Breaking Down Internal Barriers to Trade: Evidence from Canadian Interprovincial Trade Agreements

by

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Abstract

The effects of Canadian interprovincial regional trade agreements (RTAs) are disentangled by using a structural gravity model at partial and general equilibrium levels. Intra-national trade barriers present a hurdle for domestic trade by hindering labour mobility, limiting consumer variety, fragmenting markets, stifling competition and limiting effective scales of production thereby lowering productivity growth. I construct and estimate a panel from 1992-2013 of bilateral trade flows, RTAs and border covariates among the 10 Canadian provinces, the United States and a Rest of World aggregate. The estimates reveal heterogenous effects whereby only one of the seven RTAs under analysis have significantly facilitated trade growth. Furthermore, interprovincial and intra-provincial "border" estimates have increased relative to international border estimates by 36.6% and 41.7% respectively, suggesting that globalization effects have had stronger impacts on directing trade flows during the period of study than internal mechanisms.

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1. Introduction

In this paper I estimate a structural gravity model to decompose the heterogeneous effects of Canadian intra-national regional trade agreements (RTAs) that have been signed between Canadian provinces since the early 1990s. Globalization and trade liberalization have become increasingly contentious topics. Quantitative and detailed trade policy analysis are needed to give policymakers access to reliable information on the quantitative effects of trade policies on trade flows. One goal of liberalizing trade is to break down trade barriers to facilitate increased trade between participants, thus increasing economic growth and productivity. For Canada, these barriers exist at both the international and interprovincial level. Intra-national trade barriers are large and present a hurdle for domestic trade (Beaulieu et al., 2003), costing the Canadian economy between $50-$130 billion a year in lost trade opportunities (Albrecht and Tombe, 2016). Non-tariff internal trade barriers "hinder labour mobility, limit choice for consumers, fragment markets, stifle competition, and limit the effective scale of production thereby lowering productivity growth" (Alvarez et al., 2019).

These relations are not novel concepts, and the 1995 Agreement on Internal Trade (AIT) was a national effort to break down these interprovincial barriers to trade. Canadian provinces have also worked towards closer integration since the early 1990s to accelerate this national effort at a regional level with a multitude of bilateral and multilateral trade agreements between each other. The contention over trade agreements is multi-faceted but has at its nexus whether the supposed economic benefits promised at their signing have been provided. The Canadian Free Trade Agreement (CFTA) has recently been signed in 2017 to replace the AIT with the goal of achieving a modern and competitive economic union for all Canadians. Thus, it is appropriate at the current moment to evaluate the heterogeneous effects of past Canadian interprovincial trade agreements on bilateral trade flows *ex post* to determine if these effects have achieved their desired outcomes, and if not, what lessons we can learn moving forward from the results.

Despite their importance for trade flows and economic development, intra-national obstacles to trade are less-studied and less-understood than international trade frictions (Agnosteva et al., 2019). By making use of the excellent data collected by the Canadian government and Statistics Canada in a detailed, comprehensive and internally consistent manner, I expand on previous efforts in assaying the heterogeneous effects of the interprovincial border by analyzing free trade agreements within Canada at partial and general equilibrium levels.

The gravity approach will be used in this analysis as it is one of the most successful empirical models in economics and has been the focus of a very extensive literature in international trade (Yotov et al., 2016). I will employ the latest developments for estimations of structural gravity models with bilateral fixed effects to infer bilateral trade costs that carefully accounts for endogeneity concerns of the interprovincial trade agreements.

The data used in this analysis covers Canadian provincial trade flows in goods and services from 1992-2013, appended with data covering bilateral trade between the Canadian provinces and the United States and with a Rest of the World (ROW) aggregate for the same period. The advantage of this dataset is that it covers intra-provincial, interprovincial, and international trade flows for each of Canada's provinces and territories.

Following the analysis of Beaulieu and Zaman (2019), I will empirically investigate the impact of seven interprovincial trade agreements:[1] the Agreement on the Opening of Public Procurement (OPP) in 1993 between New Brunswick and Quebec; the Agreement on the Opening of Public Procurement (OQPP) for Quebec and Ontario in 1994; the Atlantic Procurement Agreement (APA) in 1996 between New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island; the Trade, Investment and Labour Mobility Agreement (TILMA) in 2007 between British Columbia and Alberta that was later expanded to include Saskatchewan in 2010 and renamed to the New West Partnership Trade Agreement (NWPTA); the Partnership Agreement on Regulation and the Economy (PARE) in 2009 between New Brunswick and Nova Scotia; and the Trade and Cooperation Agreement (TCA) in 2009 between Quebec and Ontario.

Beaulieu and Zaman (2019) find that the OPP, APA, TILMA/NWPTA agreements facilitated trade between member provinces, while the PARE and TCA deterred trade. However, they did not include international trade flows in their analysis, which may potentially bias their estimates. In particular, by omitting international trade flows, their results may be biased downwards if it is the case that the interprovincial RTAs have diverted trade away from international trading partners. Alternatively, the estimates may be biased upwards if globalization effects and international trade agreements have exerted a stronger force on the provinces than the interprovincial trade agreements. Additionally, Beaulieu and Zaman (2019) potentially did not account for a sufficiently long "phasing-in" period of the RTAs, as virtually all trade agreements

[1] Beaulieu and Zaman (2019) investigate the impact of six interprovincial trade agreements. I have included the Agreement on the Opening of Public Procurement for Quebec and Ontario (1994) to this analysis. Several other trade enhancing agreements have occurred between provinces and territories but have been omitted due to their insufficient scope or legal commitment in facilitating the breaking down of trade barriers. They can be found here: https://www.cfta-alec.ca/trade-enhancement-agreements/.

are phased-in over 10 years (Baier and Bergstrand, 2007). In my analysis, I have carefully accounted for international trade flows and sufficiently long "phasing-in" effects for the RTAs provided they fit within the period of investigation. Finally, Beaulieu and Zaman (2019) analyse RTA effects only at the partial equilibrium level, while I have extended this analysis to the general equilibrium level to capture the multiple-order effects associated with the signing of an RTA and subsequent changing incidence of trade costs that ripple throughout the world.

My empirical analysis shows that of these seven agreements, only the APA has facilitated significant trade growth between members. Furthermore, my results suggest possible concern of significant trade deterrence effects for the OQPP and TCA agreements. Policymakers could use these findings to revise or create agreements that capitalize on the apparent advantages conferred by the APA and learn from the deterrence effects created by the OQPP and TCA.

The remainder of the paper is organized as follows. Section 2 provides a survey of related literature. Section 3 sets out the theoretical foundation. Section 4 presents the econometric specifications and my identification strategy. Section 5 adds detail on how I constructed my data and key variables. Section 6 presents my main findings. Section 7 provides concluding remarks and directions for future research.

2. Related Literature

The effects of regional trade agreements have been widely studied in the literature at the international level, and often rely on *ex post* estimates of the partial effects of these agreements based upon gravity equations. Only recently have economists been able to provide more precise and unbiased *ex post* estimates of these effects on trade flows in contrast to the highly variable and economically implausible estimates generated from 1962 to 2007 (Bergstrand et al., 2015). Baier and Bergstrand (2007) constructed a panel of 96 countries over the period 1960-2000 and found that a typical economic integration agreement (EIA) increases two members aggregate goods bilateral trade about 100 percent after 10-15 years. They find that virtually every trade agreement is “phased-in” over 10 years, such as NAFTA which explicitly contained a 10-year phasing in provision. Thus, the entire economic effect cannot be captured fully in the concurrent year only. Anderson and Yotov (2016) infers the volume effects of free trade agreements (FTAs) implemented between 1990 and 2002 and find these effects to be large and comparable to the estimates of Baier and Bergstrand (2007) but varying across sectors. The results show that these FTAs significantly increased real manufacturing income of most economies in the world.

Baier et al. (2019) develop a two-stage methodology that allows them to study the empirical determinants of the *ex post* effects of past FTAs. They identify 908 unique estimates of the effects of FTAs on a sample of 70 countries over the years 1986-2006 and find that 57% of the agreements have positive effects on trade. This indicates the presence of a large measure of heterogeneity within regional trade agreements. They found that even within the same agreement, FTA effects are weaker for more distant pairs and the effects of new FTAs are similarly weaker for pairs with existing agreements already in place. The heterogeneity seen in these results accords with Kohl (2014) who finds that of 166 individual EIAs studied, 106 (63.9%) have had an insignificant effect on trade flows, 44 (26.5%) had a trade-promoting effect, while the net effect of the remaining 16 agreements (9.6%) is negative.

Compared to the international level, the literature concerned with the proper measurement of intra-national trade frictions and their implications for various economic outcomes is more limited. Agnosteva et al. (2019) assay regional frictions between Canada's provinces and find large intra-national trade costs that vary across provinces. They find that non-uniform border barriers within countries induce significant systematic distortions of inter-regional trade. Anderson and Yotov (2010) study the changing incidence of bilateral trade costs in Canada's provinces between 1992-2003 and find that exporters' incidence is on average five times higher than importers' incidence. Their most striking result is that over time, exporters' incidence falls while importers' incidence rises slightly despite constant gravity coefficients. They also find no econometric evidence that the AIT affected Canadian interprovincial trade.

Beaulieu and Zaman (2019) investigate the effects of provincial agreements on interprovincial trade flows in Canada and find that although most agreements facilitated trade between member provinces, others did not. They also find that provincial trade barriers have declined by 15% over the past two decades in Canada. It is evident that the same heterogeneity that exists across international trade agreement persists at the intra-national level from these results. However, Beaulieu and Zaman (2019) did not include international data in their analysis, which may potentially bias their estimates. It seems prudent to control for possible trade diversion at the international level when investigating the effects of intra-national RTAs. The converse of controlling for intra-national trade flows to account for trade diversion away from domestic sales is now standard in the gravity literature, and properly doing so may lead to larger, positive, and statistically significant estimates (Larch et al., 2018; Dai et al., 2014).

My contribution to this growing literature on intra-national barriers to trade is measuring the effects of Canadian interprovincial trade agreements in a way that accounts for the potential diversionary effects of international trade flows away from or towards interprovincial flows and to allow for the full phasing-in effect of RTAs where permissible given the time-horizon of the data. This will be done at the direct, or partial, level along with at the general equilibrium level which provides a general equilibrium framework operating through the multilateral resistance terms described by Anderson and van Wincoop (2003). Furthermore, I assess the multilateral resistance terms to decompose the heterogeneous trade costs facing Canadian provinces in an informative way for trade policy analysis.

3. Theoretical Foundations

3.1. The Structural Gravity Model of Trade

A review of gravity theory sets the stage for modeling and estimation of bilateral trade costs. Gravity equations are a model of bilateral interactions in which size and distance enter multiplicatively. The key feature is that countries trade in proportion to their respective market size and proximity, akin to Newton's Law of Universal Gravitation. These models have been used as a workhorse for analyzing the determinants of bilateral trade flows for 50 years since being introduced by Tinbergen (1962), and after concentrated efforts of trade theorists have become an integral and important part of international trade (Head and Mayer, 2014).

Structural gravity comprises a subset of general gravity models and relies on two important conditions. The first governs spatial allocation of expenditure for the importer while the second imposes market-clearing for the exporter (Head and Mayer, 2014). One of the main advantages of the structural gravity model is that it delivers a tractable framework for trade policy analysis in a multi-country environment (Yotov et al., 2016). Preferences and technologies are assumed to be identical across countries for national varieties differentiated by place of origin (Armington, 1969) which are traded with the rest of the world.

The structural gravity demand system derived from cost minimizing behavior yields equation (1) below and use of the market clearing condition for each origin region's shipments and each destination region's budget constraint yields equation (2) and (3) below:[2]

$$X_{ij} = \frac{Y_i E_j}{Y}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \tag{1}$$

$$\Pi_i^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \frac{Y_i}{Y} \tag{2}$$

$$P_j^{1-\sigma} = \sum_i \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \frac{Y_i}{Y} \tag{3}$$

$$p_i = \left(\frac{Y_i}{U}\right)^{\frac{1}{1-\sigma}} \frac{1}{\alpha_i \Pi_i} \tag{4}$$

$$E_i = \phi_i Y_i = \phi_i p_i Q_i \tag{5}$$

In equation (1), X_{ij} denotes the value of shipments at destination prices from origin *i* to destination *j* in goods or services; Y_i refers to total output at origin *i*; Y refers to world output; E_j refers to total expenditure at destination *j*; t_{ij} captures trade costs from *i* to *j*; and σ reflects the elasticity of substitution across goods or services. The terms Π_i and P_j are called "multilateral resistance" indexes by Anderson and van Wincoop (2003). P_j is the inward multilateral resistance (IMR) which represents importer *j*'s ease of market access and consistently aggregates the incidence of trade costs on the consumers in importer *j*. Π_i represents exporter *i*'s ease of market access and consistently aggregates *i*'s outward trade costs relative to destination price indexes. In addition, p_i is the factory-gate price for each variety of goods in the country of origin *i*; Q_i is the endowment or quantity supplied of each variety of goods in country *i*; and ϕ_i is an exogenous

[2] For the derivation of these equations, the reader is referred to Head and Mayer (2014) and Yotov et al. (2016).

parameter defining the relation between the value of output and aggregate expenditure (Yotov et al., 2016).

3.2. Multilateral Resistances

The multilateral resistance terms bear the intuitive interpretation that, all else equal, two countries will trade more with each other the more remote they are from the rest of the world (Yotov et al., 2016). They are theory-consistent aggregates of all possible bilateral trade costs to the country level. Trade between two countries depends not only on direct trade costs, but on how remote they are from the rest of their trading partners, which is captured by the multilateral resistances. Trade liberalization results in lower multilateral resistances for the RTA's members and higher multilateral resistances for all other countries in the world. This is the result that when two countries become more integrated with each other, all else equal, they also become relatively more isolated from the rest of the world (Yotov et al., 2016).

The multilateral resistances decompose the incidence of trade costs and their changes on consumers and producers in each country. They are straightforward to construct as documented by Fally (2015), who shows that the special additive property of the Poisson Pseudo-maximum Likelihood (PPML) estimator ensures a perfect match between the structural gravity terms and the corresponding directional (importer and exporter) fixed effects $\pi_{i,t}$ and $\chi_{j,t}$:

$$\exp\left(\hat{\pi}_{i,t}\right) = \frac{Y_{i,t}}{\widehat{\Pi}_{j,t}^{1-\sigma}}(E_{R,t}) \tag{6}$$

$$\exp\left(\hat{\chi}_{j,t}\right) = \frac{E_{j,t}}{\hat{P}_{j,t}^{1-\sigma}}\left(\frac{1}{E_{R,t}}\right) \tag{7}$$

where $\hat{\pi}_{i,t}$ and $\hat{\chi}_{j,t}$ are estimates of the directional fixed effects from a structural gravity estimation equation used to control for potentially any observable and unobservable characteristics that vary over time for each exporter and importer; $Y_{i,t}$ and $E_{j,t}$ are the corresponding actual values of output and expenditure in year t; $\hat{\Pi}_{j,t}^{1-\sigma}$ and $\hat{P}_{j,t}^{1-\sigma}$ are the corresponding calculated values of the multilateral resistance terms by solving (2) and (3); and $E_{R,t}$ is the expenditure of a reference country R in year t (Yotov et al., 2016).

The above properties make the multilateral indexes appealing for practical purposes from both a policy and structural estimation perspective. From a policy perspective, the multilateral resistance terms should be viewed as informative indexes that summarize the general equilibrium effects of trade costs that can be used to aggregate and decompose the impact of trade policy. From a structural estimation perspective, estimation of the structural gravity model enables the recovery and interpretation of the estimates of the coefficients on the multilateral resistance terms. Potential endogeneity concerns can also be addressed with this theory-consistent approach (Yotov et al., 2016).

3.3. General Equilibrium Effects of Trade Policy

A general equilibrium analysis accounts for all direct and indirect linkages in the economic system considered, while imposing and satisfying all goods/services market-clearing conditions. In contrast, the partial equilibrium effects of a trade policy are captured by adjusting bilateral trade costs t_{ij} in (1) while holding national output (Y_i), expenditure (E_j), world output (Y) and multilateral resistances (Π_i and P_j) constant. In a general equilibrium scenario, the value of output and expenditure is endogenized by allowing factory-gate prices (p_i) to respond to trade cost changes and the effects of trade liberalization between two countries *i* and *j* to ripple through the rest of the world via the general equilibrium multilateral resistance terms (Yotov et al., 2016). These effects on factory-gate prices then change the value of domestic production and aggregate expenditure through equation (5).

When signing an RTA, the impacts on the member countries are defined as “first-order general equilibrium effects”, because they are the strongest in magnitude while the impact on non-members are labelled “second-order general equilibrium effects”, because they are the results of changes in the member countries’ multilateral resistance terms (Yotov et al., 2016). Following trade liberalization, the inward multilateral resistance terms will decrease for members, which causes them to import less from all source regions. This causes the direct, or partial, effect of reduced trade costs to be offset slightly for RTA members, but at a lower magnitude compared to these direct trade cost reductions. Similarly, the outward multilateral resistance terms will also decrease following trade liberalization for signing members. Members will export less to all countries, which occurs because the new export cost between signing members is relatively lower than costs to non-members.

The first-order trade diversion effect between RTA members results in negative impacts on trade for non-members, but there is a second-order trade creation effect for these non-members as trade between them is now also relatively cheaper. However, part of non-members diverted trade leads to increases in intra-national trade, so the net effect is typically negative (Yotov et al., 2016).

Equations (4) and (5) capture how decreases in the outward multilateral resistances for members translate into higher factory-gate prices and thus higher output values and expenditure. This positive impact is a result of producers in liberalizing countries internalizing the favourable change in their outward multilateral resistances by increasing their prices. The opposite happens in non-member countries where producers now experience higher outward multilateral resistances and are forced to decrease their factory-gate prices at a smaller, second-order magnitude. This leads to another increase on trade for members and decrease for non-members as the value of output/nominal income increases and decreases respectively (Yotov et al., 2016). These interconnected relations are what drive the standard in trade policy analysis to occur in a general equilibrium setting.

4. Econometric Specification

To set up the econometric model, I employ a structural gravity specification with bilateral fixed effects. I augment the specification of Beaulieu and Zaman (2019) by introducing longer phasing-in effects on the RTA parameters of interest, adding the RTA effects for the OQPP, removing the time-fixed effects to be in line with Yotov et al. (2016)'s best practice guidelines, introducing international bilateral trade flows and subsequently controlling for intra-provincial time-varying effects. Cheng and Wall (2005) criticize when fixed-effects estimations are applied to data pooled over consecutive years as the dependent and independent variables cannot fully adjust in a single year's time. It follows that I use 3-year interval panel data to allow for adjustments in bilateral trade flows in response to trade policy or other changes in trade costs. The resulting estimating equation is:

$$X_{ij,t} = \exp(\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \boldsymbol{\beta}\mathbf{X})$$
$$\times \exp\left(\sum_{T=1995}^{2013} \alpha_T \, INTPL\_BRDR(T)_{ij} + \gamma_T INTRA\_BRDR(T)_{ij}\right) + \epsilon_{ij,t} \quad (8)$$

where $X_{it,t}$ is the trade flow from exporter *i* to importer *j* at time *t* and includes international along with intra-national trade. $\pi_{i,t}$ and $\chi_{j,t}$ are exporter-time fixed effects and importer-time fixed effects respectively that are included to control for the unobservable multilateral resistances and potentially any other observable and unobservable characteristics that vary over time for each exporter and importer (Anderson and van Wincoop, 2003); μ_{ij} is a set of pair fixed effects included to account for endogeneity of trade policy variables (Baier and Bergstrand, 2007) by accounting for all observable and unobservable time-invariant bilateral trade costs; **βX** is a vector containing the 7 RTA parameters of interest along with their phasing-in terms. The phasing-in effects allow for non-linear effects of RTAs and/or to capture the possibility that the effects of RTAs change over time (Yotov et al., 2016).

Additionally, an alternative specification including a lead RTA effect is added to address concerns of strict exogeneity. Wooldridge (2010) suggests that adding this future level of RTAs to the regression model is a way to test for this condition. If the RTA changes are strictly exogenous to trade flow changes, $RTA_{ij,t+1}$ should be uncorrelated with the concurrent trade flow. A key difference in this specification compared to Beaulieu and Zaman (2019) is the addition of lagged RTA terms up to 4 periods (12 years) depending on when it was first put into effect and if the time horizon of this study allows. Baier and Bergstrand (2007) note that virtually every RTA is phased-in typically over 10 years, thus it is reasonable to expect the addition of further lagged variables is necessary to fully capture the effect of these RTAs where applicable.

Following Agnosteva et al. (2019)'s specification, $INTPL\_BRDR(T)_{ij}$ = $INTPL\_BRDR_{ij}$ x T is the interaction of $INTPL\_BRDR_{ij}$, a dummy variable for interprovincial trade with a time trend T, and its estimate is intended to capture any changes in inter-provincial trade costs over the period of investigation. Similarly, $INTRA\_BRDR(T)_{ij}$ is intended to capture any changes in intra-provincial trade costs over the period of investigation. Because of perfect collinearity with the rest of the fixed effects included in (8), it is impossible to estimate these border dummies for all years so the starting year, 1992, is dropped from the specification. It follows that these coefficients should be interpreted as deviations of inter-provincial or intra-provincial Canadian trade costs from the changes in international trade costs over time (Agnosteva et al., 2019) relative to the corresponding estimate for 1992.

Following the recommendations of Santos Silva and Tenreyo (2006), I estimate (8) using Poisson Pseudo-maximum Likelihood. The PPML estimator, when applied to the gravity model expressed in multiplicative form, accounts for heteroskedasticity and can take advantage of the information contained in zero trade flows. Furthermore, the additive property of the PPML estimator ensures that the gravity fixed effects are identical to their corresponding structural terms (Fally, 2015).

The average cumulative effect of RTAs on trade after accounting for phasing-in can be constructed as $\boldsymbol{\beta} = \beta_1 + \beta_2 + \beta_3 + \beta_4$. From an econometric point of view, $\boldsymbol{\beta}$ is the total average partial effect of an RTA on bilateral trade flows, noting that RTAs also influence trade through the exporter and importer time-varying fixed effect terms $\pi_{i,t}$ and $\chi_{i,t}$ (Baier et al., 2019). Due to the presence of time-varying exporter and importer fixed effects, the impact of RTAs is only identifiable when trade increases between *i* and *j* relative to each country's trade with all other partners.

5. Data

To perform my analysis, I use data on Canadian trade flows over the period 1992-2013 which includes interprovincial, intra-provincial and international trade with the U.S. and a rest of the world (ROW) aggregate which includes all countries other than Canada and the U.S, all measured in current United States dollars. My sample consists of a total of 12 regions including the 10 Canadian provinces, the U.S., and the ROW. The Canadian territories were omitted due to missing information for the period of interest. Statistics Canada's Tables 386-0001, 386-0002 and 386-0003 are the original data sources for intra-provincial and interprovincial trade flows for both goods and services.[3] Data on trade flows between the Canadian provinces and the U.S. and ROW are taken from the Trade Data Online web interface of Industry Canada. Data on U.S.-World bilateral trade flows are from the U.S. Bureau of Economic Analysis. Internal trade data for the U.S. and ROW are obtained as the difference between output and total exports.

Because total exports are reported as gross value and aggregate production is usually measured and reported as value added (GDP), gross production (output) data is gathered following the best practices recommended in Yotov et al. (2016). This output data was compiled from the UNIDO Industrial Statistics 2 (INDSTAT2) database. The data are arranged at the 2-digit

[3] Beaulieu and Zaman (2019) note that Tables 386-0001 and Tables 386-0002 trade flows are at producer prices, whereas Table 386-0003 trade flows are at basic prices. The producer prices exclude commodity taxes, while the basic prices valuation is before this exclusion. This adjustment was suggested to be small enough to ignore and no changes were made. There is overlap in the years from these 3 tables, so I used Table 386-0002 as the base table and appended additional years to the start and end of this reference period (1997-2008).

level of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3, pertaining to the manufacturing sector, which comprises 23 industries. RTA dummy variables were constructed by using the year that each of those agreements came into force.

6. Results and Analysis

6.1 RTA Estimation Results

Table 1 presents my comparative results to Beaulieu and Zaman (2019). Column (1) is the base model and attempts to replicate Beaulieu and Zaman (2019)'s results with a single lag and lead variable and excludes international trade flows. They opt to sum the lead terms for the cumulative effect, but given the interval nature of the data, any anticipatory effects seem unlikely to play a causal factor in determining the cumulative effect of these trade agreements. Therefore, it is safest to assume that statistical significance on the lead terms raises reverse causality concerns and should be excluded from the cumulative effects. Nonetheless, for the sake of replication, column (1) will be calculated in the same manner as Beaulieu and Zaman (2019)—as the cumulative effect of the lag, lead and contemporaneous terms.

Table 1
PPML panel gravity, total goods and services, 1992-2013
Dependent variable: trade between exporter *i* and importer *j*

	(1) Base Model	(2) Base with international flows
$OPP_{ij,t}$	0.1357	0.1303
	(0.0187)***	(0.0635)**
$OPP_{ij,t-1}$	-0.1130	-0.1203
	(0.1122)	(0.0844)
$OPP_{ij,t+1}$	0.0869	0.1115
	(0.0301)***	(0.0459)**
$APA_{ij,t}$	-0.0028	0.0355
	(0.0474)	(0.0722)
$APA_{ij,t-1}$	0.2551	0.2046

	(0.1456)*	(0.1469)
$APA_{ij,t+1}$	0.0609	0.0752
	(0.0704)	(0.0923)
$PARE_{ij,t}$	-0.0709	-0.0918
	(0.0314)**	(0.0616)
$PARE_{ij,t-1}$	-0.0409	-0.0114
	(0.0852)	(0.1059)
$PARE_{ij,t+1}$	-0.2281	-0.2305
	(0.0709)***	(0.0910)**
$TCA_{ij,t}$	-0.0454	-0.0357
	(0.0198)**	(0.0326)
$TCA_{ij,t-1}$	-0.1886	-0.1701
	(0.0227)***	(0.0373)***
$TCA_{ij,t+1}$	-0.1228	-0.1103
	(0.0174)***	(0.0393)***
$TILMA\_NWPTA_{ij,t}$	0.0303	0.0240
	(0.0505)	(0.0801)
$TILMA\_NWPTA_{ij,t-1}$	-0.0058	-0.0131
	(0.0442)	(0.0457)
$TILMA\_NWPTA_{ij,t+1}$	0.0620	0.0604
	(0.0186)***	(0.0243)**
$INTPL\_BRDR_{ij1995}$	0.0218	-0.0057
	(0.0106)**	(0.0374)
$INTPL\_BRDR_{ij1998}$	0.0126	-0.0456
	(0.0156)	(0.0479)
$INTPL\_BRDR_{ij2001}$	0.0601	-0.0031
	(0.0134)***	(0.0461)
$INTPL\_BRDR_{ij2004}$	0.0417	-0.0101
	(0.0186)**	(0.0426)
$INTPL\_BRDR_{ij2007}$	0.0688	0.0094
	(0.0207)***	(0.0454)
$INTPL\_BRDR_{ij2010}$	-0.0106	-0.0566
	(0.0250)	(0.0483)
$INTPL\_BRDR_{ij2013}$	0.0888	0.0323
	(0.0215)***	(0.0506)
constant	18.8633	2.7845
	(0.1191)***	(0.0992)***
Observations	800	1152
R-squared	0.9999	0.9999
Time fixed effects	Yes	Yes
Pair fixed effects	Yes	Yes
Exporter*time fixed effects	Yes	Yes
Importer*time fixed effects	Yes	Yes

Notes: *t*, *t* - 1 and *t* + 1 denote time and its lagged and lead terms. Robust standard errors are reported in parentheses and clustered by exporter and importer pairs.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ |

These results are quantitively close to the original study of Beaulieu and Zaman (2019) with a few notable differences. First, all RTAs report statistical significance apart from OPP. Second, the magnitudes of the replicated effects are mostly smaller than in the original study. APA and TILMA/NWPTA are seen to increase trade flows by [exp(-0.0028+0.2551+0.0609)-1]x100 = 36.78% and 9% respectively. PARE and TCA are seen to decrease trade flows by 28.81% and 30% respectively. [4] The coefficient estimate of 0.0888 for $INTPL\_BRDR_{ij2013}$ implies that the declining effect of the interprovincial border has increased interprovincial trade relative to intra-national trade by 9.29% over 21 years. The statistical significance on the lead terms for OPP, PARE, TCA and TILMA/NWPTA raise concerns of reverse causality (Baier and Bergstrand, 2007) and should be interpreted with at least some caution (Larch et al., 2017).

Column (2) reports the same specification with the addition of international flows. The cumulative effect of these RTAs will be interpreted as the sum of the lag and contemporaneous terms. With this interpretation, only APA and TCA remain statistically significant with the former increasing trade flows by 28.7% and the latter decreasing trade flows by 20.86%. A notable difference between column (1) and (2) is that the interprovincial border effect in (2) is not statistically different from zero. Individual statistical significance on the RTAs is much less prevalent with the addition of international flows. The reason for the smaller estimates could be

[4] My estimates and standard errors for the OPP terms are nearly identical to Beaulieu and Zaman (2019) but I do not calculate statistical significance as they do. The Beaulieu and Zaman (2019) reported coefficient estimates for APA, PARE and TCA are closer to my replication results than the values the authors reported due to an apparent miscalculation in that paper.

that due to the inclusion of international trade, trade flows are being diverted away from interprovincial trade and towards international trade due to relatively stronger globalization effects compared to the intra-national RTA effects.

Table 2 presents my main results. Column (1) incorporates international flows, additional phasing-in effects for available RTAs, an additional RTA (OQPP), and controls for intra-provincial effects. Only the cumulative effects of the lagged and contemporaneous RTA terms are reported for brevity. Column (2) adds lead RTA terms to test for strict exogeneity. From column (1), OQPP, APA and TCA are the only statistically significant RTAs. APA increased trade flows by 26.47%, OQPP and TCA decreased flows by 12.55% and 8.56% respectively. The set of all interprovincial and intra-provincial "border" effects is highly statistically significant. The coefficient estimate of -0.456 for $INTPL\_BRDR_{ij2013}$ implies that the inclining effect of the interprovincial border has decreased interprovincial trade relative to international trade by 36.6% over 21 years. The coefficient estimate of -0.532 for $INTRA\_BRDR_{ij2013}$ implies that the inclining effect of the intra-provincial "border" has decreased intra-provincial trade relative to international trade by 41.26% over 21 years. Column (2) reports statistical significance on the lead term for OQPP and TCA but not for APA, thus any interpretation of the effects of OQPP and TCA should be done with caution due to reverse causality concerns.

Table 2
PPML panel gravity, total goods and services, 1992-2013
Dependent variable: trade between exporter *i* and importer *j*

	(1) Full Phasing-in	(2) Leads and Contemporaneous Only
$OPP_{ij,t}$	-0.0447	0.0209
	(0.1409)	(0.1129)
$OQPP_{ij,t}$	-0.1341	-0.0225

	(0.0290)***	(0.0462)
$APA_{ij,t}$	0.2348	0.2182
	(0.1232)*	(0.1054)**
$PARE_{ij,t}$	-0.1123	-0.0856
	(0.1744)	(0.1155)
$TCA_{ij,t}$	-0.0895	-0.0377
	(0.0350)***	(0.0290)
$TILMA\_NWPTA_{ij,t}$	-0.0102	0.0154
	(0.1161)	(0.0734)
$INTPL\_BRDR_{ij1995}$	-0.4299	-0.4212
	(0.0493)***	(0.0475)***
$INTPL\_BRDR_{ij1998}$	-0.6595	-0.6438
	(0.0901)***	(0.0894)***
$INTPL\_BRDR_{ij2001}$	-0.6480	-0.6473
	(0.1023)***	(0.1021)***
$INTPL\_BRDR_{ij2004}$	-0.5307	-0.5608
	(0.0989)***	(0.0992)***
$INTPL\_BRDR_{ij2007}$	-0.5480	-0.5539
	(0.1371)***	(0.1372)***
$INTPL\_BRDR_{ij2010}$	-0.4230	-0.4329
	(0.1722)**	(0.1722)**
$INTPL\_BRDR_{ij2013}$	-0.4560	-0.4559
	(0.1805)**	(0.1802)**
$INTRA_{ij1995}$	-0.4585	-0.4583
	(0.0422)***	(0.0422)***
$INTRA_{ij1998}$	-0.6512	-0.6507
	(0.0861)***	(0.0862)***
$INTRA_{ij2001}$	-0.7066	-0.7065
	(0.1003)***	(0.1003)***
$INTRA_{ij2004}$	-0.6028	-0.6031
	(0.0973)***	(0.0973)***
$INTRA_{ij2007}$	-0.6153	-0.6153
	(0.1344)***	(0.1344)***
$INTRA_{ij2010}$	-0.4131	-0.4131
	(0.1681)**	(0.1682)**
$INTRA_{ij2013}$	-0.5325	-0.5325
	(0.1782)***	(0.1782)***
$OPP_{ij,t+1}$		0.1233
		(0.0515)**
$OQPP_{ij,t+1}$		0.1636
		(0.0410)***
$APA_{ij,t+1}$		0.0531
		(0.0845)
$PARE_{ij,t+1}$		-0.1919
		(0.1075)*
$TCA_{ij,t+1}$		-0.1058

		(0.0445)**
TILMA_NWPTA$_{ij,t+1}$		0.0640
		(0.0262)**
constant	8.4044	2.6785
	(0.2024)***	(0.1132)***
Observations	1152	1152
R-squared	0.9999	0.9999
Time fixed effects	No	No
Pair fixed effects	Yes	Yes
Exporter*time fixed effects	Yes	Yes
Importer*time fixed effects	Yes	Yes

Note: For brevity, the cumulative effects for RTAs are reported in column (1) and calculated as the sum of all lagged and contemporaneous RTA terms.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The heterogeneity and magnitude of these results accords with findings in Baier et al. (2019) and Kohl (2014). Baier et al. (2019) find statistically significant results for 53.9% of the RTAs in their sample, with the average partial effect of these RTAs increasing trade flows by 34%. Kohl (2014) finds positive and significant effects for 26.5% of the agreements in his study with trade promotion reaching at most 50%. Why do some RTAs facilitate trade while others do not? Baier et al. (2019) attempt to decompose the sources of RTA heterogeneity. In part, it is expected that distance between parties is expected to negatively impact the efficacy of an RTA either because more distant parties are more sensitive to changes in trade policies (Baier et al. 2018) or because they simply sign weaker agreements due to weaker cultural affinities. They find that countries that already have a prior trade agreement should experience weaker trade creation because earlier agreements have likely addressed barriers to trade. Further, contiguous countries and countries with common legal systems are expected to have increased trade creation effects for RTAs and their positive and significant results reinforce this. The authors note that because they already have in place an "inclusive" measure of trade costs in the form of pair fixed effects, these variables may be affecting the efficacy of an RTA through affecting initial trade costs.

These international results seem very applicable to a federated nation with diverse and mostly distant provinces such as Canada. The trade promotion effects of the APA may have been amplified by the comparatively close proximity of the signatories, whereas the trade diversion effects of the OQPP and TCA between Quebec and Ontario could have been attributed to the comparatively far distance between the two and relatively weaker cultural affinities. PARE and TCA were signed between common signatories in the already established APA and OQPP respectively, thus barriers to trade had already been significantly weakened which dampened the overall efficacy of the latter two agreements. Generally, all agreements between Quebec were either not significant or negatively impacted trade flows. The positive and significant sign for countries with common legal systems may merit further discussion as evidenced by Baier et al. (2019). Quebec is unique among Canadian provinces by having a juridical legal system under which civil matters are regulated by French-heritage civil law while public law, criminal law and other federal law operate according to Canadian common law.

Controlling for the phasing-in effects of RTAs also plays a role in the heterogeneity seen in these results. The APA was signed in 1996, so the period of analysis (1992-2013) fully encompasses the 10-year time horizon that virtually every RTA is phased-in over (Baier and Bergstrand, 2007). Most of the agreements in this analysis do not allow for the entire cumulative effect of having several lags controlled for such as the TCA signed in 2009 which was seen to deter trade flows.

Finally, another cause of heterogeneity in RTAs may stem from the provisions and policy areas covered within the agreements themselves. Kohl (2014) finds that while perfect coverage of all trade policy areas is no guarantee for trade-promoting treaties, more extensive agreements tend to be trade promoting. The APA's purpose is to eliminate all forms of discrimination among the participating governments and public entities within their jurisdiction through procurement contracts for goods, services, and construction awarded by government funded bodies, municipalities, academic institutions, schools and health and social services organizations. Notably, the APA has the lowest bidding thresholds than any other internal agreement in Canada (Kukucha, 2015). Kukucha (2015) argues that the adoption of a "negative list" approach, which is used with the specific intent of liberalizing markets and calls for the non-discriminatory movement of all goods and services, unless specifically excluded would facilitate the removal of trade barriers. The TILMA/NWPTA adopts this approach, and while the APA relies heavily on positive lists, it has liberalized a negative list approach in procurement thresholds. The TCA and PARE also rely heavily on positive lists, but feature elements of the negative list approach.

Beaulieu and Zaman (2019) note that the TCA and PARE were sector-specific agreements and only covered a small number of goods and services. They hypothesize that this kind of partial, sector-specific liberalization provides enough scope for interprovincial trade barriers to accumulate in the other sectors, so in aggregate the agreement might end up deterring trade flows. Future analysis could investigate the efficacy of these agreements at the sectoral level. The trade data covered for this analysis covers all goods and services trade, thus the scope of these inter-provincial trade agreements may simply not be extensive enough to impact this aggregate measure.

In summary, with the addition of international trade flows and longer "phasing-in" period effects for RTAs, fewer RTAs were found statistically significant, and those significant had reduced magnitudes. This main result is attributed to the trade diversion effect that occurred at the international level, which resulted in relatively more prohibitive interprovincial and intra-provincial "borders".

6.2 Multilateral Resistance Estimation Results

The heterogeneity in trade costs across the Canadian provinces calls for nuance in any approach to trade policy analysis. The multilateral resistance terms consistently aggregate the incidence of trade costs for consumers and producers, so this section is devoted to analyzing the fluctuations incurred on these terms for the Canadian provinces following estimates from the specification of equation (8). I use the method and Stata package *ppml_panel_*sg developed and used in Larch et al. (2017) to produce estimates for the multilateral resistance terms, solved through equations (2) and (3) based on estimated trade costs, over the period 1992-2013.

Figure 1 presents these results and plots the outward multilateral resistance terms and inward multilateral resistance terms relative to the Canadian average over the period of investigation for each province following the methodology of Baggs, Fung and Lapham (2019) such that:

$$REL\Pi_{i,t} \equiv \frac{\widehat{\Pi}_{i,t}}{\widehat{\Pi}_t} \quad (9)$$

$$RELP_{i,t} \equiv \frac{\widehat{P}_{i,t}}{\widehat{P}_t} \quad (10)$$

where $REL\Pi_{i,t}$ is denoted at the relative outward multilateral resistance term and $\widehat{\Pi}_t$ is the average of the estimates of outward multilateral resistances across all Canadian provinces. Similarly, $REL\mathrm{P}_{i,t}$ is the relative inward multilateral resistance term and $\widehat{\mathrm{P}}_t$ the average of the estimates of inward multilateral resistances across all Canadian provinces.

In theory, an RTA should decrease the multilateral resistances for signatories as they become more integrated with each other and relatively more isolated with the rest of the world. The results depicted in Figure 1 and Figure 2, apart from possibly the APA, do not indicate that any of the RTAs were substantial enough to cause such relative decreases in multilateral resistances. This accords with the dearth of positive statistical significance found in the previous section.

The larger regions trade more with themselves, which may explain why their relative IMRs far exceed that of the smaller regions. The necessity, or trade-off cost, of purchasing outside of these provinces is relatively higher due to high industry concentration. The OMRs exhibit more heterogeneity in the earlier periods than later, possibly due to globalization or reallocation effects (Anderson and Yotov, 2010) effectively making all Canadian regions comparatively less remote to each other and the world over time.

Figure 2: Relative MR estimates

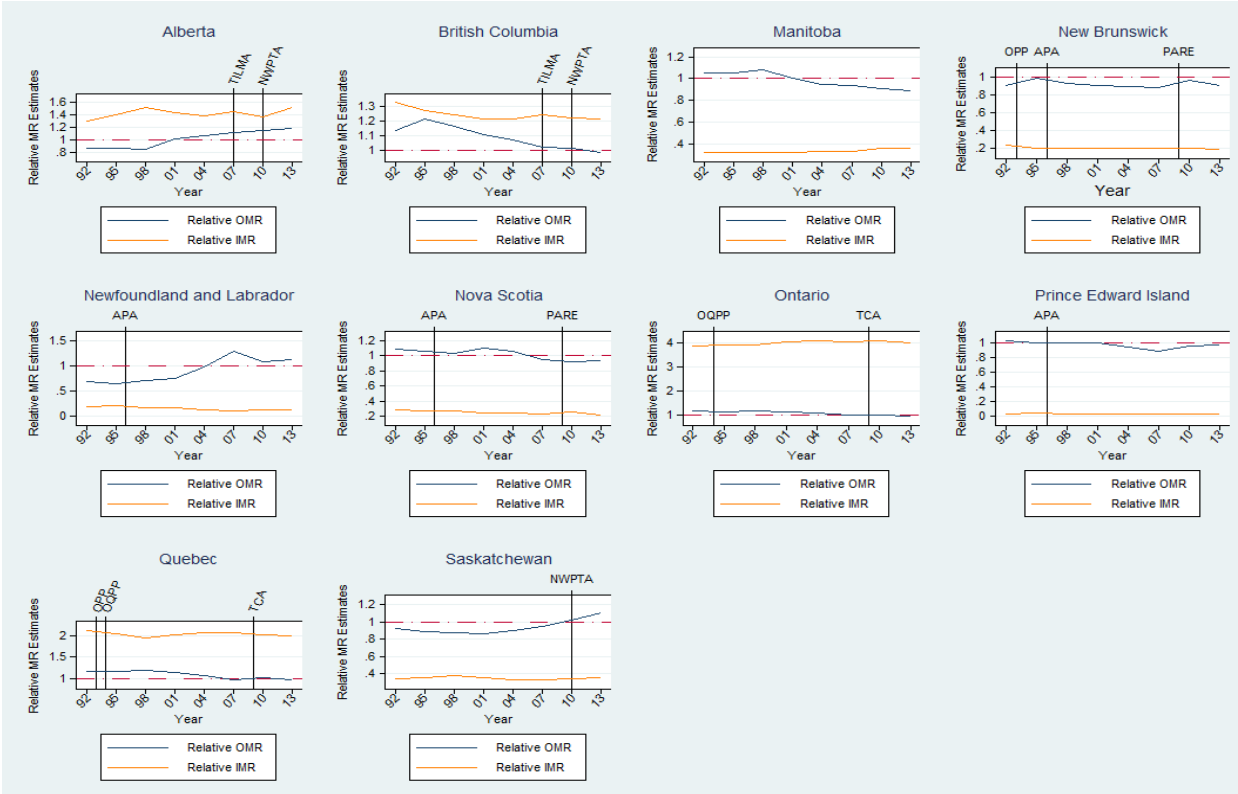
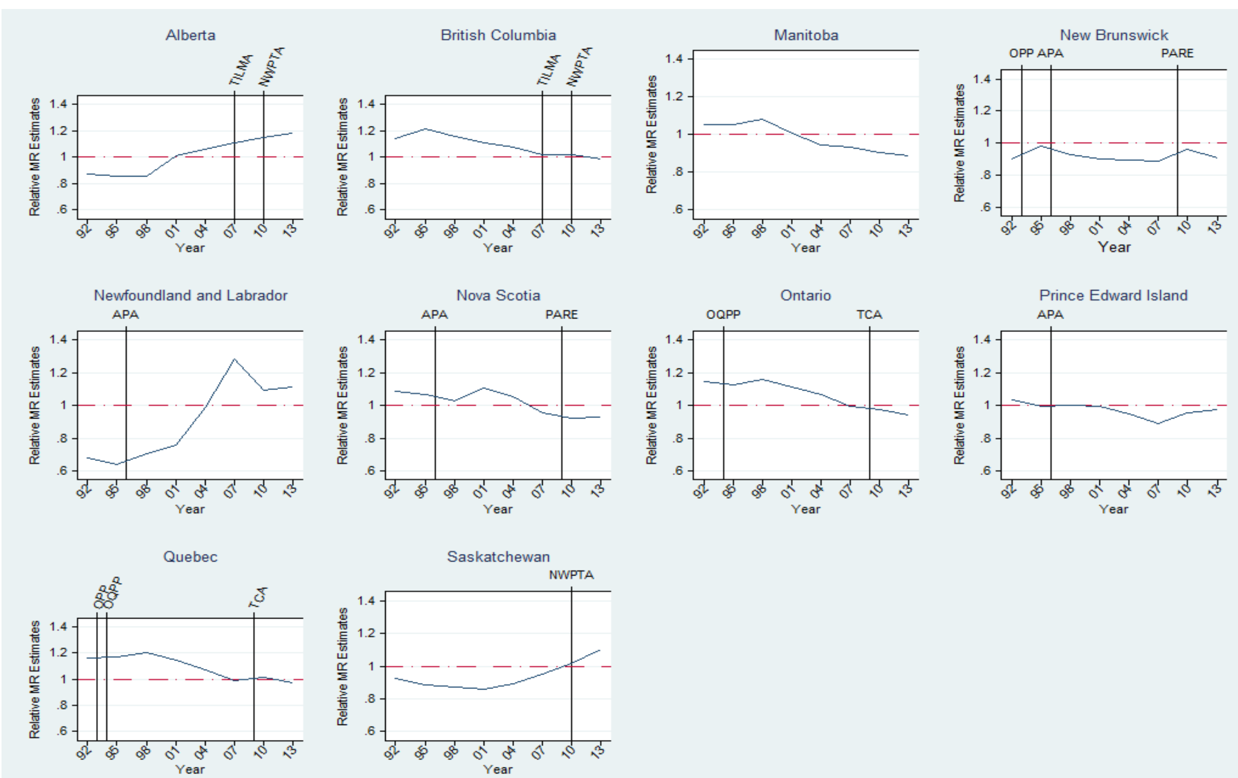


Figure 3: Relative same-scale OMR estimates



6.3 General Equilibrium Effects of the APA, OQPP and TCA

The paper so far has evaluated partial, or direct, RTA effects. General equilibrium effects are also important for quantitative evaluation of trade-policy changes as Anderson and van Wincoop (2003) suggest, because a change in bilateral trade costs between two countries will trigger general equilibrium effects that affect the trade costs and their incidence on consumers and producers in all other countries in the world. Table 3 lists the general equilibrium effects for overall trade and welfare of the APA, OQPP and TCA across all regions assayed in this dataset between 1992-2013, using 1992 as the base year to calculate initial trade values and trade balances. Following the methodology of Baier et al. (2019), I assume trade elasticity (σ) = 4.

The RTAs have a larger effect on trade flows than they do on welfare because the implied cost of substituting to one's own supplies is relatively small.[5] In the partial equilibrium scenario, all signatories receive the same common average effect of signing an RTA, whereas the general equilibrium scenario introduces a new layer of heterogeneity. The signatories of the APA received the largest benefit in trade volumes and welfare across all regions, with Prince Edward Island notably experiencing a 9.54% increase in exports and 0.64% increase in welfare. All regions not included in the agreement experience small losses due to trade diversion, with the largest losses accruing in Quebec. The OQPP and TCA, both between Ontario and Quebec, deterred trade between signatories, with notable ripple effects increasing trade and welfare for all non-members as consumers substituted away from goods of members. The heterogeneity in the

[5] Baier et al. (2019) note that this result is from assuming a single differentiated good with a trade elasticity of 4. If σ differs across industries, changes in trade can have very large welfare effects.

magnitude of the ripple effects on non-members suggest that distance plays a significant role in the efficacy of a trade agreement. This result accords with expectations from theory.

Table 4 reports the general equilibrium effects of trade amongst signatories only. The expectation here is that the growth in trade would be smaller in the general equilibrium scenario than in the partial scenario, as decreases in the inward multilateral resistances of members would cause consumers to substitute away from all other varieties, thus slightly offsetting the trade gains from the partial scenario where multilateral resistances are held constant. In the partial scenario, the APA was reported to increase trade flows by 26.47%, and with all regions other than Newfoundland and Labrador being slightly below this number in the general equilibrium scenario, the results reflect this adjustment. Similarly, the OQPP and TCA deterred trade flows by 12.55% and 8.56% respectively in the partial scenario with decreased magnitudes in the general equilibrium scenario.

Table 3: General equilibrium effects across all regions

Percentage change in trade and welfare, by region

	APA			OQPP			TCA		
Region	Δ% Exports	Δ% Imports	Δ% Welfare	Δ% Exports	Δ% Imports	Δ% Welfare	Δ% Exports	Δ% Imports	Δ% Welfare
Alberta	-0.006	-0.009	-0.001	0.070	0.103	0.006	0.047	0.070	0.004
British Columbia	-0.009	-0.008	0.000	0.067	0.054	0.004	0.046	0.037	0.003
Manitoba	-0.007	-0.006	0.000	0.097	0.088	0.008	0.066	0.060	0.005
New Brunswick	3.920	3.226	0.303	0.128	0.106	0.011	0.087	0.072	0.007
Newfoundland and Labrador	4.128	2.091	0.263	0.182	0.092	0.010	0.124	0.063	0.007

Nova Scotia	4.916	3.360	0.254	0.124	0.085	0.008	0.084	0.057	0.005
Ontario	-0.021	-0.023	-0.002	-1.551	-1.706	-0.135	-1.055	-1.160	-0.092
Prince Edward Island	9.544	7.314	0.639	0.139	0.106	0.010	0.094	0.072	0.007
Quebec	-0.032	-0.033	-0.002	-3.748	-3.973	-0.257	-2.550	-2.703	-0.175
ROW	-0.001	-0.001	0.000	0.010	0.011	0.000	0.007	0.007	0.000
Saskatchewan	-0.003	-0.004	0.000	0.061	0.072	0.007	0.042	0.049	0.004
United States	-0.002	-0.002	0.000	0.026	0.024	0.002	0.018	0.017	0.001

Table 4: General equilibrium effects amongst signatories

Region	Δ% Exports	Δ% Imports
APA		
New Brunswick	24.062	25.809
Newfoundland and Labrador	28.287	21.942
Nova Scotia	24.001	25.456
Prince Edward Island	25.034	23.293
OQPP		
Ontario	-11.483	-12.352
Quebec	-12.352	-11.483
TCA		
Ontario	-7.805	-8.412
Quebec	-8.412	-7.805

7. Conclusions and Future Research

In this paper, I developed a structural gravity econometric method and used the framework to estimate the effects of Canadian intra-national RTAs signed between the period 1992-2013. My approach accounts for a more robust decomposition of these RTA effects by accounting for international, interprovincial and intra-provincial trade flows along with the full "phasing-in" effects observed to exist in virtually all RTAs. My results present estimates of lower magnitude and statistical significance than Beaulieu and Zaman (2019), suggesting that globalization effects and international trade agreements have diverted more trade away from between provinces than the intra-national RTAs have created. Of the remaining significant RTAs, only the APA has increased trade flows while the OQPP and TCA have deterred flows.

As data is available at the sectoral level over the same period, incorporating this disaggregation would be valuable for future research to more precisely account for the different scopes of the RTA's provisions. This would provide a suitable framework for additional RTAs such as the Interim Agreement on Internal Trade in Agriculture and Food Goods signed in 2006 between British Columbia, Alberta, Saskatchewan, Manitoba and the Yukon which was an agreement to enhance interprovincial agriculture and food trade. Labor mobility has been among one of the cited areas mostly affected by trade barriers (Alvarez et al., 2019), as well as "prohibitive" barriers that unintentionally prohibit internal trade such as restrictions on the sale of alcoholic beverages to customers in other provinces. Anderson's (2011) gravity model of migration would present a rich environment to analyse the provisions contained within the RTAs designed to break down barriers hinder labour mobility.

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