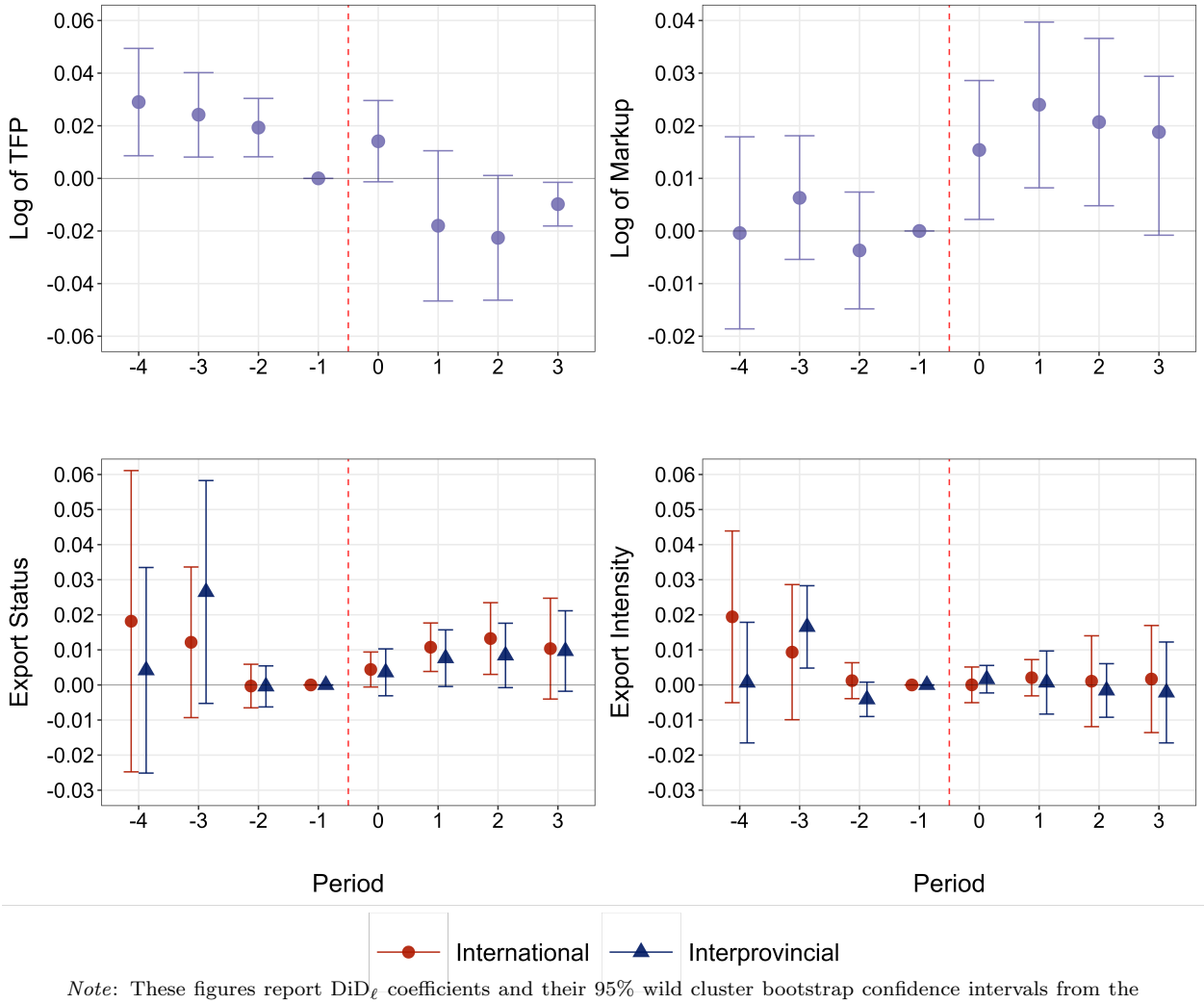
Note: This table shows the TWFE and DiD$_\ell$ estimates that pool all post-agreement years together from equation (7). Log total factor productivity (TFP) is from the estimation of equation (5) while log markups are from the estimation of equation (6). Export status is an indicator for whether a plant exports interprovincially or internationally while export intensity is measured as the share of total output that is shipped to other provinces or countries. Standard errors are clustered at the NAICS 4-digit industry level and are given in parentheses. Significance levels: ***: 0.01, **: 0.05, *: 0.1.

Figure A7: Dynamic Effects of the TCA on TFP, Markups, Export Status and Export Intensity (TWFE)



Note: These figures report TWFE coefficients and their 90% wild cluster bootstrap confidence intervals from the estimation of Equation (7) for the outcomes of log TFP (top left panel), log markups (top right panel), export status (bottom left panel) and export intensity (bottom right panel) for 2004-2012. The coefficients represent the change in outcomes for provinces subject to the TCA relative to other provinces. The TCA was signed in 2009 between Ontario and Quebec, I show the five years before and three years after signing.

Figure A8: Dynamic Effects of the TCA on TFP, Markups, Export Status and Export Intensity (DiD_ℓ)



Note: These figures report DiD_ℓ coefficients and their 95% wild cluster bootstrap confidence intervals from the estimation of Equation (7) for the outcomes of log TFP (top left panel), log markups (top right panel), export status (bottom left panel) and export intensity (bottom right panel) for 2004-2012. The coefficients represent the change in outcomes for provinces subject to the TCA relative to other provinces. The TCA was signed in 2009 between Ontario and Quebec, I show the four years before (due to restrictions imposed by the estimator) and three years after signing.