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THE CHANGING INCIDENCE OF GEOGRAPHY

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ABSTRACT

The incidence of bilateral trade costs is calculated here using neglected properties of the structural gravity model, disaggregated by commodity and region, and re-aggregated into forms useful for economic geography. For Canada's provinces, 1992- 2003, incidence is on average some five times higher for sellers than for buyers. Sellers' incidence falls over time due to specialization, despite constant gravity coefficients. This previously unrecognized globalizing force drives big reductions in 'constructed home bias', the disproportionate predicted share of local trade; and large but varying gains in real GDP.

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The large gravity literature has revealed much information about bilateral trade costs (Anderson and van Wincoop, 2004). But the literature has not addressed the incidence of trade costs. Incidence is what matters for most issues of regional specialization, welfare and policy. For example, even with trade costs that are uniform over sectors, incidence differences across goods have non-uniform impacts on specialization, all else equal. As for welfare, uniform trade cost reductions across trading partners, either exogenous or from infrastructure policy, confer benefits with incidence split unevenly between buyers and sellers. Recently discovered properties of structural gravity are used here to calculate general equilibrium sectoral incidence measures of trade costs for Canada's provinces, 1992-2003.

Canada's trade has been the focus of a prominent literature that draws wider implications for economic geography from Canada's physical geography, sharp regional differences and high quality bilateral shipments data. We add to this literature new methods and new empirical lessons. Inward and outward multilateral resistance (Anderson and van Wincoop, 2003, 2004) are identified here as buyers' and sellers' aggregate (across partners) incidences. We calculate incidence and decompose incidence into domestic and international components. We account for home bias due to trade costs, directly and through multilateral resistance, in a new Constructed Home Bias (CHB) index. CHB gives the predicted value of internal trade given the estimated trade costs relative to the predicted value of internal trade with zero trade costs.

Our general equilibrium incidence measures are a natural extension of standard partial equilibrium incidence measures. The latter divide the trade cost of a single shipment into buyers' and sellers' margins relative to a hypothetical frictionless price such that the expenditure by the buyer and the net receipt of the seller is preserved. Our method aggregates shipments and apportions incidence relative to a hypothetical 'world' price such that aggregate expenditures and net receipts are preserved. For sellers it is as if each origin region pays a uniform-over-destinations trade cost to ship the same value of goods as in the actual equilibrium to a 'world' market. For buyers it is as if each destination region pays a uniform-over-origins trade cost to bring home from a 'world' market the same aggregate value of goods from all origins as in the actual equilibrium. Multilateral resistance contrasts with the market access and supplier access variables that have been used in the economic geography literature[1] to summarize the effect of bilateral trade costs. These do not measure incidence, do not aggregate consistently, and our results show that they are weakly and sometimes negatively correlated with multilateral resistance.

Bilateral trade costs are calculated from disaggregated gravity estimation. Distance and border effects on trade costs vary widely by commodity in patterns that make intuitive sense. Our gravity regressions fit well and are reasonably stable over time, the same properties that have legitimized the aggregate gravity literature.[2] Our results indicate downward bias in previous, mostly aggregate, gravity estimates of border effects such as Anderson and van Wincoop (2003).

Sellers' incidence always exceeds buyers' incidence, about 5 times larger in the early 90's. This striking regularity is consistent with supply being more affected than demand by the equilibrium tendency to substitute away from high trade costs in the cross section of regions, all else equal, as explained below in Proposition 2, drawing on Proposition 1.

Our most striking finding is that over time, sellers' incidence falls while buyers' incidence rises slightly despite constant gravity coefficients. Other authors have also observed constant gravity coefficients over time, a finding some call the 'missing globalization puzzle' (Coe, Subramanian and Tamarisa, 2002). The incidence changes drive a dramatic 16%-50% fall in Constructed Home Bias in Canadian provinces, 1992-2003, averaging around 40%. A previously unappreciated force of globalization changes multilateral resistances through sellers' and buyers' share changes that reduce the total trade cost bill, as explained below in Proposition 3.

Recognizing multilateral resistance changes as isomorphic to Total Factor Productivity

[1]See for example Redding and Venables (2004).

[2]Previous disaggregated gravity results in the literature indicating worse fit and unreasonable coefficients appear to be due to failure to use fixed effects to control for multilateral resistance.

(TFP) changes,[3] a linear approximation of the real GDP effect of the changes in outward and inward multilateral resistances is calculated. All but Northwest Territories, Saskatchewan, and Yukon gain. Prince Edward Island (PEI) gains most, followed by New Brunswick, British Columbia, and Ontario. The magnitudes are economically significant, averaging across provinces to around 1/3 of the Canadian average for 1992-2003. For PEI the rise is equal to its measured TFP growth over 1992-2003.

In contrast to falling sellers' incidences overall, Domestic Trade Cost (DTC) indexes for Canada's provinces are constant over time. The Agreement on Internal Trade (AIT) of 1995 was intended to reduce internal trade costs, to offset the lower international incidence documented here. Our econometric work finds no consistent evidence that the AIT can be picked out from other forces that affect Canada's trade. We simulate the intent of the AIT with hypothetical domestic cost reductions. A uniform decrease in interprovincial trade costs promotes equality: the gain for the poorer and more remote regions is bigger than the gain for the developed regions. Our simulations suggest the possibility of 'immiserizing globalization': a uniform fall in trade costs can harm the welfare of the 'core' regions through a combination of sellers' incidence declines offset by buyers' incidence rises.

Sellers' incidence varies widely across industries for a single province and across provinces for a single product line. More remote regions face higher sellers' incidence and products likely to have high distribution margins have higher sellers' incidence. Buyers' incidence varies less than sellers', but buyers' incidence is higher in more remote regions. Similarly, the CHB and DTC indexes have sensible patterns of variation and magnitudes.

The conceptual base of the project is set out in Section 1. Section 2 deals with the application methods and Section 3 describes the data used, with further details in the appendix. Section 4 presents the results.

[3] See Anderson (2008) for full discussion.

1 Conceptual Base

Begin with definitions of variables. Let X_{ij}^k denote the value of shipments at destination prices from origin i to destination j in goods class k. Let E_j^k denote the expenditure at destination j on goods class k from all origins, while Y_i^k denotes the sales of goods at destination prices from i in goods class k to all destinations. Let $t_{ij}^k \geq 1$ denote the variable trade cost factor on shipment of goods from i to j in class k. σ_k is the elasticity of substitution parameter for goods class k.

The budget constraints (one for each destination in each goods class) and the market clearance equations (one for each origin in each goods class) together with a CES demand system specification combine to yield the gravity model.

1.1 The Gravity Model

The CES demand function (for either final or intermediate products) gives expenditure on goods of class k shipped from origin i to destination j as:

$$X_{ij}^k = (\beta_i^k p_i^{*k} t_{ij}^k / P_j^k)^{1-\sigma_k} E_j^k. \tag{1}$$

Here, p_i^{*k} is the factory gate price and β_i^k is a CES share parameter. The CES price index is $P_j^k = [\sum_i (\beta_i^k p_i^{*k} t_{ij}^k)^{1-\sigma_k}]^{1/(1-\sigma_k)}$, an implication of the budget constraint.

Market clearance implies: $Y_i^k = \sum_j (\beta_i^k p_i^{*k})^{1-\sigma_k} (t_{ij}^k / P_j^k)^{1-\sigma_k} E_j^k$. Define $Y^k \equiv \sum_i Y_i^k$ and divide the market clearance equation by Y^k. The result implies that world supply shares are equal to world expenditure shares. With globally common CES preferences, the 'world expenditure shares' are effectively generated by

$$(\beta_i^k p_i^{*k} \Pi_i^k)^{1-\sigma_k} = Y_i^k / Y^k, \tag{2}$$

where $\Pi_i^k \equiv \sum_j (t_{ij}^k / P_j^k)^{1-\sigma_k} E_j^k / Y^k$, and the CES 'world' price index is equal to 1 because summing (2) yields:

$$\sum_i (\beta_i^k p_i^{*k} \Pi_i^k)^{1-\sigma_k} = 1. \tag{3}$$

Thus (2) implies that effectively origin i ships good k to a 'world' market at average trade cost Π_i^k.

Next, use (2) to substitute for $\beta_i^k p_i^{*k}$ in (1), the market clearance equation and the CES price index. This yields the structural gravity model:

$$X_{ij}^k = \frac{E_j^k Y_i^k}{Y^k} \left(\frac{t_{ij}^k}{P_j^k \Pi_i^k} \right)^{1-\sigma_k} \tag{4}$$

$$(\Pi_i^k)^{1-\sigma_k} = \sum_j \left(\frac{t_{ij}^k}{P_j^k} \right)^{1-\sigma_k} \frac{E_j^k}{Y^k} \tag{5}$$

$$(P_j^k)^{1-\sigma_k} = \sum_i \left(\frac{t_{ij}^k}{\Pi_i^k} \right)^{1-\sigma_k} \frac{Y_i^k}{Y^k}. \tag{6}$$

Here, Π_i^k is outward multilateral resistance, also interpreted as sellers' incidence. Then t_{ij}/Π_i^k is the bilateral buyers' incidence. P_j^k, the CES price index, is equal to inward multilateral resistance generated by (5)-(6). P_j^k is interpreted as buyers' incidence because it is a CES index of the bilateral buyers' resistances on flows from i to j in class k, the weights being $\{Y_i^k/Y^k\}$. It is as if buyers at j pay a uniform markup P_j^k for the bundle of goods purchased on the world market.

(4) leads to a useful quantification of home bias that summarizes the effect of all trade costs acting to increase each province's trade with itself above the frictionless benchmark, $E_j^k Y_i^k / Y^k$.[4] Constructed Home Bias is defined by

$$CHB_i^k \equiv \left(t_{ii}/\Pi_i^k P_i^k \right)^{1-\sigma_k}.$$

Two regions i and j with the same internal trade cost $t_{ii} = t_{jj}$ may have quite different CHB's because $\Pi_i^k P_i^k \neq \Pi_j^k P_j^k$.

[4] $t_{ij}^k = 1, \forall i, j$ implies $P_j^k = \Pi_i^k = 1, \forall i, j$, using (5)-(6).

The Armington assumption of products differentiated by place of origin can be explained on the demand side by monopolistic competition forces and free entry to determine the β's. It is alternatively explained on the supply side in Eaton and Kortum's Ricardian model with random productivity draws that assign proportions of products to regions, the β's now reflecting absolute advantage in the productivity draw distributions while the role of $1-\sigma$ is played by $-\theta$ where θ is a Frechet distribution parameter reflecting comparative advantage. Moving outside the CES (or Frechet distribution) framework to include demand structures with endogenous reservation prices has unexplored implications for gravity type estimation.

The gravity model nests inside many full general equilibrium models characterized by trade separability: two stage budgeting and iceberg trade costs $\Rightarrow$ distribution uses resources in the same proportions as production. This paper takes the supply and expenditure shares as exogenously given. Iceberg trade costs can include fixed costs, with fixed costs helping to explain the many zeroes that are found in bilateral trade flows. We abstract from fixed costs here because our econometric work will not be able to identify them. Implicitly, the response of trade volume on the extensive margin is picked up as part of the variable cost, as explained by Helpman, Melitz and Rubinstein (2008). This biases gravity coefficients upward as estimates of variable cost.

1.2 Properties of Multilateral Resistance

Multilateral resistances are ideal indexes in the following sense (Anderson and van Wincoop, 2004). If the actual set of bilateral trade costs is replaced by $\widetilde{t}_{ij}^k = P_j^k \Pi_i^k$, all budget constraints and market clearance conditions continue to hold; and factory gate prices and supply and expenditure shares remain constant. Thus $\{P_j^k \Pi_i^k\}$ is the general equilibrium analog to the incidence decomposition of the principles course.[5]

Since (5)-(6) solves for $\{\Pi_i^k, P_j^k\}$ only up to a scalar for each class k, an additional

[5]In the one dimensional case, the buyers' price is also unchanged by replacing the actual tax with the product of buyers' and sellers incidence factors. In the structural gravity model, the aggregate expenditure and buyers' incidence remain constant but the actual purchase pattern shifts.

restriction from a normalization is needed.[6] (3) implies full general equilibrium consistency between trade allocation within sectors and sectoral allocations within regions. Within sectors, relative multilateral resistances are what matter,[7] so alternative normalizations are admissible for convenience in the absence of information on $\beta_i^k p_i^{*k}$'s. Our empirical procedure is $P_i^k = 1, \forall k$ for a convenient reference region i. Other normalizations are used below for clean theoretical results.

Three propositions about the properties of multilateral resistance help explain our results, even though the conditions for them are unrealistic. The first two characterize the cross section pattern of multilateral resistances while the third proposition characterizes how share changes affect home bias. Proofs are in Appendix D. Let b_i denote the expenditure share and s_i the supply share of country i, suppressing the goods class index k.

Proposition 1 *If $\sigma > 1$, the trade frictions are uniform border barriers and $\Pi_i^{1-\sigma}$ and $P_i^{1-\sigma}$ are normalized to have equal averages, then multilateral resistances are (i) decreasing in net import shares $b_i - s_i$ given supply shares s_i and (ii) decreasing in supply shares given net import shares.*

The intuition for 1(ii) is that larger regions trade more with themselves, hence less of their trade incurs the border cost. This lowers multilateral resistance in larger regions. The intuition is based on the case of no net trade. Appendix D shows that $b_i - s_i = 0 \Rightarrow \Pi_i^{1-\sigma} = P_i^{1-\sigma}$ and multilateral resistance is decreasing in the share $b_i (= s_i)$.[8] Proposition 1 shows that the same intuition applies even with net trade. The intuition for 1(i) is based on the familiar transfer problem analysis. Trade costs induce home bias in expenditure shares, hence a transfer recipient with $b_i - s_i > 0$ for given s_i experiences a terms of trade advantage relative to its partners, expressed here as lower multilateral resistance. Other normalizations introduce an additional expenditure share effect; see Appendix D.

[6] If $\{\Pi_i^0, P_j^0\}$ is a solution then so is $\{\lambda\Pi_i^0, P_j^0/\lambda\}$.

[7] Specifically, the trade flow in equation (4) is not affected by changes in the scalar λ of the preceding footnote.

[8] A related proposition in Anderson and van Wincoop (2003) characterizes the comparative static effect of introducing a small uniform border barrier in a one good balanced trade economy, reaching similar conclusions and the same intuition.

Next is a proposition that helps explain why our measures of outward multilateral resistance exceed inward. Building on the intuition of Proposition 1, suppose that across regions multilateral resistances tend to be lower the larger is the supply share and the larger is the expenditure share. Suppose that this effect acts more powerfully with respect to supply shares than expenditure shares, suggested by the observed greater variation in supply shares. This pattern also plausibly reflect specialization, with causation running from multilateral resistances to supply (and demand) shares.

Proposition 2 *If bilateral trade costs are symmetric and incidence is normalized so that the* $1 - \sigma$ *power transforms of average bilateral buyers' and sellers' incidences are equal, then on average sellers' incidence exceeds buyers' incidence if and only if the covariance of supply shares with outward multilateral resistance is more negative than the covariance of expenditure shares with inward multilateral resistance.*

Third, the comparative statics of multilateral resistance with respect to supply and expenditure shares suggest why Constructed Home Bias falls over time. Differentiate (5)-(6) with respect to the shares at constant bilateral trade costs $\{t_{ij}\}$.[9] The changes in the expenditure shares reflect response to factory gate price changes, possibly lagged, or changes in tastes (for final goods) or technology (for intermediate goods). The changes in the supply shares reflect response to price changes, possibly lagged or changes in technology or endowments. The price changes themselves are driven by exogenous technology, taste and endowment parameter changes.

Proposition 3 *Normalizing weighted average changes in multilateral resistance to zero, Constructed Home Bias falls on average if and only if sales tend to fall from origins that face high average bilateral buyers' incidence and purchases tend to fall from destinations that face high average sellers' incidence.*

The share change condition expresses the intuitive force of shipment bill minimizing adjustment of shares, reallocating both supply and demand at given costs of shipment to and

[9] Constant trade costs are implied by our results.

from an ‘as if’ unified world market.[10] In full general equilibrium, economizing occurs on many more margins than trade costs, the multilateral resistances are determined simultaneously with the shares, and there is no guarantee that the condition will be met.[11] Our results are at least consistent with the condition.

The necessary and sufficient condition of Proposition 3 drives lower the average bilateral incidences that are normalized to be equal in the condition of Proposition 2. Thus the share changes in Proposition 3 are consistent with sellers’ incidence exceeding buyers’ incidence.

Individual CHB’s may rise, but Appendix D indicates that this will be under special conditions. Appendix D also helps interpret our empirical finding that P’s rise gently over time while Π’s fall.

2 Application Methods

The structural gravity model (4) can be estimated using fixed effects to control for multilateral resistance and using proxies for bilateral trade cost such as distance and borders. Estimates of multilateral resistance will be calculated from (5)-(6) based on the estimated t_{ij}’s.

The unobservable costs are assumed to be related to observable variables:

$$(t_{ij}^k)^{1-\sigma} = e^{\alpha_1 LNDIST_{ij} + \alpha_2 CB\_P\_P_{ij} + \alpha_3 CB\_P\_S_{ij} + \alpha_4 BRDR\_CA_{ij} + \alpha_5 SMCTRY_{ij}}, \tag{7}$$

where: $LNDIST_{ij}$ is the logarithm of bilateral distance between trading partners i and j. Motivated by Brown and Anderson (2002), who find that provinces and states that share a common border tend to have higher levels of trade, we introduce two variables that capture contiguity: $CB\_P\_P_{ij}$ is a dummy variable equal to one if the two trading partners are

[10]No single actor minimizes, but rather the invisible hand of market forces.

[11]Literally minimizing the trade cost bill with respect to shares subject to the adding up constraint will generally result in corner solutions. But because share changes affect marginal costs and benefits on margins other than trade costs, these ‘frictions’ prevent the corners from being reached.

provinces and they share a common border; similarly, $CB\_P\_S_{ij}$ reflects the presence of contiguous border when one of the trading partners is a province and the other is a state. $BRDR\_CA_{ij}$ is an indicator variable that captures the presence of an international Canadian border. Finally, $SMCTRY_{ij}$ takes a value of one for internal trade, e.g. when a province trades with itself.[12]

The econometric model is completed by substituting (7) for t_{ij}, then expanding the gravity equation with a multiplicative error term. The structural model implies that size-adjusted trade is the natural dependent variable[13] in the gravity regression:

$$\frac{X_{ij}^k Y^k}{Y_i^k E_j^k} = \left(\frac{t_{ij}^k}{\Pi_i^k P_j^k} \right)^{1-\sigma_k} \epsilon_{ij}^k, \tag{8}$$

where ϵ_{ij}^k is the error term. The standard OLS procedure used to estimate (8), after translating it into a logarithmic form, has been criticized on two main grounds. First, it throws away all the information contained in the zero trade flows.[14] Second, it does not account for the heteroskedasticity that is present in the trade data. To resolve these issues, we follow Santos Silva and Tenreyro (2007) who propose estimating (8) in multiplicative form with a Poisson Pseudo-Maximum Likelihood (PPML) estimator that utilizes the information contained in the zero trade flows and tends to control for heteroskedasticity.

We use directional (source and destination) fixed effects PPML with Eicker-White robust standard errors to consistently estimate Equation (8) for each commodity and each year in our sample. Our dependent variable deviates from the specification in (8) because, due to lack of data on total imports of individual states, we were not able to construct expenditures

[12] See Anderson and van Wincoop (2004) for more discussion of the specification of (7).

[13] By bringing output and expenditure shares on the left-hand side in our estimations, we impose unitary estimates of the coefficients of theses variables, as suggested by theory, but we also address the issues of heteroskedasticity in the trade data and of endogeneity in supply and expenditures.

[14] Helpman, Melitz and Rubinstein (2008) develop a formal model of selection. Potential exporters must absorb fixed costs to enter a market, screening out the less productive ones. The HMR technique requires an exogenous variable that enters selection but is excluded from determination of the volume of trade. In their cross country case, common religion was the excluded variable, but in our state and province based data set there is no plausible variable that differs across the observations.

at the state level. Therefore, the effect of the missing expenditures in our specification is picked up by the destination fixed effects.

Multilateral resistance variables are computed using the estimated t's in (4)-(6) along with a normalization. We set Alberta's inward multilateral resistances to be equal to one for each good, $(P^k_{AB})^{1-\sigma_k} = 1$. Relative multilateral resistances are what matters for resource allocation in general equilibrium.

One final issue with the data must be resolved to calculate multilateral resistances. To solve (4)-(6) we need data on individual state expenditures at the commodity level. Unfortunately, we lack data on total US state imports. The problem is resolved by aggregating to the US level for calculating multilateral resistances for Canadian provinces. Thus, the inputs needed to solve the multilateral resistances system are the provincial outputs and expenditures, the US output and expenditure and the ROW output and expenditure along with the bilateral trade costs. The original bilateral trade costs come from gravity equations that give province to individual US state bilateral trade costs. These costs must be aggregated consistently to form the appropriate US to province bilateral trade costs for the multilateral resistance calculations. We form an aggregate bilateral trade cost from each Canadian province to the US (aggregate), and from the US (aggregate) to each Canadian province as follows. The generic commodity ships from Canadian province i to US state j with trade cost (from gravity) given by t_{ij}. The average bilateral trade cost to the US from province i is given by:

$$\bar{t}^{1-\sigma}_{i,US} = \sum_{j \in US} w_{ij} t^{1-\sigma}_{ij},$$

where $w_{ij} = X_{ij} / \sum_{j \in US} X_{ij}$. The average bilateral trade cost from the US to Canadian province i is given by:

$$\bar{t}^{1-\sigma}_{US,i} = \sum_{j \in US} w_{ji} t^{1-\sigma}_{ji},$$

where $w_{ji} = X_{ji} / \sum_{j \in US} X_{ji}$. The last step in setting the system (4)-(6) in operational form is to aggregate trade costs from the US (aggregate) to ROW, and from ROW to the US (aggregate). We follow the same procedure and define the aggregate trade cost from the US to the rest of the world as:

$$\bar{t}_{US,ROW}^{1-\sigma} = \sum_{j \in US} w_{j,ROW} t_{j,ROW}^{1-\sigma},$$

where $w_{j,ROW} = X_{j,ROW} / \sum_{j \in US} X_{j,ROW}$. Finally, aggregate costs from ROW to the US (aggregate) are defined as:

$$\bar{t}_{ROW,US}^{1-\sigma} = \sum_{j \in US} w_{ROW,j} t_{ROW,j}^{1-\sigma},$$

where $w_{ROW,j} = X_{ROW,j} / \sum_{j \in US} X_{ROW,j}$. After aggregating the US costs, we are able to solve (4)-(6) for the inward and outward multilateral resistances at the commodity level for each province and territory, the US as a whole, and the rest of the world.

3 Data Description

This study covers the period 1992-2003. The trading partners in our sample include all Canadian provinces and territories,[15] the fifty US states and the District of Columbia, and the rest of the world (ROW), which we define as an aggregated region consisting of all other countries. Data availability allowed us to investigate 19 commodities.[16] In order to estimate gravity and calculate multilateral resistances, we use industry level data on bilateral

[15] We treat Northwest Territories and Nunavut as one unit, even though they are separate since April 1, 1999.

[16] Commodity selection is based on (but is not completely identical to) the S-level of aggregation as classified in the Statistics Canada's Hierarchical Structure of the I-O Commodity Classification (Revised: January 3, 2007). The 19 commodity categories include: Agriculture (crop and animal production); Mineral Fuels (coal, natural gas, oil); Food; Leather, Rubber and Plastic Products; Textile Products; Hosiery, Clothing and Accessories; Lumber and Wood Products; Furniture, Mattresses and Lamps; Wood Pulp, Paper and Paper Products; Printing and Publishing; Primary Metal Products; Fabricated Metal Products; Machinery; Motor Vehicles, Transportation Equipment and Parts; Electrical, Electronic, and Communications Products; Non-metallic Mineral Products; Petroleum and Coal Products; Chemicals, Pharmaceutical, and Chemical Products; Miscellaneous Manufactured Products. The few commodities missing from the complete S-level I-O Commodity Classification spectrum are Forestry Products, Fish, Metal Ores, and Tobacco and Beverages. Reliable bilateral trade data ware not available for those products.

trade flows, output, and expenditures for each trading partner. In addition, we use data on bilateral distances, population, contiguous borders, the presence or absence of provincial or international borders, and elasticities of substitution at the commodity level. Lastly, we generate a dummy variable to explore the effects the Agreement on Internal Trade (AIT), effective since July 1, 1995, on trade flows and trade costs within Canada. Table 1 provides summary statistics for the most important variables used in the estimations, for the first and the last years in our sample.[17] Appendix A provides a detailed description of the data, the data sources, and the data procedures.

4 Results

We begin with the results of estimating gravity equation (8) for each year and commodity in our sample. Then, we calculate and analyze inward and outward multilateral resistances. Next, we present constructed home bias indexes over provinces and time. These indicate a significant fall in home bias associated with trade-cost reducing effects of specialization. A crude measure of the real GDP gains that result is calculated over 1992-2003. Next, we present the domestic trade cost component of outward multilateral resistance, the average incidence facing provincial sellers within Canada. Finally, we assess the effects of the Agreement on Internal Trade, and perform counterfactual experiments to gauge how hypothetical cost reductions from AIT would affect domestic trade cost indexes within Canada.

4.1 Gravity Results

Our gravity coefficient estimates vary significantly across commodities and are relatively stable over time.[18] Thus, the values in Table 2, which are the estimates for the mid-year in

[17]A summary statistics table for the rest of the variables is available upon request.

[18]The only exception is the distance coefficient for Fuels, which is relatively unstable over the years. The economic theory of gravity (Anderson and van Wincoop, 2004) implies that gravity regressions pick up *relative* trade costs in a cross section, and cannot reflect changes in the level. Compression of trade costs could occur over time as external trade costs fall relative to internal ones, but this force is apparently absent. The effect of the fall in the *level* of trade costs might also be picked up by time-and-region dummy

our sample, are representative for the rest of the gravity estimation results.[19]

Without going into details, we briefly summarize our PPML gravity estimates, reported in Table 2.[20] The coefficient on distance is always negative and significant at any level. There is significant variability in the effect of distance on trade across different commodities. Distance is a bigger obstacle to trade for low value/weight commodities such as Petroleum and Coal, Paper and Paper Products, and Furniture, while a lesser obstacle for commodities such as Electrical Products and Hosiery and Clothing. Transportation costs are the natural explanation. Contiguity matters, but only when the common border is between a province and a state. We find weak evidence that contiguous provinces trade more with each other. The estimate on CB_P_P, capturing the presence of a common border between provinces is positive and significant for only four of the nineteen commodities in our sample. However, we find strong evidence that trade flows are larger between contiguous provinces and states.[21] This should not be surprising since almost every province is contiguous to at least one US state, and this is likely to be a major trade partner as well. Our estimates present evidence supporting the argument in Brown and Anderson (2002) that contiguous provinces and states trade more with each other. Therefore, breaking the contiguity dummy variable into two is important.

The international Canadian border has a big depressing effect on trade. For every commodity category, the point estimate of the coefficient on $BRDR\_CA$ is always negative and very statistically and economically significant. The Canadian border effect varies widely across commodities.

Aggregation (a feature of almost all gravity investigations) biases gravity estimates.[22] To

variables in the gravity model. (Unfortunately these can also reflect forces other than trade costs, such as scale economies, nonhomothetic preferences or other size related unobservable variables.) Our results do not reveal any systematic decline in trade cost levels over time via this channel.

[19]Estimation results for individual commodities in each year are available upon request.

[20]We also estimate (8) using OLS. Comparisons between the PPML and the OLS estimates reveal that the latter are biased upward. This is in accordance with the findings from Santos Silva and Tenreyro (2007) and Helpman, Melitz and Rubinstein (2008).

[21]Fuels is the only commodity category for which the coefficient on the dummy variable capturing contiguity between provinces and states is consistently insignificant.

[22]Anderson and van Wincoop (2004) provide an extensive discussion of aggregation bias in gravity esti-

investigate aggregation bias, we estimate the gravity equation using data on aggregate trade flows and output, obtained by summing up commodity level values for each province and state. Estimation results, available upon request, reveal that the aggregate border effects are significantly lower than the average border effects estimated with commodity level data. The aggregate border effects estimates are relatively stable over time.[23]

We find some empirical evidence that internal provincial trade is higher than interprovincial and international trade, all else equal. In other words, there is a provincial border barrier.[24] The point estimates of the coefficient on the variable SMCTRY are positive and significant for about two-thirds of the commodities in our sample.

The overall good fit and relative stability of the gravity coefficient estimates over time argue that our gravity regressions pick up a genuine statistical regularity, while the economic theory of gravity assigns economic significance to those coefficients. These properties have legitimized the empirical gravity literature based on aggregate data, so we think they legitimize our disaggregated results.

4.2 Multilateral Resistance Results

Inward and outward multilateral resistance indexes are calculated by solving system (5)-(6), normalized by setting the inward multilateral resistances for Alberta equal to one.[25]

mation, setting out forces pushing in either direction, and concluding that no theoretical presumption can be created.

[23]Downward aggregation bias is present in both the PPML and the OLS estimates. The bias is more severe in the OLS estimates, which provides an additional advantage of its PPML counterpart. The border effects discussed in the paper are slightly larger than those inferred from aggregate trade flow data in Anderson and van Wincoop (2003) using OLS as opposed to PPML.

[24]Wolf (2000) found evidence of US state border effects using aggregate shipments data. It should be noted however, that the reference groups in the two studies are different. In our case, the reference group is interprovincial as well as international trade, while Wolf compares intrastate trade to interstate trade only.

[25]Mechanically, we solve system (5)-(6) for the power transforms $\{(\Pi_i^k)^{1-\sigma_k}, (P_j^k)^{1-\sigma_k}\}$. To obtain $\{(\Pi_i^k), (P_j^k)\}$, we use estimates of elasticity of substitution at the commodity level based on country level data from Broda et al (2006). See the data appendix for details. Theory calls for valuing shipments at delivered prices while our data is at FOB prices. Gravity coefficients are unbiased by this practice because the fixed effects control for effect of the measurement error on the gravity equation. In contrast, the MR estimates could be biased if the measurement errors in the shares Y_k^i/Y_k and E_k^j/Y_k are correlated with the calculated trade costs t_{ij}^k. The alternative procedure is to use transport cost markups to value shipments at CIF prices. These markups are well-known to be full of measurement error as well, so there is no ideal

For the purposes of describing multilateral resistance over time, it seems desirable to have a time-invariant normalization, resembling the use of CPI or GDP deflators to convert current prices to base year prices.[26] The procedure we adopt is to convert Alberta's current inward multilateral resistance into base year Alberta inward multilateral resistance.[27] Thus, initially we calculate MR's for each commodity with $P_A(t) = 1$ for each year t. This yields (for each commodity) a set $\{P_i(t), \Pi_i(t)\}$ for each region i and year t. We aggregate the commodity level MR's to form the provincial MR's. To convert them to intertemporally comparable values, we construct an inflator variable for Alberta, drawn from province level CPI's (for goods only, excluding services). The inflator is equal to $\pi_A(t) = CPI_A(t)/CPI_A(1992)$. The new set of 'time-consistent' MR's is $\{\pi_A(t)P_i(t), (1/\pi_A(t))\Pi_i(t)\}$. Conceptually, any region's inward MR is converted to a 1992 dollars Alberta equivalent. For example, $P_i(t)/P_A(t)$ is replaced by $P_i(t)/P_A(1992)$. The scale of outward MR's is inversely related to the scaling of inward MR's due to the structure of (5)-(6), so outward MR's are also interpreted as being in 1992 Alberta dollars. The undeflated series shows essentially flat inward MR's and declining outward MR's while the CPI deflated series has upward trend in inward MR's and amplified downward trend in outward MR's.

To gauge the significance of our indexes, we calculate standard errors by bootstrapping the constructed bilateral trade costs from our regression model. We adopt the following procedure. First, we generate 150 sets of bootstrapped PPML coefficient estimates, which we use to calculate 150 sets of multilateral resistance indexes. We then use the bootstrapped

procedure.

[26]Within each year, only relative multilateral resistances have allocation consequences.

[27]The IMR values in principle are comparable to price indexes, and in particular their variation across provinces might be expected to reflect variation in consumer (or user) price indexes across provinces. The IMR's have more variation than CPI's, and they only loosely track variations in consumer price indexes. The difference does not necessarily indicate problems with our approach of calculating IMR's. The difference has a number of explanations. First, the inward incidence of trade costs probably falls on intermediate goods users in a way that does not show up in measured prices. Second, the production weighted IMR's are not really conceptually comparable to the consumer price indexes of final goods baskets. Third, home bias in preferences may be indicated by our results. Home bias in preferences results in attributions to 'trade costs' that cannot show up in prices. But fourth, the IMR's are no doubt are subject to measurement error and are based on a CES model that itself may be mis-specified. We think it is premature to adopt this negative interpretation that vitiates our approach.

MR indexes to estimate standard errors for each index reported in the paper according to the following formula:

$$\widehat{se}_{IND} = \sqrt{\frac{\sum_{i=1}^{n}(\widehat{IND}_i - \widehat{IND})^2}{n}},$$

where: n is the number of bootstrapped samples;[28] $\widehat{IND}_i$ is the index from the i^{th} bootstrap sample; and $\widehat{IND}$ can be any index obtained from the original data.

We find significant variation, within reasonable bounds, in IMR's across provinces and territories for a single product, and across commodity lines for a given province or territory. For brevity we concentrate on IMR's aggregated over goods as they vary across provinces and territories. Commodity level results are summarized in Appendix C.[29] Table 3 summarizes the evolution over time of IMR's by province and territory across all product lines.[30] The values in each column are the yearly average inward multilateral resistances for each province across all goods weighted by the provincial expenditure share on each commodity. As can be seen from the table the IMR values are precisely estimated. They are significantly different across provinces, and the pattern of IMR variation makes good intuitive sense. More 'remote' regions, geographically and in terms of industry concentration, face larger buyers' incidence: The Northwest Territories (NT)(including Nunavut), the Yukon Territories (YT), and Newfoundland and Labrador (NL) are consistently among the regions with largest IMR indexes. In contrast, Ontario (ON) and Quebec (QC) are consistently among the regions with lowest buyers' incidence.

Alberta is representative of our results.[31] Inward trade costs for most commodity categories put Alberta somewhere in the middle as compared to the high-cost NT, YT, and NL on the one hand, and the low-cost ON and QC on the other. There are, however, a few expected exceptions. Alberta has very low relative IMR indexes for several commodity

[28]To speed up the computational procedure, we set 110 as the cap for the number of iterations in the system solving for the multilateral resistances. This resulted in less than 2% of instances where the system did not converge. These cases were dropped from our bootstrapped samples.

[29]Estimation results at the commodity level are available upon request.

[30]Individual figures presenting the variation of internal multilateral resistance across regions are available upon request.

[31]This made Alberta our choice for normalization.

categories including Agricultural Products, Fuels, Mineral Products, Petroleum and Coal Products, and Chemical Products. Given Alberta's fuels resources, it should be no surprise that the inward trade costs for Fuels and Petroleum and Coal Products are relatively low. The low inward multilateral resistance for Agricultural Products should also be expected since Alberta is one of the biggest agricultural producing provinces in Canada. Chemical Products is another industry where Alberta has a low inward multilateral resistance index, higher only than the corresponding indexes for Ontario and Quebec. Along with ON and QC, Alberta dominates production in this industry, especially when Petrochemicals and Synthetic Resins are considered. Finally, Alberta has the fourth lowest inward trade cost for Mineral Products, which reflects the province's fourth place, after Ontario, Quebec, and British Columbia, in terms of output share in this industry.

OMR's are also precisely estimated and they are considerably larger than the inward multilateral resistances. The result is consistent with implications of Propositions 1 and 2. Larger supply or expenditure shares tend to reduce multilateral resistances, by Proposition 1. The greater dispersion of supply shares drives average outward above average inward multilateral resistance. The pattern also plausibly reflects specialization, with causation running from multilateral resistances to supply (and demand) allocations.[32]

The OMR's vary widely across industries for a single province and across provinces for a single product line. The pattern of variation makes good sense for the most part. We summarize our findings about the variation of aggregated OMR's across provinces in Table 4.[33] This time, we use commodity shipment shares as weights in order to calculate the average OMR's for each province or territory across all goods. Interestingly, the most developed regions, Ontario (ON) and Quebec (QC), face larger sellers' incidence along with the

[32]The large OMR's may at first appear implausible, since they may appear to imply large relative factor price differences between regions for immobile factors. But this is not a necessary implication because the large amount of regional specialization allows substantial factor price equality to coexist with large differences in OMR's. Note that our method in principle allows the construction of a Π_i^k for a province i that produces no k.

[33]We summarize our findings about the patterns of OMR variation across commodity categories in Appendix C. Estimation results of our findings about the patterns of OMR variation across commodity categories are available upon request.

more remote regions, such as the Yukon Territories (YT) and Newfoundland and Labrador (NL). On the other hand, the Northwest Territories (NT)(including Nunavut) are among the regions with lowest sellers' incidence along with British Columbia (BC) and Alberta (AB).

The explanation for the high OMR values for ON and QC, as compared to the low indexes for NT, BC, and AB, is that the latter three provinces export primarily resource commodities with very low individual OMR indexes and our aggregation process attaches more weight to those categories. For example, in the case of the Northwest Territories, the low OMR value is driven by the fact that Fuels, which take more than 70% of NT's shipments, are a commodity category with relatively low outward trade cost. Fuels also explain the low OMR values for Alberta. Finally, British Columbia has very low relative outward multilateral resistances for commodity categories such as Food, Leather, Rubber, and Plastic Products, Printing and Publishing, Fabricated Metals, and Machinery, which represent the leading manufacturing industries in the province.

For comparison, in Table 5, we report outward multilateral resistances obtained as a simple average across all commodity categories. This time, Ontario and Quebec are among the provinces with lowest OMR's, while the Yukon Territories, the Northwest Territories, and Newfoundland and Labrador have the three largest indexes. The explanation is the combination of remote vs. central geographical location and low vs. high industry concentration in these regions.

Over time there is strong evidence of a decline in OMR's. See Tables 4 and 5. Since gravity coefficients are stable over time, we take the suggestion from Proposition 3 that the decline in OMR's is interpreted as driven by economizing on the trade cost bill.

The pattern suggested by Proposition 1 holds up well in our data when applied to OMR's. Columns (1)-(4) of Table 6 illustrate our results at the province level:[34] the OMR transform $\Pi_i^{1-\sigma}$ is significantly increasing in output shares and increasing in net import shares. As

[34]To obtain these results, we correlate OMR's to the power of $(1-\sigma)$ with output shares and net import shares for each province in our sample. NLS regressions estimating equations (16) and (17) at the province level obtain very similar results. The latter are omitted for brevity but are available upon request.

predicted by Proposition 1, most partial correlation coefficients on output shares are positive and significant. The only three exceptions where we do not find a significant correlation are NT, YT, and PE. Results on the correlation between the OMR's and the net import shares are similar. This time, the only two insignificant correlation coefficients are those of NT and PE.

In contrast, the sign pattern is sometimes reversed for IMR's. Our partial correlations, presented in Columns (1)-(4) of Table 7, indicate a mixed relationship between IMR's and output shares and net import shares at the province level. Part of the explanation is econometric: low variability in the inward MR indexes and hence the weak correlations with output shares and net import shares. From a theoretical perspective, Proposition 1 imposes unrealistic conditions, so its rejection by IMR data is not surprising.

MR's stand in sharp contrast to share-weighted Laspeyres indexes of bilateral trade costs.[35] Share-weighted indexes are 'naive incidence' measures that put all incidence on alternately the seller or buyer. In practice, naive and MR incidence measures are very significantly different. We omit the tables with share-weighted indexes for brevity, but they are available upon request.[36] Several properties stand out. First, share-weighted indexes vary across provinces in a counter-intuitive way. For example the Yukon Territories are consistently among the regions with lowest trade costs. Our methods yield more plausible rankings. Second, the share-weighted index suggests that the 'average' incidence of the constant bilateral costs has increased over time, while outward multilateral resistance decreases over time. Third, there is unsystematic correlation between multilateral resistance and share-weighted indexes of bilateral trade costs. As shown in columns 5-6 of Table 6, OMR is positively correlated with the corresponding share-weighted index at the province level.[37] Most correlation coefficients are positive and statistically different than zero, but

[35]Similar measures have been used by Redding and Venables (2004), among others. Their measures are CES aggregators $[\sum_i s_i t_{ij}^{1-\sigma}]^{1/(1-\sigma)}$ for inward costs and $[\sum_j b_j t_{ij}^{1-\sigma}]^{1/(1-\sigma)}$ for outward costs. These differ inessentially from Laspeyres indexes.

[36]The outward index is calculated as $\sum_k T_i^k Y_i^k / \sum_k Y_i^k$ where $T_i^k \equiv \sum_j t_{ij}^k X_{ij}^k / Y_i^k$. The inward counterpart calculation is $\sum_k T_j^k E_j^k / \sum_k E_j^k$ where $T_j^k \equiv \sum_i t_{ij}^k X_{ij}^k / E_j^k$.

[37]For consistency, we report the correlations between the MR transform to the power of $(1-\sigma)$ and the

significantly lower than one. YT and PE are the two provinces with insignificant coefficients. Interestingly, IMR is negatively correlated with its counterpart share-weighted index. Columns 5-6 of Table 7 illustrate. Combined with the weak correlation in the OMR case, this suggests that the share-weighted Laspeyres indexes are not informative about buyers' or sellers' incidence.

Next, we investigate the correlation between the multilateral resistance indexes and the corresponding fixed effect gravity estimates. Results for the outward indexes at the province level are presented in columns 7-8 of Table 6. On average, we find a negative and significant correlation between the OMR's power transform $\Pi_i^{1-\sigma}$ and the outward fixed effect estimates.[38] The correlation is not significant for NT, ON, and YT. It is positive and significant for MB only. The relationships between the IMR's and their corresponding fixed effect estimates are stronger. Correlations, reported in 7-8 of Table 7, are mostly negative and very significant. PE is the only province for which we find a positive and significant correlation between IMR and the gravity estimate of the destination fixed effect. Overall, our results reveal a positive and significant, but far from perfect, correlation between the multilateral resistances and their gravity estimates. This suggests that the gravity fixed effect estimates are an imperfect proxy for the MR indexes. The explanation is that the directional fixed effects account for other country-specific characteristics in addition to the MRs.

Constructed Home Bias captures the combined implications of gravity for home bias. The calculation is based on

$$\left(\frac{t_{ii}^k}{\Pi_i^k P_i^k}\right)^{1-\sigma_k},$$

where t_{ii}^k is the estimated from gravity internal trade cost for province or territory i and commodity k relative to the smallest internal provincial trade cost for commodity k across all provinces and territories.[39] Recall that CHB is interpreted as the ratio of predicted

corresponding power transform of the share-weighted Laspeyres indexes.

[38]Since the fixed effects are used as proxies for $\Pi_i^{\sigma-1}$, we expect a negative correlation with $\Pi_i^{1-\sigma}$.

[39]In most cases, the smallest internal provincial cost is the one in Prince Edward Island due to its small size and, therefore, small internal distance.

trade flows to predicted frictionless trade flows.[40] Note that the normalization used to solve system (4)-(6) does not play any role: CHB is independent of the normalization. Notice also that CHB is independent of the elasticity of substitution because it is constructed using the $1-\sigma_k$ power transforms of t's, Π's and P's. The reported CHB values are calculated for each province and territory as the weighted average of commodity level values of $(t^k_{ii}/\Pi^k_i P^k_i)^{1-\sigma}$.

Table 8 displays the variation and the evolution of CHB across the provinces and territories in our sample. Three properties stand out. First, the values are all big, there is massive home bias in trade flows. Second, CHB is larger for more remote and the smaller regions and lower for more developed regions. In each year, the Yukon Territories (YT), Prince Edward Island (PE), and Newfoundland and Labrador (NL) are the three regions with highest CHB, while Ontario (ON) and Quebec (QC) are the two provinces with lowest CHB. Third, most strikingly, home bias falls significantly over time. Table 8 shows that, on average, each Canadian province or territory experiences a relatively stable decrease in CHB over time. The last row of Table 8 reports the percentage change in CHB. There is a very economically significant decrease in CHB for each province and territory. Ontario (ON) and Quebec (QC) are the two provinces that experience the smallest CHB decrease. The change for the rest of the regions is relatively homogeneous. It varies between 34% for the Yukon Territories and 50% for the Northwest Territories.

The dramatic fall in CHB's reflects 'globalization', a fall in external (both international and inter-provincial) trade costs relative to internal trade costs. The fall is not due to the usual understanding of globalization because the fitted t_{ij}'s are nearly constant due to almost constant gravity coefficients.[41] Instead, the fall in home bias is due to the general equilibrium effect of changes in production and expenditure shares on multilateral resistance. Neverthe-

[40] A complementary approach captures another aspect of the effect of time on trade flows via the *residual fixed effects*, the difference between directional fixed effects and OMR's. Our results indicate no systematic effect of time on home bias via this channel.

[41] We also note that the residual fixed effects, the difference between the estimated fixed effects and the calculated multilateral resistances, have no evident time series pattern. Thus our CHB fall contains all the power of gravity to explain the fall in home bias.

less, a fall in the *level* of trade costs[42] could be causing the specialization in production over time that drives the fall in constructed home bias.

Finally, the changes in OMR's and IMR's over the period 1992-2003 have sizable effects on real GDP. We construct a crude approximation of real GDP changes as follows. Assume for simplicity that no rent is associated with the trade barriers. Fix all the supply and expenditure shares for a first order approximation to the change in real GDP by province.[43] The real GDP change is given by the sum of the effects of OMR changes on sellers and the effects of IMR changes on buyers (both final and intermediate). We use changes in the undeflated (current Alberta prices) MR's, but the measure we construct is invariant to the normalization, as we explain below.

The gross effect of OMR changes on sellers from a particular province or territory is given by a weighted average of the decreases in OMR's in each product, where the weights are the average shares of shipments of each product in the total provincial shipments for the period 1992-2003.[44] Formally:

$$\sum_k \widehat{OMR}_{i,k} WS^w_{i,k},$$

where $\widehat{OMR}_{i,k}$ is the percentage decrease (as a positive number) in the outward multilateral resistances that each province i faces when shipping product k to the rest of the world, including all other Canadian provinces and territories, and $WS^w_{i,k}$ is the average product k's shipment share in province i's shipments to the rest of the world for the period 1992-2003. The gross effects on sellers and their bootstrapped standard errors are reported in column 2 of Table 9. The effects are positive for most provinces and territories. The sellers in Ontario and Quebec are the ones to experience the largest and significant gains. The effects on the sellers in the more remote regions, even though negative, are not significant. The negative

[42]The level of trade cost is not identifiable from gravity because size-adjusted trade is invariant to equiproportionate reductions in bilateral trade costs.

[43]A full general equilibrium treatment requires specifying the upper level supply and expenditure allocation processes, while treating rents requires marginal dead weight loss calculations.

[44]We also experiment by using the 1992 shares of shipments of each product in the total provincial shipments and the results are very similar to the ones discussed here.

values for those regions can be explained with intensified competition from the developed regions and from the rest of the world.

The gross effect of IMR changes on buyers (including intermediate input buyers) is given by:

$$\sum_k \widehat{IMR}_{i,k} WD_{i,k},$$

where $\widehat{IMR}_{i,k}$ is the percentage decrease in the trade costs faced by buyers in province i from 1992-2003, and $WD_{i,k}$ is product k's expenditure share in province i's total expenditure. Gross effects on provincial buyers, reported in column 3 of Table 9, vary from statistically insignificant to moderate losses. The explanation is that, as discussed earlier, the IMR's can be thought of as consumer price indexes. Both the levels and the changes in the incidence of trade costs fall much more on sellers than on buyers.

The net real GDP effect of the changing incidence of trade costs is the sum of columns 2 and 3 from Table 9, given in column 4. A fall in outward MR permits an accompanying rise in 'factory gate' prices and hence returns to primary factors. A rise in inward MR lowers returns to primary factors due to intermediate input cost increases. The net effect on value added is given by the sum of the two. This measure is isomorphic to change in Total Factor Productivity. Real GDP changes are obtained by subtracting the effect of changing buyers' incidence on the consumer price index.[45] The changes imply economically significant TFP effects, averaging over 1/3 of Canada's TFP performance over the same period. In PEI's case, the TFP effect of incidence (9% rise in real GDP from 1992 to 2003) equals the TFP measure over the same period reported by Statistics Canada (2008).[46]

The gain from specialization is stronger for the more developed regions and weaker for the more remote regions. For example, Ontario enjoys a 7% increase in real GDP and Quebec experiences a 6% in real GDP. The corresponding numbers the Yukon Territories and the

[45] The normalization does not affect net welfare because an x% fall in outward MR induces an x% rise in producer factory gate prices while an x% rise in inward MR induces an x% rise in input prices and final goods prices, the net effect canceling out.

[46] Author's calculation based on Table 7, which uses hours worked as the labor input.

Northwest Territories are not significant. Globalization in this sense increases inequality among Canada's provinces and territories.

4.3 Incidence of Domestic Costs

Decompositions of multilateral resistance into domestic and international incidence is important for countries like Canada with sharp regional differences. We focus here on the decomposing the sellers' incidence of trade costs. The much bigger magnitude and intertemporal variation of supply side incidence justifies concentrating on sellers, as does political economy.

We define the uniform domestic trade cost for inter-provincial trade that preserves each province's shipments to Canada as a whole, and thus each province's shipments to the world as a whole. Complementary to this we define the uniform external trade cost that preserves each province's shipments to the outside world.

Consider a generic product shipped from i to j within Canada, temporarily deleting the k superscript for simplicity. The gravity equation gives the fitted trade flow as

$$\widetilde{X}_{ij} = \frac{Y_i E_j}{Y}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \tag{9}$$

where Y is world trade and the t's, P's and Π's are fitted values. The aggregate fitted volume shipped from i to locations within Canada is

$$\bar{Y}_{iC} = \sum_{j \in C} \frac{Y_i E_j}{Y}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}, \tag{10}$$

from summing equation (9). Here the subscript C stands for within Canada.

The theoretical uniform trade cost is calculated with two steps. The first step is a partial equilibrium calculation that takes the MR's as given. The uniform domestic trade cost solves

$$\bar{Y}_{iC} = \sum_{j\in C} E_j(\frac{\Pi_{iC}}{\Pi_i P_j})^{1-\sigma}. \tag{11}$$

This single equation can be solved for Π_{iC} for each province i. Π_{iC} is recognized as the supply side incidence of domestic shipment costs using the same reasoning that identifies outward multilateral resistance on shipments to all locations as supply side incidence to a world market. Solving for Π_{iC}:

$$\Pi_{iC} = \Pi_i \left(\sum_{j\in C}(P_j)^{\sigma-1}\frac{E_j Y_i/Y}{\bar{Y}_{iC}}\right)^{1/(\sigma_k-1)}. \tag{12}$$

The fitted value of internal trade Y_{iC} being larger than the frictionless value, the term multiplying Π_i^k should ordinarily be less than one, satisfying the intuitive property that the supply side incidence on domestic sales is lower than the incidence on all sales. Solidifying intuition, note that the expression on the right-hand-side of equation (12) simplifies to Π_i when aggregation is across all locations in the world instead of just across the regions within Canada.

The same logic as in (12) yields the supply side incidence on external trade:

$$\Pi_{i\bar{C}} = \Pi_i \left(\sum_{j\in \bar{C}}(P_j)^{\sigma-1}\frac{E_j Y_i/Y}{\sum_{j\in\bar{C}}\widetilde{X}_{ij}}\right)^{1/(\sigma-1)}. \tag{13}$$

Here, $\bar{C}$ denotes destinations not in Canada. Ordinarily $\Pi_{i\bar{C}} > \Pi_i$.

The general equilibrium solution is to solve for the Π_{iC}'s and the Π_i's and P_j's simultaneously from the system formed by (11) combined with (5)-(6) and the normalization for all $i \in C$.[47] DTC's are independent of the normalization because buyers' and sellers' incidence

[47]Sensitivity checks show that the uniform internal Canadian costs calculated in the general equilibrium system are very close to the the corresponding costs obtained when we first solve for the MR's using system (4)-(6), and then substitute those MR's directly into to (11).

appear as a product in (11).

In the setup above, t_{ii} is part of the $t_{ij}, i \in C$. An alternative concept of domestic trade costs aggregates *interprovincial* trade costs. Then in the preceding steps, Π_{iC} is defined as above for all $i \neq j; i, j \in C$. while all other t_{ij}'s remain unchanged: those inside Canadian provinces and those for all trade that is not interprovincial. This interprovincial DTC is the one we use.

Summary results for the DTC's for each province and territory across all commodities and for each year in our sample are presented in Table 10.[48] On average, the provincial DTC's are a little less than half than the corresponding multilateral resistances.[49] The DTC's are very stable over time and uniform across provinces and territories. Since outward multilateral resistance falls significantly, that means that the second term of (12) rises, due to fitted shipments within Canada $\bar{Y}_{iC}$ falling toward their frictionless level.

The method of decomposition in this section is very general and has many applications. Our methodology can be adapted to decompose incidence of different trade cost component, for example the portion of trade cost incidence due to distance vs. other causes, and so forth. The method allows for trade cost aggregation for any specific region of interest.

4.4 Assessing the AIT

The Agreement on Internal Trade (AIT) is a voluntary agreement by provinces to reduce barriers to trade within Canada that came into effect on July 1, 1995. To capture the AIT effect econometrically we introduce a dummy variable, which takes a value of one for the years after 1995 and a value of zero for the years before 1996, and we estimate equation (8) using time-varying directional fixed effects in a panel setting.[50] To account for the potential endogeneity of the AIT, we use the panel data econometric techniques applied to investigate

[48] In Appendix C, we discuss our findings about DTC's at the commodity level. Estimation results are available upon request.

[49] We perform mean comparison tests to find that, without exception, each province faces significantly lower uniform trade costs to its Canadian partners as compared to the world as a whole.

[50] Moving the cutoff date for the "AIT" variable forward and back in time to an earlier or a later year did not have any effect on the significance of our estimation coefficients.

the effects of free trade agreements on bilateral tradel flows in Baier and Bergstrand (2007). More specifically, in addition to the directional fixed effects we also include country-pair fixed effects and estimate a dynamic version of equation (8). We find no consistent evidence that the AIT reduced Canada's internal trade costs.[51] The estimates of the coefficient on the AIT dummy variable are small, they vary in sign, and are insignificant for almost all commodity categories. The only two exceptions are Fuels and Machinery, for which the AIT coefficient is actually negative and significant, and Transportation Products, for which the coefficient is negative and significant. Overall, our econometric work finds no consistent evidence that the AIT can be picked out from other forces that affect Canada's trade.

Possible effects of the *intent* of the AIT are revealed by counterfactual experiment. Assume that the first year after the introduction of the AIT (1996), there is a uniform decrease in all interprovincial bilateral trade costs. We re-calculate the multilateral resistance indexes using the new bilateral trade costs and use the changes in trade costs to estimate the real GDP effects in each province and territory.[52] Our measures are impact effects at constant supply and expenditure shares, with constancy imposed for simplicity in the absence of a full general equilibrium model of demand and supply across sectors. We experiment with a uniform decrease of 5%, 10%, 20%, and 30%, respectively.

Table 11 presents our findings. Overall, we find that any uniform decrease in interprovincial trade costs lowers both OMR's and IMR's. More importantly, the responses of IMR's and OMR's vary significantly across industries for a single province and across provinces for a single product line. The effect is much stronger for the outward multilateral resistances, corresponding to the incidence of trade costs being more on the supply side. The real GDP effects are calculated using the changes in OMR's and IMR's and the methodology introduced in Section 4.2. The pass-through of the trade cost changes into welfare effects is always less than one. The effects are stronger and more significant the larger the decrease in

[51]Estimation results are available upon request.

[52]Our DTC methodology could be used to decompose the AIT welfare effects into those due to the domestic trade cost reduction and those due to the full incidence changes. Moreover, the same techniques could be applied to trace the welfare effects on producers and consumers by commodity category.

trade costs. Our simulations indicate that a 5% or a 10% uniform decrease in interprovincial trade costs is not sufficient to generate significant welfare effects. Therefore, in what follows, we discuss the effects of the 30% decrease trade costs, which are presented in the last three columns of Table 11.

Gross effects on provincial buyers are reported in column (10) of Table 11. Buyers in most provinces gain from a reduction in interprovincial trade costs. The three exceptions are British Columbia, Ontario, and Quebec. The explanations is that when domestic Canadian trade costs are decreased, firms from these industrial regions find it more profitable to 'export' to the rest of Canada, which naturally increases internal prices in the three provinces, hurting buyers. The gross gains to sellers by province of origin are reported in column (11) of Table 11. They are positive for all provinces and territories and slightly stronger for the more remote regions. The gross effect on sellers is systematically higher than on buyers.

The net real GDP effect is the sum of columns (10) and (11) in Table 11, given in column (12). The gain is larger for the more remote and the smaller regions and lower for the more developed regions. For example, the Yukon Territories, Newfoundland and Labrador, and Prince Edward Island all enjoy an increase of about 25% in real GDP, while the corresponding numbers for Ontario and Quebec are only 6% and 15%, respectively. Thus, a uniform decrease in interprovincial trade costs would promote equality among the Canadian provinces and territories. The fall in inequality is opposite to the result of globalization over 1992-2003. It is driven by a fall in bilateral trade costs rather than the effect of specialization.

Our simulations point to the theoretical possibility of 'immiserizing globalization'. A uniform fall in domestic Canadian trade costs induces 'core' regions to trade more intensively with the rest of Canada, raising prices to provincial buyers in core regions. Ontario's numbers illustrate. The 6% loss to buyers happens to be more than offset by the 13% gain to sellers, but the net positive effect is not guaranteed.

The non-neutral effects may imply that efficient trade cost policy should be tailored with particular industries and particular provinces in mind. The conditional general equilibrium techniques used for the simulation of the effects of a hypothetical AIT are readily applicable to different policy issues and exogenous shocks. For example, similar counterfactual experiments could trace the effects on trade costs and welfare of the opening in 1997 of the Confederation Bridge linking Prince Edward Island to the continental part of Canada.

5 Conclusion

This paper pioneers the application of multilateral resistance theory to economic geography. Constructed home bias falls over time in Canada, due to a fall in sellers' incidence of trade costs. The fall in sellers' incidence is driven by trade-cost-bill reducing reallocation of supply and demand, a previously unappreciated force of globalization. Real GDP effects on Canada's provinces are big, in some cases comparable to TFP performance in the same period.

We decompose sellers' incidence to break out inter-provincial sellers' incidence. Inter-provincial incidence is constant over time; globalization is acting on Canada's external trade. The AIT was an attempt to promote internal trade but we find no econometric evidence it affected Canadian inter-provincial trade. Reflecting AIT's intent, we simulated a uniform fall in trade costs on within-Canada trade. It has unequal effects that promote equality between the Canadian provinces and territories. The simulation indicates that general equilibrium effects can amplify or offset the direct effect of a fall in internal trade costs.

Our results point to questions for future research. The cross sectional variation of multilateral resistance over provinces and commodities is large, with large implications for resource and expenditure allocation that can be checked. The decline in Constructed Home Bias despite constant gravity coefficients is striking. Does it extend beyond Canadian data? Does sellers' incidence tend to fall with market share?

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Table 1: Summary Statistics

Commodity Description	1992					2003					Sigma
	Exports		Output			Exports		Output			
	Mean	Std. D.	Mean	Std. D.	N	Mean	Std. D.	Mean	Std. D.	N	
Agriculture	924.8	25012.0	344890.3	3.2e+06	1312	1889.7	55778.3	299801.2	2.7e+06	1345	5.85
Chemical Products	1934.7	60417.9	142857.1	1.2e+06	1314	6911.8	234133.9	146507.8	1.0e+06	1363	7.55
Electrical Products	2266.4	68934.4	155422.6	1.3e+06	1304	7330.7	247383.4	122179.2	886594.1	1349	5.83
Fabricated Metal Products	718.2	20692.8	78253.4	633893.0	1393	2232.0	70818.6	80428.8	541640.9	1369	5.56
Food	1334.0	40744.8	201666.8	1.7e+06	1331	3686.0	114604.0	134317.3	831284.8	1370	7.43
Fuels	1122.4	32203.4	82444.6	634253.9	1273	5957.8	187112.2	217625.3	1.7e+06	1270	12.00
Furniture	178.2	4826.4	21194.4	166831.7	1393	707.4	21621.8	24359.0	148234.4	1344	4.00
Hosiery and Clothing Products	689.8	22627.7	31526.8	254953.5	1306	1387.4	46710.9	23114.4	167448.9	1312	4.35
Leather, Rubber, and Plastic Products	661.2	20173.3	72517.1	641260.9	1319	2209.4	72165.1	63276.7	471765.4	1358	5.26
Lumber and Wood Products	417.4	10528.2	33750.0	229800.7	1332	895.6	23173.5	34929.1	152712.6	1368	6.15
Machinery	2854.8	98489.6	146526.9	1.3e+06	1393	7064.1	244002.3	111004.6	874188.1	1359	6.44
Mineral Products	312.6	9013.4	57808.2	517277.9	1304	919.1	29317.5	46056.3	350731.9	1344	7.19
Miscellaneous Products	1010.1	34793.6	40344.5	281119.3	1393	2184.0	74524.2	42377.0	267196.7	1359	5.75
Petroleum and Coal Products	196.9	2252.9	69054.3	573025.9	1295	527.2	6884.6	56700.2	307491.9	1338	12.00
Primary Metal Products	1216.5	36132.9	99789.8	839085.4	1299	3657.1	118813.4	82229.0	582463.8	1332	6.99
Printing and Publishing Products	200.7	3886.2	56888.6	418746.3	1298	440.7	10534.8	41252.0	260902.5	1364	4.16
Textile Products	572.0	18655.4	55536.8	501958.0	1321	1447.9	49995.8	35109.5	288179.0	1345	5.81
Transportation Products	2436.4	64825.7	179293.3	1.2e+06	1393	6568.7	184434.3	218715.2	1.4e+06	1353	4.09
Wood Pulp and Paper Products	682.7	17201.8	51090.8	352152.5	1318	1560.8	45261.3	44616.1	209959.5	1354	10.08

Notes: This table reports descriptive statistics for the key estimation variables for the first and the last years in our sample. Summary statistics for the rest of the variables are available upon request. Bilateral export values and output are measured in 100,0000 Canadian dollars. Elasticity values are aggregated, as described in the data Appendix, from the 3-digit HS Canadian indexes in Broda et al (2006).

Table 2: PPML Gravity Estimations by Product, 1998.

	Agric	Fuels	Food	Lthr_Rbbr_Plst	Textile	Apparel	Wood	Furnit	Paper	Print_Publ
LNDIST	-1.091	-1.252	-0.857	-1.291	-0.705	-0.380	-1.264	-1.406	-1.421	-0.972
	(0.206)**	(0.305)**	(0.107)**	(0.117)**	(0.138)**	(0.130)**	(0.106)**	(0.126)**	(0.186)**	(0.167)**
CB_P_P	1.105	-1.267	0.280	-0.257	-0.026	0.409	-0.218	-0.527	-0.372	0.265
	(0.331)**	(0.840)	(0.179)	(0.228)	(0.229)	(0.209)*	(0.270)	(0.341)	(0.360)	(0.319)
CB_P_S	1.393	0.203	0.876	1.241	1.913	2.463	0.547	0.969	0.729	1.387
	(0.372)**	(0.595)	(0.303)**	(0.223)**	(0.326)**	(0.382)**	(0.269)*	(0.262)**	(0.395)+	(0.382)**
BRDR_CA	-1.124	-2.300	-2.017	-1.951	-3.563	-3.554	-2.635	-2.175	-1.389	-3.605
	(0.418)**	(0.597)**	(0.264)**	(0.274)**	(0.424)**	(0.363)**	(0.481)**	(0.451)**	(0.515)**	(0.478)**
SMCTRY	2.328	-1.082	0.960	-0.414	0.763	1.321	0.357	-0.345	0.042	1.991
	(0.422)**	(0.990)	(0.324)**	(0.415)	(0.345)*	(0.370)**	(0.249)	(0.361)	(0.559)	(0.439)**
CONST	20.282	21.736	19.609	22.398	17.088	14.348	20.140	21.809	21.731	18.540
	(1.489)**	(2.514)**	(0.849)**	(0.957)**	(1.012)**	(1.049)**	(0.813)**	(1.022)**	(1.457)**	(1.290)**
N	1350	1279	1367	1357	1336	1345	1366	1341	1354	1358
LL	-8.2e+07	-1.6e+08	-7.6e+07	-4.4e+07	-2.5e+07	-1.6e+07	-2.3e+07	-1.5e+07	-3.4e+07	-1.6e+07

	Prim_Metal	Fabr_Metal	Machinery	Transport	Electric	Minerals	Petr_Coal	Chemicals	Miscell
DIST	-1.001	-1.132	-1.043	-1.067	-0.670	-1.268	-1.791	-1.135	-0.966
	(0.161)**	(0.109)**	(0.151)**	(0.138)**	(0.163)**	(0.114)**	(0.221)**	(0.157)**	(0.112)**
C_P_P	0.154	0.332	0.129	0.249	0.120	0.427	0.091	0.782	0.752
	(0.296)	(0.259)	(0.304)	(0.285)	(0.342)	(0.266)	(0.299)	(0.364)*	(0.268)**
C_P_S	1.160	1.754	1.195	2.025	1.808	1.631	1.665	1.194	1.561
	(0.399)**	(0.251)**	(0.328)**	(0.397)**	(0.383)**	(0.233)**	(0.389)**	(0.294)**	(0.285)**
BRDR_CA	-1.869	-2.375	-1.570	-2.046	-1.504	-2.204	-1.565	-1.854	-1.888
	(0.408)**	(0.402)**	(0.411)**	(0.350)**	(0.337)**	(0.497)**	(0.618)*	(0.405)**	(0.402)**
SMCTRY	0.721	0.673	1.206	0.732	1.820	1.587	-0.201	0.781	1.930
	(0.520)	(0.302)*	(0.507)*	(0.440)+	(0.648)**	(0.296)**	(0.460)	(0.431)+	(0.309)**
CONST	20.255	21.037	20.358	21.091	17.519	20.492	24.578	20.940	17.814
	(1.304)**	(0.868)**	(1.225)**	(1.111)**	(1.425)**	(0.826)**	(1.566)**	(1.250)**	(0.850)**
N	1351	1367	1357	1359	1346	1349	1348	1359	1355
LL	-9.7e+07	-4.2e+07	-1.1e+08	-2.1e+08	-1.8e+08	-1.9e+07	-4.6e+07	-1.1e+08	-1.7e+07

Notes: + $p < 0.10$, * $p < .05$, ** $p < .01$. Huber-Eicker-White robust standard errors (clustered by country pair) are reported in parentheses. Dependent variable is always $\frac{X_{ij}^k}{y_i^k}$. Each estimation is performed with directional (source and destination) fixed effects.

Table 3: Evolution of Weighted IMR's by Province

Year	AB	BC	MB	NB	NL	NS	NT	ON	PE	QC	SK	YT
1992	1.00	0.93	0.94	1.04	1.10	1.03	1.16	0.72	1.04	0.81	1.04	1.16
	(.00)	(.02)	(.03)	(.02)	(.02)	(.02)	(.01)	(.02)	(.05)	(.02)	(.03)	(.02)
1993	1.00	0.94	0.94	1.02	1.09	1.01	1.14	0.71	1.01	0.80	1.02	1.14
	(.00)	(.02)	(.02)	(.02)	(.01)	(.02)	(.01)	(.01)	(.04)	(.01)	(.03)	(.01)
1994	1.01	0.96	0.96	1.05	1.11	1.04	1.15	0.75	1.05	0.83	1.03	1.15
	(.00)	(.01)	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)	(.03)	(.01)	(.02)	(.01)
1995	1.03	0.96	0.97	1.09	1.14	1.06	1.18	0.77	1.04	0.85	1.04	1.17
	(.00)	(.02)	(.04)	(.03)	(.02)	(.02)	(.02)	(.02)	(.07)	(.02)	(.05)	(.03)
1996	1.05	0.99	1.01	1.11	1.17	1.09	1.22	0.80	1.10	0.88	1.08	1.21
	(.00)	(.01)	(.02)	(.02)	(.01)	(.02)	(.02)	(.02)	(.03)	(.02)	(.03)	(.02)
1997	1.08	1.02	1.03	1.12	1.19	1.11	1.24	0.82	1.14	0.89	1.10	1.25
	(.00)	(.02)	(.02)	(.03)	(.02)	(.02)	(.01)	(.01)	(.04)	(.02)	(.02)	(.01)
1998	1.08	1.02	1.04	1.12	1.19	1.11	1.24	0.82	1.14	0.90	1.10	1.25
	(.00)	(.01)	(.02)	(.01)	(.01)	(.01)	(.01)	(.01)	(.03)	(.01)	(.02)	(.01)
1999	1.10	1.04	1.06	1.15	1.22	1.14	1.27	0.84	1.15	0.92	1.13	1.28
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.02)	(.01)	(.01)	(.01)
2000	1.14	1.08	1.12	1.19	1.26	1.19	1.34	0.89	1.21	0.97	1.18	1.34
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.02)	(.02)	(.01)	(.01)	(.01)
2001	1.16	1.11	1.14	1.22	1.30	1.20	1.35	0.93	1.21	0.99	1.20	1.35
	(.00)	(.01)	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)	(.03)	(.01)	(.02)	(.01)
2002	1.19	1.11	1.13	1.29	1.33	1.23	1.37	0.94	1.16	1.01	1.21	1.37
	(.00)	(.03)	(.05)	(.03)	(.02)	(.03)	(.01)	(.02)	(.09)	(.03)	(.05)	(.02)
2003	1.24	1.17	1.19	1.30	1.38	1.27	1.44	0.99	1.25	1.06	1.27	1.44
	(.00)	(.01)	(.02)	(.02)	(.01)	(.01)	(.01)	(.01)	(.03)	(.01)	(.02)	(.01)

Notes: Each provincial index in this table is calculated as a weighted average across all 19 commodity categories with expenditure shares used as weights. All indexes are CPI deflated as described in the text. Standard errors, reported in parentheses, are obtained from 150 multilateral resistance sets calculated with bootstrapped PPML coefficient estimates as described in the text.

Table 4: Evolution of Weighted OMR's by Province

Year	AB	BC	MB	NB	NL	NS	NT	ON	PE	QC	SK	YT
1992	3.66	4.31	6.73	4.05	5.12	6.17	3.89	8.47	5.61	6.30	4.71	6.21
	(.2)	(.17)	(.45)	(.16)	(.19)	(.25)	(.38)	(.56)	(.56)	(.27)	(.7)	(.25)
1993	3.90	4.24	6.97	3.97	4.83	6.29	4.58	8.64	5.85	6.35	5.13	7.27
	(.19)	(.14)	(.4)	(.13)	(.18)	(.26)	(.51)	(.66)	(.52)	(.3)	(.6)	(.31)
1994	3.54	3.76	6.21	3.62	4.50	5.66	4.09	6.84	5.11	5.39	4.58	6.45
	(.15)	(.11)	(.34)	(.11)	(.2)	(.31)	(.41)	(.64)	(.36)	(.29)	(.47)	(.29)
1995	3.60	3.91	6.66	3.64	4.45	6.19	4.09	8.01	5.39	5.84	4.69	6.50
	(.18)	(.11)	(.37)	(.1)	(.15)	(.27)	(.47)	(.64)	(.39)	(.27)	(.5)	(.25)
1996	3.49	3.80	6.08	3.46	4.11	5.81	4.53	6.99	5.09	5.26	4.28	7.13
	(.19)	(.1)	(.33)	(.08)	(.12)	(.21)	(.56)	(.52)	(.31)	(.22)	(.46)	(.31)
1997	3.10	3.66	5.83	3.44	4.08	5.55	4.09	6.53	4.91	5.04	3.99	6.34
	(.12)	(.08)	(.26)	(.07)	(.12)	(.17)	(.34)	(.39)	(.23)	(.16)	(.34)	(.22)
1998	3.31	3.84	5.95	3.65	3.96	5.82	3.78	6.41	4.80	4.98	4.03	6.06
	(.11)	(.08)	(.26)	(.11)	(.13)	(.2)	(.24)	(.36)	(.24)	(.16)	(.33)	(.22)
1999	3.14	3.81	5.88	3.47	3.93	5.53	3.99	6.47	4.83	4.74	3.89	6.32
	(.1)	(.09)	(.21)	(.07)	(.14)	(.16)	(.31)	(.43)	(.15)	(.15)	(.19)	(.25)
2000	2.95	3.68	5.74	3.21	3.55	5.11	3.25	6.25	4.99	4.57	3.67	5.08
	(.13)	(.09)	(.23)	(.06)	(.14)	(.16)	(.33)	(.54)	(.18)	(.17)	(.2)	(.24)
2001	2.84	3.48	5.62	3.05	3.32	4.76	3.15	5.76	4.62	4.61	3.68	4.39
	(.09)	(.07)	(.23)	(.06)	(.11)	(.13)	(.2)	(.35)	(.17)	(.15)	(.23)	(.18)
2002	2.89	3.45	6.13	3.09	2.64	4.89	2.87	5.51	5.13	4.43	4.09	5.66
	(.08)	(.13)	(.55)	(.11)	(.07)	(.17)	(.17)	(.33)	(.52)	(.15)	(.46)	(.23)
2003	2.55	3.02	4.89	2.57	2.54	4.03	3.01	5.01	4.37	3.78	3.34	4.54
	(.08)	(.06)	(.19)	(.04)	(.1)	(.08)	(.18)	(.26)	(.17)	(.09)	(.16)	(.13)

Notes: Each provincial index in this table is calculated as a weighted average across all 19 commodity categories with output shares used as weights. All indexes are CPI deflated as described in the text. Standard errors, reported in parentheses, are obtained from 150 multilateral resistance sets calculated with bootstrapped PPML coefficient estimates as described in the text.

Table 5: Evolution of Simple Average OMR's by Province

Year	AB	BC	MB	NB	NL	NS	NT	ON	PE	QC	SK	YT
1992	5.63	5.27	6.30	6.76	7.70	6.65	8.59	5.42	6.95	5.59	6.36	7.97
	(.14)	(.15)	(.17)	(.19)	(.25)	(.19)	(.33)	(.17)	(.16)	(.16)	(.17)	(.23)
1993	5.78	5.27	6.42	6.81	7.84	6.75	8.68	5.50	6.98	5.63	6.48	8.09
	(.13)	(.14)	(.18)	(.21)	(.27)	(.2)	(.34)	(.19)	(.18)	(.18)	(.18)	(.24)
1994	5.47	4.93	6.08	6.43	7.36	6.36	8.12	5.17	6.60	5.29	6.11	7.54
	(.15)	(.13)	(.16)	(.2)	(.27)	(.2)	(.35)	(.16)	(.16)	(.16)	(.18)	(.24)
1995	5.84	5.27	6.45	6.87	8.01	6.83	8.90	5.46	6.94	5.59	6.56	8.19
	(.15)	(.15)	(.19)	(.23)	(.3)	(.22)	(.38)	(.18)	(.18)	(.18)	(.2)	(.27)
1996	5.52	5.01	6.05	6.39	7.44	6.41	8.27	5.08	6.55	5.20	6.13	7.65
	(.12)	(.12)	(.15)	(.17)	(.23)	(.17)	(.29)	(.15)	(.14)	(.14)	(.15)	(.22)
1997	5.10	4.63	5.68	5.99	6.96	5.99	7.61	4.74	6.28	4.88	5.72	7.14
	(.09)	(.09)	(.13)	(.14)	(.19)	(.13)	(.27)	(.12)	(.12)	(.12)	(.12)	(.17)
1998	5.22	4.68	5.82	6.12	7.21	6.18	8.05	4.89	6.31	4.97	5.98	7.23
	(.1)	(.08)	(.13)	(.15)	(.2)	(.14)	(.3)	(.13)	(.12)	(.12)	(.13)	(.16)
1999	5.03	4.60	5.50	5.82	6.80	5.88	7.61	4.61	6.02	4.72	5.71	6.82
	(.1)	(.09)	(.12)	(.14)	(.19)	(.13)	(.3)	(.12)	(.11)	(.11)	(.13)	(.16)
2000	4.98	4.46	5.51	5.84	6.89	5.89	7.99	4.56	5.97	4.63	5.77	6.86
	(.11)	(.1)	(.14)	(.15)	(.2)	(.14)	(.32)	(.13)	(.12)	(.12)	(.14)	(.18)
2001	4.90	4.42	5.43	5.76	6.87	5.80	7.82	4.59	5.81	4.63	5.63	6.62
	(.1)	(.09)	(.13)	(.15)	(.2)	(.14)	(.29)	(.13)	(.11)	(.12)	(.13)	(.16)
2002	4.77	4.34	5.33	5.52	6.65	5.61	7.50	4.39	5.61	4.43	5.50	6.43
	(.09)	(.12)	(.15)	(.16)	(.21)	(.16)	(.25)	(.13)	(.14)	(.12)	(.14)	(.19)
2003	4.17	3.82	4.61	4.79	5.74	4.90	6.43	3.82	4.93	3.85	4.80	5.66
	(.06)	(.06)	(.08)	(.09)	(.12)	(.09)	(.17)	(.08)	(.08)	(.08)	(.08)	(.11)

Notes: Each of the provincial indexes in this table is obtained as a simple average across all commodity categories. All indexes are CPI deflated as described in the text. Standard errors, reported in parentheses, are obtained from 150 multilateral resistance sets calculated with bootstrapped PPML coefficient estimates as described in the text.

Table 6: OMR Correlations by Province

	Output Shares		Net Import Shares		Gravity Costs		Fixed Effects	
Province	Corr	P-val	Corr	P-val	Corr	P-val	Corr	P-val
AB	0.258	0.000	0.284	0.000	0.179	0.007	-	-
BC	0.417	0.000	0.369	0.000	0.259	0.000	-0.093	0.160
MB	0.407	0.000	0.464	0.000	0.134	0.043	0.156	0.018
NB	0.561	0.000	0.533	0.000	0.451	0.000	-0.262	0.000
NL	0.324	0.000	0.288	0.000	0.235	0.000	-0.206	0.002
NS	0.333	0.000	0.315	0.000	0.371	0.000	-0.295	0.000
NT	0.031	0.643	0.041	0.541	0.512	0.000	0.072	0.278
ON	0.226	0.001	0.359	0.000	0.335	0.000	-0.039	0.556
PE	-0.005	0.940	-0.043	0.519	-0.009	0.890	-0.555	0.000
QC	0.210	0.001	0.143	0.031	0.467	0.000	-0.136	0.040
SK	0.247	0.000	0.257	0.000	0.245	0.000	-0.361	0.000
YT	0.013	0.847	0.201	0.002	0.051	0.454	-0.016	0.806
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Notes: This table reports correlations of $\Pi_i^{1-\sigma}$ with output shares, net import shares, Laspeyres index trade costs, and exporter fixed effects. Correlations between the OMR's transform and output and net import shares are partial correlations. Gravity costs are bilateral trade costs implied from the PPML estimations, aggregated per each province and commodity with shipments used as weights. Exporter fixed effects are the PPML coefficient estimates of the source fixed effects. The sample size is always 228 (19*12).

Table 7: IMR Correlations by Province

	Output Shares		Net Import Shares		Gravity Costs		Fixed Effects	
Province	Corr	P-val	Corr	P-val	Corr	P-val	Corr	P-val
BC	0.073	0.273	-0.097	0.144	-0.168	0.011	-0.092	0.168
MB	0.137	0.039	-0.151	0.023	-0.084	0.207	-0.196	0.003
NB	-0.352	0.000	-0.361	0.000	-0.390	0.000	-0.541	0.000
NL	0.023	0.724	0.220	0.001	-0.325	0.000	-0.546	0.000
NS	-0.083	0.214	-0.187	0.005	-0.278	0.000	-0.565	0.000
NT	-0.256	0.000	-0.047	0.476	-0.142	0.032	-0.102	0.123
ON	0.405	0.000	-0.132	0.047	-0.157	0.017	-0.278	0.000
PE	0.021	0.750	0.049	0.465	-0.250	0.000	0.234	0.000
QC	0.124	0.063	0.012	0.859	-0.188	0.004	-0.280	0.000
SK	-0.029	0.665	-0.044	0.513	-0.119	0.074	-0.553	0.000
YT	-0.141	0.034	0.026	0.696	-0.118	0.075	-0.015	0.817
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Notes: This table reports correlations of $P_j^{1-\sigma}$ with output shares, net import shares, Laspeyres index trade costs, and exporter fixed effects. Correlations between the IMR's transform and output and net import shares are partial correlations. Gravity costs are bilateral trade costs implied from the PPML estimations, aggregated per each province and commodity with expenditures used as weights. Importer fixed effects are the PPML coefficient estimates of the destination fixed effects. The sample size is always 228 (19*12).

Table 8: Evolution of Constructed Home Bias by Province

Year	AB	BC	MB	NB	NL	NS	NT	ON	PE	QC	SK	YT
1992	449	458	1258	1279	1959	1429	813	125	7120	256	1005	15146
	(246)	(84)	(288)	(1559)	(1349)	(1236)	(768)	(76)	(986)	(168)	(524)	(2680)
1993	527	492	1323	1755	2012	1787	748	151	6866	329	1078	14491
	(1008)	(223)	(1023)	(4898)	(3283)	(3242)	(566)	(315)	(757)	(567)	(2102)	(3585)
1994	422	405	1077	1268	1781	1364	761	121	5487	241	869	12866
	(954)	(304)	(1132)	(3126)	(1891)	(1909)	(1337)	(294)	(496)	(304)	(2194)	(2768)
1995	462	453	1253	1289	2013	1509	801	131	6376	257	940	17686
	(398)	(156)	(423)	(1857)	(2059)	(1227)	(701)	(164)	(488)	(175)	(707)	(2280)
1996	459	469	1198	1705	2054	1697	743	151	6202	302	973	14358
	(1564)	(312)	(1389)	(7349)	(8836)	(4343)	(802)	(419)	(476)	(543)	(2987)	(3281)
1997	376	397	1033	1005	1710	1283	822	109	6132	208	788	14598
	(231)	(81)	(121)	(1286)	(1185)	(596)	(363)	(101)	(497)	(161)	(313)	(1878)
1998	359	382	992	986	1631	1233	752	101	5566	199	759	13774
	(90)	(36)	(107)	(552)	(569)	(266)	(321)	(44)	(392)	(72)	(189)	(1942)
1999	371	379	1030	1007	1623	1237	766	105	5273	209	792	13296
	(130)	(44)	(107)	(569)	(758)	(276)	(364)	(58)	(294)	(98)	(182)	(1461)
2000	421	385	1078	1117	1739	1309	819	136	5593	263	861	15481
	(677)	(145)	(586)	(1932)	(3527)	(782)	(444)	(383)	(302)	(465)	(1108)	(1898)
2001	324	350	960	906	1436	1136	631	111	4970	215	725	13262
	(109)	(49)	(88)	(393)	(481)	(196)	(184)	(52)	(360)	(73)	(131)	(1874)
2002	335	336	982	831	1295	1098	555	100	5093	199	728	14372
	(43)	(31)	(94)	(183)	(239)	(132)	(175)	(19)	(261)	(27)	(101)	(1615)
2003	277	279	765	798	1110	884	404	105	3637	209	637	10072
	(137)	(64)	(176)	(480)	(610)	(204)	(184)	(78)	(212)	(117)	(311)	(1335)
$\%\Delta 92-03$	-38	-39	-39	-38	-43	-38	-50	-16	-49	-18	-37	-34
	(30)	(16)	(16)	(38)	(29)	(20)	(24)	(61)	(6)	(48)	(31)	(11)

Notes: Calculation of the CHB indexes at commodity level is based on $\left(\frac{t_{ii}^k}{\Pi_i^k P_i^k}\right)^{1-\sigma_k}$, where t_{ii}^k is the estimated from gravity internal trade cost for province or territory i and commodity k relative to the smallest internal provincial trade cost for commodity k across all provinces and territories. Provincial indexes are weighted averages across all 19 commodities with expenditures used as weights. Values at the bottom of the table represent the percentage change in CHB over the sample period. Standard errors, reported in parentheses, are obtained from 150 sets of multilateral resistances and t_{ii}^k's calculated with bootstrapped PPML coefficient estimates as described in the text.

Table 9: Trade Costs and Real GDP Effects by Province 1992-2003

Province	Sellers	Buyers	Real GDP
Alberta	0.01	0.00	0.01
	(.06)	(.00)	(.06)
British Columbia	0.09	-0.02	0.07
	(.04)	(.03)	(.03)
Manitoba	0.05	-0.01	0.04
	(.08)	(.04)	(.05)
New Brunswick	0.08	0.00	0.08
	(.05)	(.02)	(.04)
Newfoundland and Labrador	0.01	0.00	0.01
	(.06)	(.01)	(.06)
Northwest Territories	-0.09	-0.01	-0.10
	(.16)	(.01)	(.16)
Nova Scotia	0.06	-0.01	0.05
	(.04)	(.02)	(.03)
Ontario	0.18	-0.10	0.07
	(.07)	(.05)	(.04)
Prince Edward Island	0.06	0.03	0.09
	(.09)	(.05)	(.06)
Quebec	0.13	-0.06	0.06
	(.05)	(.03)	(.03)
Saskatchewan	-0.03	0.02	-0.01
	(.11)	(.04)	(.08)
Yukon	-0.02	-0.01	-0.03
	(.09)	(.02)	(.09)
	(1)	(2)	(3)

Notes: Sellers' effect is calculated as the proportional change in outward resistances for the period 1992-2003 weighted by commodity shipment shares: $\sum_k \widehat{OMR}_{i,k} WS^w_{i,k}$. Buyers' effect is calculated as the proportional change in inward resistances weighted by expenditure shares: $\sum_k \widehat{IMR}_{i,k} WD_{i,k}$. The real GDP effect is the sum of the values in columns 2 and 3. Standard errors, reported in parentheses, are obtained from 150 sets of bootstrapped indexes.

Table 10: Evolution of DTC by Province

Year	AB	BC	MB	NB	NL	NS	NT	ON	PE	QC	SK	YT
1992	2.46	2.85	3.29	2.30	2.77	2.93	2.29	5.52	2.94	3.35	2.53	3.18
	(.11)	(.07)	(.11)	(.05)	(.07)	(.08)	(.3)	(.31)	(.12)	(.11)	(.16)	(.14)
1993	2.57	2.88	3.36	2.23	2.65	2.95	2.78	5.44	2.92	3.26	2.66	3.70
	(.12)	(.06)	(.11)	(.05)	(.07)	(.09)	(.35)	(.35)	(.13)	(.12)	(.16)	(.17)
1994	2.46	2.69	3.20	2.13	2.54	2.82	2.50	4.59	2.82	2.82	2.77	3.41
	(.13)	(.07)	(.12)	(.05)	(.09)	(.12)	(.32)	(.37)	(.12)	(.11)	(.17)	(.18)
1995	2.53	2.66	3.40	2.12	2.54	2.93	2.61	5.13	2.85	2.94	2.77	3.50
	(.12)	(.06)	(.11)	(.04)	(.05)	(.08)	(.29)	(.33)	(.09)	(.09)	(.15)	(.13)
1996	2.55	2.68	3.26	2.11	2.45	2.86	2.74	4.86	2.92	2.82	2.74	3.90
	(.12)	(.05)	(.12)	(.04)	(.05)	(.06)	(.35)	(.28)	(.1)	(.07)	(.18)	(.2)
1997	2.26	2.72	3.08	2.18	2.61	2.86	2.21	4.74	2.84	2.73	2.48	3.11
	(.12)	(.05)	(.11)	(.04)	(.05)	(.06)	(.22)	(.23)	(.09)	(.06)	(.17)	(.11)
1998	2.40	2.91	3.14	2.30	2.57	2.93	2.19	4.70	2.78	2.79	2.55	2.84
	(.08)	(.05)	(.1)	(.04)	(.06)	(.07)	(.16)	(.22)	(.08)	(.06)	(.13)	(.12)
1999	2.40	2.84	3.19	2.29	2.57	2.94	2.36	4.90	2.88	2.81	2.51	3.08
	(.1)	(.05)	(.08)	(.03)	(.08)	(.05)	(.21)	(.24)	(.06)	(.05)	(.11)	(.12)
2000	2.41	3.04	3.39	2.32	2.58	2.99	2.29	5.56	2.97	2.96	2.52	3.01
	(.14)	(.06)	(.09)	(.04)	(.12)	(.06)	(.32)	(.36)	(.07)	(.06)	(.13)	(.21)
2001	2.33	2.95	3.40	2.26	2.47	2.88	2.14	5.13	2.82	2.93	2.51	2.71
	(.09)	(.05)	(.1)	(.04)	(.07)	(.06)	(.16)	(.27)	(.06)	(.06)	(.11)	(.13)
2002	2.52	2.96	3.72	2.33	2.26	3.06	2.56	5.16	3.06	2.90	2.78	3.51
	(.11)	(.04)	(.11)	(.04)	(.08)	(.06)	(.2)	(.24)	(.11)	(.05)	(.07)	(.11)
2003	2.38	2.75	3.29	2.18	2.25	2.85	2.32	5.05	2.91	2.75	2.51	3.10
	(.1)	(.04)	(.07)	(.04)	(.1)	(.04)	(.17)	(.22)	(.05)	(.04)	(.08)	(.11)

Notes: DTC indexes for each province-commodity pair are obtained simultaneously along with multilateral resistances as described in the text. The numbers in this table are aggregates per province across all commodities with output shares used as weights. Standard errors, reported in parentheses, are obtained from 150 multilateral resistance sets calculated with bootstrapped PPML coefficient estimates as described in the text.

Table 11: Hypothetical AIT Effects by Province

	5% Cost Decrease			10% Cost Decrease			20% Cost Decrease			30% Cost Decrease		
Province	Buyers	Sellers	GDP	Buyers	Sellers	GDP	Buyers	Sellers	GDP	Buyers	Sellers	GDP
Alberta	0.000	0.006	0.006	0.000	0.015	0.015	0.000	0.040	0.040	0.000	0.083	0.083
	(.00)	(.071)	(.071)	(.00)	(.071)	(.071)	(.00)	(.07)	(.07)	(.00)	(.068)	(.068)
British Columbia	-0.002	0.014	0.012	-0.004	0.030	0.027	-0.009	0.074	0.066	-0.016	0.137	0.121
	(.012)	(.025)	(.024)	(.012)	(.025)	(.023)	(.011)	(.024)	(.023)	(.01)	(.023)	(.022)
Manitoba	0.002	0.017	0.018	0.004	0.036	0.040	0.008	0.088	0.097	0.015	0.159	0.173
	(.021)	(.059)	(.045)	(.02)	(.058)	(.043)	(.019)	(.054)	(.041)	(.018)	(.049)	(.039)
New Brunswick	0.011	0.020	0.030	0.024	0.044	0.067	0.056	0.108	0.164	0.093	0.193	0.285
	(.017)	(.021)	(.023)	(.015)	(.02)	(.022)	(.013)	(.019)	(.019)	(.012)	(.017)	(.018)
Newfoundland and Labrador	0.008	0.018	0.026	0.018	0.040	0.058	0.042	0.101	0.143	0.068	0.186	0.254
	(.01)	(.025)	(.025)	(.009)	(.024)	(.025)	(.008)	(.023)	(.023)	(.007)	(.022)	(.022)
Nova Scotia	0.007	0.020	0.027	0.016	0.043	0.059	0.037	0.104	0.142	0.061	0.184	0.246
	(.012)	(.024)	(.018)	(.011)	(.023)	(.017)	(.01)	(.022)	(.017)	(.009)	(.02)	(.017)
Northwest Territories	0.010	0.016	0.026	0.020	0.035	0.055	0.044	0.079	0.122	0.067	0.130	0.197
	(.01)	(.2)	(.202)	(.009)	(.196)	(.198)	(.008)	(.181)	(.183)	(.007)	(.158)	(.159)
Ontario	-0.007	0.014	0.007	-0.015	0.031	0.016	-0.035	0.073	0.038	-0.063	0.129	0.066
	(.025)	(.043)	(.028)	(.024)	(.04)	(.027)	(.022)	(.035)	(.025)	(.019)	(.031)	(.023)
Prince Edward Island	0.011	0.020	0.031	0.022	0.044	0.066	0.046	0.103	0.149	0.068	0.177	0.246
	(.025)	(.06)	(.045)	(.025)	(.058)	(.043)	(.023)	(.053)	(.04)	(.022)	(.048)	(.036)
Quebec	-0.002	0.016	0.014	-0.004	0.035	0.031	-0.006	0.086	0.079	-0.006	0.158	0.152
	(.016)	(.023)	(.013)	(.016)	(.022)	(.012)	(.015)	(.019)	(.012)	(.014)	(.017)	(.013)
Saskatchewan	0.006	0.013	0.018	0.012	0.029	0.041	0.028	0.073	0.101	0.047	0.136	0.183
	(.025)	(.099)	(.089)	(.024)	(.096)	(.087)	(.022)	(.09)	(.082)	(.021)	(.082)	(.076)
Yukon	0.007	0.018	0.025	0.014	0.040	0.054	0.032	0.097	0.128	0.050	0.175	0.225
	(.011)	(.084)	(.086)	(.01)	(.081)	(.083)	(.008)	(.073)	(.075)	(.007)	(.064)	(.065)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

Notes: Columns 2-4 report the effects of a hypothetical 5% uniform interprovincial trade costs decrease in 1996. Effects on buyers are calculated as the change in inward resistances weighted by expenditure shares. Effects on sellers are calculated as the change in outward resistances weighted by output shares. Real GDP effects are calculated as the sum of the effect on buyers and sellers. Columns 5-7, 8-9, and 10-12 repeat for 10%, 20%, and 30% hypothetical decrease, respectively. Standard errors, reported in parentheses, are obtained from 150 sets of bootstrapped indexes.

Appendix A: Data

The primary source of our data are Statistics Canada's tables 386-0001 and 386-0002, which report data on interprovincial trade flows, provincial output, and provincial expenditures at the S-level of commodity aggregation.[53] Data on trade between Canadian provinces and territories and individual states, as well as trade between the provinces and the rest of the world (ROW) are from the Trade Data Online web interface of Industry Canada, which provides access to Canadian and US trade data by product classified according to NAICS.[54] An advantage of this database is that it reports f.o.b. import values.[55] We use the United Nation Statistical Division (UNSD) Commodity Trade (COMTRADE) Data Base to calculate trade flows for ROW, which we define as the difference between total world exports and world exports to Canada and the US. We also use COMTRADE to get total US exports and imports to and from ROW, which we employ to calculate aggregate commodity level US expenditures. The latter data are needed to calculations multilateral resistances due to lack of data on the imports of individual states from the world.[56] COMTRADE's data is in annual US dollars. We use the exchange rates tables of the Federal Reserve Bank of Saint Louis to convert the values to Canadian dollars.[57] Unavailability of state trade data with the rest of the world, as well as interstate imports and exports caps the maximum number of possible observations for each commodity in a given year to 1393 (64*64-51*53). Data inspection shows that about 30% of the non-missing observations are zeroes with the

[53]Data for five categories of commodities including Furniture, Fabricated Metals, Machinery, Transportation Products, and Miscellaneous was missing for the period 1992-1996. We have extrapolated those values using provincial consumer price data from Statistics Canada's Table 326-0021.

[54]Concordance tables between NAICS and the S-level of commodity aggregation, as well as other classification concordances that we have prepared specifically for this project, are available upon request.

[55]In principle, gravity theory calls for valuation of exports at delivered prices. In practice, valuation of exports FOB avoids measurement error arising from poor quality transport cost data. This deviation from theory is without consequence for our results save for possible effects on the multilateral resistance calculations that will be examined below.

[56]Every 5 years, starting at 1993, the US department of transportation publishes a database, the Commodity Flow Survey, which includes interstate trade flows and individual state exports to the world. Unfortunately, data for individual state imports is not available.

[57]Url: http://research.stlouisfed.org/fred2/categories/283 The original source of the data is the Board of Governors of the Federal Reserve System.

majority of those being for the 'remote' regions such as YT, NT, and NL.

Industrial output level data comes from several sources. Provincial output at the S-level of commodity disaggregation is from Statistics Canada's tables 386-0001 and 386-0002. As discussed earlier, we extrapolate output data for five commodities which are missing in the original tables for the period 1992-1996. In addition, in order to complete the provincial output data needed for calculation of multilateral resistances, we interpolate the rest of the missing output values, which account for 11.6% of the observations. The primary source of output data for individual states are the Regional Economic Accounts of the Bureau of Economic Analysis, U.S. Department of Commerce, which provide industry output data at producer prices in current US dollars classified according to SIC for the years before 1998, and according to NAICS for the years after 1998. Data on output for ROW is mainly from United Nations' UNIDO Industrial Statistics database, which reports industry level output data at the 3 and 4-digit level of ISIC Code (Revisions 2 and 3). In addition to UNIDO, we use the World Database of International Trade (BACI) database, constructed by CEPII, as a secondary source of product level output data. Unfortunately, neither UNIDO nor BACI provide data on agricultural and mining output. Therefore, we use two additional data sources: the United Nations Food and Agriculture Organization (FAOSTAT) web page provides data on agricultural output, and the Energy Information Administration provides official energy statistics on the value of fuel production (including oil, natural gas, and coal) for the world.

In order to calculate the multilateral resistance indexes, we need data on elasticities of substitution at the commodity level. These data are obtained from Broda et al (2006) who estimate and report 3-digit HS indexes for 73 countries including Canada. An additional advantage of their elasticity estimates is that they are calculated for the period 1994-2003, which almost coincides with the period of investigation in our study. We obtain the values reported in the last column of Table 1 by aggregating the original Canadian indexes to the S-level of commodity aggregation using the value of imports as weights. In addition, since some of the original indexes seem implausible,[58] we bound the originals in the interval [4,12] before aggregation. As can be seen from Table 1, the elasticity numbers seem plausible with higher indexes for more homogeneous categories such as Fuels, Petroleum and Coal products and Wood, Pulp, and Paper products, and lower values for Furniture and Transportation products.

Provincial expenditures data are from Statistics Canada's tables 386-0001 and 386-0002. As in the case of output, we need a complete set of expenditures in order to calculate multilateral resistances. Therefore, in addition to extrapolating the values for the five commodities for which data was not available for the period 1992-1996, we interpolate the rest of the missing expenditures, which account for 5.2% of the observations. Commodity level expenditures for the US and ROW are calculated as the sum of production and imports less exports of each commodity in a given year.

To calculate bilateral distances we adopt the procedure from Mayer and Zignago (2006), which is based on Head and Mayer (2000). We use the following formula to generate weighted distances: $d_{ij} = \sum_{k \in i} \frac{pop_k}{pop_i} \sum_{l \in j} \frac{pop_l}{pop_j} d_{kl}$ where pop_k is the population of agglomeration k in trading partner i, and pop_l is the population of agglomeration l in trading partner j.[59] To calculate population weights, we take the biggest 20 agglomerations (in terms of population) in each trading partner when the partner is a province, a territory, or a state, and the biggest 50 cities when the partner is ROW.[60] Finally, d_{kl} is the distance between agglomeration k and agglomeration l, measured in kilometers, and calculated by the Great Circle Distance Formula.[61] All data on latitude, longitude, and population is from the World Gazetteer web page. A very appealing argument for the use of this particular approach in constructing

[58] For example the elasticity estimate for the 3-digit HS commodity category 680, which includes Articles of asphalt, Panels,boards,tiles,blocks, Friction materials etc. is 195.95 while the estimate for category 853 including Electrical capacitors, Electrical resistors, Electric sound/visual signalling equipment etc. is 1.07.

[59] Head and Mayer (2000) propose the use of GDP shares rather than population shares as weights in the distance formula. Even though using GDP shares is the better approach, data availability did not allow us to use it in our analysis.

[60] In the few instances, where data was not available for 20 agglomerations within a single trading partner, we take only the cities for which data is available.

[61] Following Mayer and Zignago (2006), we use 32.19 kilometers as inner-city distance.

is that the same procedure is applied when we calculate internal distances and bilateral distances. In addition, it allows us to consistently aggregate distances between any partner and the rest of the world. Finally, we generate the dummy variables that pick up contiguous borders and the presence of provincial or international border, as well as the effects of the implementation of the Agreement on Internal Trade (AIT).

Appendix B: Proofs of Propositions

Take a representative good, so the superscript k is suppressed. Let s_j denote country j's share of world shipments (at delivered prices) of the generic good, while b_i denotes the expenditure share of country i on the generic good.

Proof of Proposition 1 Let $t_{ij} = t > 1, \forall i \neq j$ and $t_{jj} = 1$. (5)-(6) become:

$$\Pi_i^{1-\sigma} = t^{1-\sigma}\bar{h}' + (1 - t^{1-\sigma})b_i/P_i^{1-\sigma}, \tag{14}$$

$$P_j^{1-\sigma} = t^{1-\sigma}\bar{h} + (1 - t^{1-\sigma})s_j/\Pi_j^{1-\sigma}; \tag{15}$$

where $\bar{h} = \sum_i s_i \Pi_i^{\sigma-1}$ and $\bar{h}' = \sum_j P_j^{\sigma-1} b_j$. Multiply both sides of (15) by $\Pi_i^{1-\sigma}$ and multiply both sides of (14) by $P_i^{1-\sigma}$. Use the resulting equation to solve

$$P_i^{1-\sigma} = \Pi_i^{1-\sigma}\frac{\bar{h}}{\bar{h}'} - \frac{(1 - t^{1-\sigma})(b_i - s_i)}{\bar{h}' t^{1-\sigma}}.$$

Then substitute into (14) and extract the positive root[62] of the resulting quadratic equation in the transform $\Pi_i^{1-\sigma}$. Impose the normalization $\bar{h} = \bar{h}' \iff \sum_i P_i^{1-\sigma}/n = \sum_i \Pi_i^{1-\sigma}/n$ where the equivalence is shown by summing the preceding equation. Then:

$$2\Pi_i^{1-\sigma} = \gamma_i + \sqrt{\gamma_i^2 + 4(1 - t^{1-\sigma})s_i} \tag{16}$$

[62]The positive root of the quadratic is necessary for $\Pi > 0$.

where

$$\gamma_i = \bar{h}t^{1-\sigma} + \frac{(1 - t^{1-\sigma})(b_i - s_i)}{\bar{h}t^{1-\sigma}}.$$

At this solution

$$2P_i^{1-\sigma} = \bar{h}t^{1-\sigma} + \sqrt{\gamma_i^2 + 4(1 - t^{1-\sigma})s_i}. \tag{17}$$

Both P_i and Π_i are decreasing in supply share s_i for given net import shares $b_i - s_i$ and decreasing in import shares for given supply shares.‖

The solution for $\bar{h} = \bar{h}'$ is implicit in the next expression, obtained from using the definition of $\bar{h}$ and the preceding solution for Π_i,

$$\bar{h} = 2\sum_i s_i[\bar{h}t^{1-\sigma} + (\gamma_i^2 + 4(1 - t^{1-\sigma})b_i)^{1/2}]^{-1},$$

where γ_i is given as a function of $\bar{h}$ above.

Alternative normalizations that shift $\bar{h}/\bar{h}'$ far from 1 blur the clarity of Proposition 1 by inducing a separate influence of expenditure shares on multilateral resistances. The term under the radical in (16) becomes $\gamma_i^2 + 4(1 - t^{1-\sigma})[s_i - b_i(1 - \bar{h}/\bar{h}')]$, all other terms remaining the same. Propositions 2 and 3 similarly use normalizations chosen to reach clean results.

Proof of Proposition 2 (5)-(6) imply

$$\Pi_i^{1-\sigma} = \frac{1}{n}\sum_j (t_{ij}/P_j)^{1-\sigma} + \sum_j (t_{ij}/P_j)^{1-\sigma}(b_j - 1/n)$$

while

$$P_j^{1-\sigma} = \frac{1}{n}\sum_i (t_{ij}/\Pi_i)^{1-\sigma} + \sum_i (t_{ij}/\Pi_i)^{1-\sigma}(s_i - 1/n).$$

Here, n is the number of regions. Sum the preceding equations, subtract the second from the first and use the normalization $\sum_{i,j}(t_{ij})^{1-\sigma}\Pi_i^{\sigma-1} = \sum_{i,j}(t_{ij})^{1-\sigma}P_j^{\sigma-1}$ to yield

$$\frac{1}{\sum_{i,j} t_{ij}^{1-\sigma}}[\sum_i \Pi_i^{1-\sigma} - \sum_j P_j^{1-\sigma}] = \sum_i w_i'\Pi_i^{\sigma-1}(s_i - 1/n) - \sum_j w_j P_j^{\sigma-1}(b_j - 1/n),$$

where $w_j = \sum_i t_{ij}^{1-\sigma}/\sum_{i,j} t_{ij}^{1-\sigma}$ and $w_i' = \sum_j t_{ij}^{1-\sigma}/\sum_{i,j} t_{ij}^{1-\sigma}$. The left hand side is negative when sellers' incidence exceeds buyers' incidence on average. On the right hand side, with symmetric trade costs, $w_j = w_j', \forall j$, hence the right hand side is equal to $Cov(\Pi^{\sigma-1}, s) - Cov(P^{\sigma-1}, b)$, the weights of the covariances being common. Then $Cov(\Pi^{\sigma-1}, s) - Cov(P^{\sigma-1}, b) < 0 \iff [\sum_i \Pi_i^{1-\sigma} - \sum_j P_j^{1-\sigma}]/n < 0.\|$

The conditions of Proposition 2 imply that average Π exceeds average P.

Proof of Proposition 3 Let $CHB = \{CHB_i\}$. Let $\widehat{p}$ denote the vector of proportional rates of change in $\{P_j^{\sigma-1}\}$ and let $\widehat{\pi}$ denote the vector of proportional rates of change in $\{\Pi_i^{\sigma-1}\}$. Let ι denote the vector of ones.

Differentiating (5)-(6) at constant t's yields

$$-\widehat{p} = W'(\widehat{s} + \widehat{\pi}) \tag{18}$$

$$-\widehat{\pi} = \Omega(\widehat{b} + \widehat{p}); \tag{19}$$

where $\Omega = \{\omega_{ij}\}, W = \{W_{ij}\}, \omega_{ij} = t_{ij}^{1-\sigma} P_j^{\sigma-1} b_j / \sum_j t_{ij}^{1-\sigma} P_j^{\sigma-1} b_j, W_{ij} = t_{ij}^{1-\sigma} \Pi_i^{\sigma-1} s_i / \sum_i t_{ij}^{1-\sigma} \Pi_i^{\sigma-1} s_i$. Note that $\Omega\iota = \iota = W'\iota$. Adding (18) to (19):

$$\widehat{CHB} = \widehat{p} + \widehat{\pi} = -W'\widehat{s} - \Omega\widehat{b} - W'\widehat{\pi} - \Omega\widehat{p}. \tag{20}$$

Average CHB is given by

$$\iota'\widehat{CHB} = -\iota' W'\widehat{s} - \iota'\Omega\widehat{b}$$

using the normalization $\iota' W'\widehat{\pi} + \iota'\Omega\widehat{p} = 0'$. $\iota'\widehat{CHB} < 0 \iff \iota' W'\widehat{s} + \iota'\Omega\widehat{b} > 0.\|$

Because shares sum to 1, $\iota' ds = \iota' db = 0$, the condition $W'\widehat{s} > 0$ implies that changes in supply shares s_i are positively correlated with $\sum_j [(t_{ij}/\Pi_i)^{1-\sigma}/\sum_i (t_{ij}/\Pi_i)^{1-\sigma}]$ and hence negatively correlated with average bilateral buyers' incidences facing each origin i while the condition $\Omega\widehat{b} > 0$ implies that changes in expenditure shares b_j are positively correlated with $\sum_i [(t_{ij}/P_j)^{1-\sigma}/\sum_j (t_{ij}/P_j)^{1-\sigma}]$ and hence negatively correlated with average bilateral sellers' incidences facing each destination j. Proposition 3 means a fall in average CHB implies that the forces driving the equilibrium changes in shares act to reduce the total trade cost bill.

System (18)-(19) yields an interpretation of our finding that Π's fall while P's rise. Normalize the multilateral resistance changes by $\Omega\widehat{p} = 0$. Then

$$\widehat{\pi} = -\Omega\widehat{b},$$

$$\widehat{p} = W'[\Omega\widehat{b} - \widehat{s}].$$

Outward multilateral resistances fall if $\Omega\widehat{b} > 0$ and the given normalization. Inward multilateral resistances may rise or fall.

Appendix C: Trade Costs by Product

IMR's. Our findings indicate that Agricultural Products, Chemical Products, Petroleum and Coal Products, Fuels, Wood Products, and Paper Products have consistently high relative inward multilateral resistances across almost all provinces and territories. On the other hand, Leather, Rubber and Plastic Products, Printing and Publishing Products, Transportation Products, and Textile Products have consistently low relative IMR indexes across different provinces and territories. A natural explanation for such findings could be industry concentration: On the one hand, Agriculture, Fuels, Petroleum and Coal Products, and Wood Products are all resource industries with high concentration in certain regions. On the other hand, Printing and Publishing Industry, which has the lowest IMR's, is considered the most widely dispersed Canadian manufacturing industry. Industry concentration does not explain the low inward multilateral resistance in the Textile and Apparel industry, which is mainly concentrated in Ontario and Quebec. Through intensive capital investment over the last several decades, the Canadian Textile and Apparel industry has gained efficiency and has become more and more competitive on the world market. A big proportion of domestic demand is met by domestic production, which naturally translates into lower trade costs for the Canadian Consumer.

OMR's. We find that Furniture, Printing and Publishing Products, and Transportation Products are always the three commodity categories with highest outward trade costs regardless of the province or territory in question, while Fuels, Machinery, Electrical Products, Petroleum and Coal Products, and Chemical Products are consistently among those with lowest OMR indexes. World competition is a natural candidate to explain our findings: Given, Canadian resources, Fuels and Petroleum and Coal Products are among the products for which Canada has clear advantage on the world market, while at the same time, it faces fierce competition in sectors such as Transportation Products. In both cases we draw intuition from Proposition 1 that in the special case of uniform inter-regional trade costs, the OMR is decreasing in supply share.

Gravity Implied Trade Costs. We find wide variability of implied trade costs across commodities: Transportation Products and Furniture have significantly higher values, while resource commodities have low implied values. This is similar to the OMR findings. We find no clear trend in the time evolution of gravity trade costs at the commodity level. In contrast, outward multilateral resistance indexes fall over time at the product level. As in the case of our comparisons at the province level, this suggests that gravity implied trade costs are not informative about the sellers' incidence.

DTC's. We find some differences and some similarities between the distributions of OMR's and provincial domestic trade costs to Canada when we compare them at the commodity level. OMR's and DTC's are quite similar for the 'resource' commodity categories such as Agriculture, Fuels, Food, Paper, Wood Products, and Petroleum and Coal Products. A possible explanation for this is the large home bias in consumption of those goods. Outward multilateral resistances are significantly higher than domestic trade costs for commodities such as Printing and Publishing Products, Transportation Products, Electric and Electrical Products, and Machinery. Finally, there are also some commodity categories for which DTC's exceed the corresponding OMR indexes. These products include Chemicals and Chemical Products and Textile Products. Overall, in contrast to our comparisons between OMR's and DTC's at the provincial level, we do not find clear empirical evidence that the outward multilateral resistance indexes are higher than their DTC counterparts. This suggests that there are new empirical insights to be drawn from a more thorough investigation at the commodity level.