How Much Does Geography Deflect Services Trade? Canadian Answers*†

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April 12, 2013

Abstract

We estimate geographic barriers to trade in nine service categories for Canada's provinces from 1997 to 2007 with novel high quality bilateral provincial trade data. The border directly reduces average provincial trade with the US relative to interprovincial trade to 2.4% of its borderless level. Incorporating multilateral resistance reduces foreign trade relative to interprovincial to 0.1% of its frictionless potential. Geography reduces services trade some 7 times more than goods trade overall. Surprisingly, intra-provincial (local) trade in services and goods is equally deflected upward, implying that the border increases interprovincial trade much more in services than goods.

JEL Classification Codes: F13, F14, F16
Keywords: Gravity, home bias, border effects.

*We are grateful to Denis Caron at Statistics Canada for invaluable help with the Canadian services data and to Bernard Hoekman for directions with the US data. We thank Miss Milot's doctoral defense's committee (Yazid Dissou, Hafez Bouarek, RoseAnn Devlin, Marcel Merette, Michel Demers), and Julian Diaz for useful feedback and discussions. We also thank seminar participants at Boston College, Drexel University, the University of Ottawa, the 2011 Southern Economics Association meetings and the 2012 Kiel-World Bank Workshop on Services Trade for their comments. We gratefully acknowledge financial support from the Department of Industry, Canada. All errors are our own.

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Introduction

Services trade and the barriers it faces are a very prominent concern of developed country policymakers. This paper contributes to discussion of the concern with measures of the size of impediments to services trade imposed by geography, natural and manmade. We infer border barrier measures inferred from structural gravity methods using new high quality data on Canada's provinces bilateral services trade (internal, inter-provincial and international) of 9 sectors from 1997 to 2007.

The prominence of services trade policy concerns arises because, despite the comparative advantage in services that many developed countries enjoy, services exports appear to face strong impediments absolutely and relatively to goods exports. For example, in 2008 services production accounted for 67% of Canada's GDP yet services exports were only 13% of GDP. Qualitatively, surveys of Canadian exporters suggest that obstacles to trade in services are important (Vance, 2007).

Despite appearances, little is quantitatively known about the trade impediments facing services exporters. Believable quantitative measures of international services trade barriers, sectorally disaggregated, are needed to move the services trade policy discussion forward. Previous attempts to quantify the size of the barriers to trade in services have been hampered by poor quality trade data with limited coverage. The provincial bilateral trade, production and expenditure data used in this paper crucially allow us to distinguish between the effects of international border barriers and of localization.[1] Disaggregation into 9 sectors allows us to delineate sectorally heterogeneous effects of geography on services. The intertemporal dimension of our data allows us to identify evolving features of Canadian services trade barriers. Finally, the data structure and methods used here allow for comparison of barriers to services trade with barriers to goods trade because they closely resemble and extend those of Anderson and Yotov (2010) for the goods trade of Canada's provinces.

[1] To the best of our knowledge, our paper is the first such gravity model of services trade. Gravity modeling of services has been scanty due to lack of even bilateral *international* trade data, let alone regional bilateral trade data. Nevertheless, there is potential for progress due to advances in measurement such as the GATS 4 modes of supply, the WTOs dataset of services commitments in regional trade agreements (RTAs), and the UNs Manual on Statistics of International Trade in Services (MSITS). MSITS develops and maintains the "OECD Statistics on International Trade in Services" database, which covers more than 2/3 of the services trade in the world. Another useful global data source for services trade is the "United Nations International Trade in Services Database".

The international border is estimated from our gravity regressions to directly reduce overall provincial services trade with the US relative to interprovincial trade to an estimated 2.4% of its hypothetical borderless value. Border volume reduction effects range widely across the nine sectors from a 0.4% (for Wholesale) to 10.7% (for Accommodations). The overall relative volume displacement can be converted into a border tax equivalent. For example, using an assumed elasticity of substitution ranging between 10 and 6 with the aggregate volume reduction to 2.4% of frictionless trade yields a border tax equivalent ranging from 52% to 111%.

Geographic barriers further affect bilateral trade volumes through third party general equilibrium effects captured by multilateral resistance (Anderson and van Wincoop, 2003). The novel Constructed Bias indexes of this paper combine bilateral and multilateral resistances into measures of the deflection of intra-provincial (Constructed Home Bias, CHB), inter-provincial (Constructed Domestic Bias, CDB) and international (Constructed Foreign Bias, CFB) services trade flows from their frictionless benchmark values.[2] CDB and CFB are extensions of CHB (Anderson and Yotov, 2010).

Constructed Home Bias (CHB) is defined as the ratio of predicted to hypothetical frictionless intra-provincial trade. CHB in services is much bigger than 1. Constructed Foreign Bias (CFB) is the ratio of predicted to hypothetical frictionless foreign trade, aggregating over foreign partners. CFB in services is much smaller than 1. Constructed Domestic Bias (CDB) is the ratio of predicted to hypothetical frictionless inter-provincial trade. CDB is greater than 1 but much smaller than CHB. Thus the deflection of services trade at the international border leads to 'excess' inter-provincial trade despite much greater deflection into local trade.

The ratio of CFB to CDB measures the displacement of the ratio of foreign to inter-provincial trade (relative to its frictionless trade benchmark) due to relative trade friction differences. Directly, the relative trade friction difference combines the effect of crossing the border with the effect of differences in distance and contiguity between inter-provincial and international trade. Indirectly, CFB/CDB incorporates all the general equilibrium third party

[2]Deflection is used here metaphorically in its engineering sense. *Constructed* bias refers to the bias measured being a general equilibrium construct drawing on the calculations based on the full structural gravity model. It is distinct from and more general than the use of 'home bias' in the earlier literature referring to a preference parameter in tastes or technology that favors home goods over external substitutes, all else equal. Home bias in tastes, if any, is a component of the CHB index that (i) incorporates all other sources of trade cost differences that favor home goods over external substitutes and (ii) includes the general equilibrium third party effects captured by inward and outward multilateral resistance.

effects of trade frictions on the ratio of foreign to inter-provincial trade. For overall services trade, frictions directly and indirectly reduce the ratio of foreign to domestic services trade to a mere 0.1% of its neutral frictions (or frictionless) benchmark. (Compare this with the reduction to 2.4% of potential from the direct US border effect.)

Our services trade deflection results are readily compared with the goods trade results for Canada's provinces in Anderson and Yotov (2010) because a common estimation method is used. International services trade is reduced some 7 times more than goods trade by geographic barriers: overall CFB(goods)$>$ 7$\cdot$CFB(services).[3] In contrast, inter-provincial trade in services is deflected upward more than it is in goods, deflection being measured by CDB. (The CFB and CDB calculations for goods summarized here use Anderson and Yotov's (2010) data for 19 manufacturing and primary goods industries of Canada's provinces from 1992 to 2003. For Fuels CDB$<$ 1 but overall CDB$>>$ 1.) Finally, to our surprise, the upward deflection of intra-provincial trade measured by CHB is about the same in goods and services. In other words, localization operates about equally on goods and services, so localization does not explain the much lower CFB in services than in goods. (On net, a higher CDB in services offsets the lower CFB, thus meeting the requirement that a weighted average of CDB, CFB and CHB must always sum to 1.)

New security measures were implemented on the Canadian-American border after the events of 9/11. The new measures were perceived by service exporters as imposing additional costs (Vance, 2007). Shifts in the estimated border barrier over the decade 1997-2007 provided below reveal changes (mostly border thickening) following September 2001 as well as some directional asymmetries in both the border and thickening estimates.

A general caveat is illustrated by the difficulty of interpreting border thickening/thinning: why the border so reduces trade in services is not explained by our paper. We estimate the size of border, contiguity and distance effects, not their causes. Economic intuition suggests that the amount of trade deflected by the border is partly endogenous, because private agents can invest in reducing the impact of governmentally imposed regulatory and security barriers and government can respond to trade changes with altered regulations. Our results point

[3]Direct border effect estimates are smaller in absolute value for goods than for services but account for only part of the smaller deflection of trade.

to large potential gains to be reaped from lower barriers to inter-provincial and especially international barriers to trade in services, but our methods cannot identify specific policy instruments to leverage these reductions. Government and World Bank efforts have described the many dimensions of regulatory policy barriers but their qualitative nature almost precludes assigning direct tax equivalent measures. Using the regulatory measures as control variables in gravity regressions can potentially yield inferred tax equivalents, but the endogeneity and high dimensionality of the regulatory barrier data make this procedure difficult to defend. In contrast, borders are reliably exogenous (except over very long horizons).

The chief caveat about our results concerns aggregation and its effects. The mixed nature of most of the nine service categories in our sample make it hard to interpret our findings of directional and sectoral differences in border thickening/thinning. The magnitude and directional asymmetries of our border and thickening estimates point to the need for further investigation of the factors behind these effects. Disaggregation to firm level data is also important for better understanding services trade barriers. Regulatory barriers are likely to pose important fixed costs on potential service exporters that differ in impact by firm. The sector-province data used in this paper does not permit the identification of selection of heterogeneous firms from sectoral data developed by Helpman, Melitz and Rubinstein (2008), but firm level data might be able to shed light on the importance of fixed trade costs.

The success of our methods in this paper suggests they are likely to be useful on services trade more broadly. Since bilateral trade data is rife with measurement error in any case, the good performance of the gravity model here suggests that larger measurement error in trade flows need not preclude reasonably precise and reliable results.

The paper is organized as follows: Section 1 reviews the structural gravity model. Section 2 presents the empirical analysis. Section 3 concludes.

1 Theoretical Foundation

The theoretical development of the gravity model reviewed here follows Anderson and Yotov (2010). Their Constructed Home Bias index is complemented here by two new general equilibrium trade cost indexes, Constructed Foreign Bias (CFB) and Constructed Domestic Bias

(CDB), measuring the ratio of predicted (Foreign and Domestic) trade to hypothetical frictionless trade.

Assume identical preferences or technology across countries for national varieties of services differentiated by place of origin for every service category k, represented by a globally common Constant Elasticity of Substitution (CES) sub-utility or production function. The structural gravity model that is implied is written as:[4]

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

$$(\Pi_i^k)^{1-\sigma_k} = \sum_j \left(\frac{t_{ij}^k}{P_j^k} \right)^{1-\sigma_k} \frac{E_j^k}{Y^k} \quad (2)$$

$$(P_j^k)^{1-\sigma_k} = \sum_i \left(\frac{t_{ij}^k}{\Pi_i^k} \right)^{1-\sigma_k} \frac{Y_i^k}{Y^k}, \quad (3)$$

where X_{ij}^k denotes the value of shipments at destination prices from region of origin i to region of destination j in services class k. Here and henceforth in the paper, the order of double subscripts denotes origin to destination. E_j^k is the expenditure at destination j on services in k from all origins. Y_i^k denotes the sales of services k at destination prices from i to all destinations, while Y^k is the total output, at delivered prices, of services k. $t_{ij}^k \geq 1$ denotes the variable trade cost factor on shipment of services from i to j in class k, and σ_k is the elasticity of substitution across services in k. P_j^k is the inward multilateral resistance (IMR), and also the CES price index of the demand system. Π_i^k is the outward multilateral resistance (OMR), which from (2) aggregates i's outward trade costs relative to destination price indexes. Anderson and Yotov (2010) note that P_j^k and Π_i^k are respectively the buyers' and sellers' overall incidence of trade costs to their counter-parties worldwide.

The right hand side of (1) comprises two parts, the frictionless value of trade $E_j^k Y_i^k / Y^k$ and the distortion to that trade induced by trade costs $(t_{ij}^k / \Pi_i^k P_j^k)^{1-\sigma_k}$ directly (in the numerator) and indirectly (in the denominator). In the hypothetical frictionless equilibrium, i's share of total expenditure by each destination j is equal to Y_i^k / Y^k, i's share of world shipments in each sector k, the pattern of a completely homogenized world. "Frictionless" and "trade costs" are

[4]See Anderson (2011) for details and discussion of two other theoretical foundations for (1)-(3). For services, a plausible alternative foundation models buyers with heterogeneous preferences over varieties that make choices distributed as in the CES 'love of variety' representative buyer model.

used here for simplicity and clarity, but the model can also reflect local differences in tastes that shift demand just as trade costs do, suggesting "resistance" rather than costs.

Constructed Home Bias (CHB) defined by Anderson and Yotov (2010) measures the ratio of predicted to hypothetical frictionless internal trade of services in class k within any given region i:

$$CHB_i^k = \frac{\hat{X}_{ii}^k}{Y_i^k E_i^k / Y^k} = \left(\frac{\hat{t}_{ii}^k}{\hat{\Pi}_i^k \hat{P}_i^k} \right)^{1-\sigma_k}. \tag{4}$$

Theory posits that the unobserved true bilateral trade flow is equal to the right hand side of (1) while its econometric estimate gives an unbiased predicted value. The middle expression in (4) is the predicted (fitted) value of internal trade, $\hat{X}_{ii}^k$, relative to the theoretical value of internal trade in a frictionless world, $E_i^k Y_i^k / Y^k$. The rightmost expression in (4) is based on (1). It gives the effect of all fitted trade costs acting directly and indirectly to increase each province's trade with itself above the frictionless benchmark. Note that two regions i and j with the same internal trade cost $t_{ii}^k = t_{jj}^k$ may have quite different CHB's due to the general equilibrium effect of trade costs when $\Pi_i^k P_i^k \neq \Pi_j^k P_j^k$.

An alternative form of CHB is useful for comparison with the constructed bias indexes introduced below. Since P_i is the buyers' incidence on purchase at i, this implies that $t_{ii}/P_i = \Pi_{ii}$, the sellers' incidence on local sales. Thus

$$CHB_i = \widehat{\Pi}_{ii}^{1-\sigma} / \widehat{\Pi}_i^{1-\sigma}, \tag{5}$$

the $1-\sigma$ power transform of the ratio of sellers' incidence on local sales to sellers' incidence on all sales.

The constructed bias idea extends to a family of constructed bias indexes composed of subsets of bilateral trades that are of interest. This paper focuses on Constructed Foreign Bias (CFB) for province-international exports and Constructed Domestic Bias (CDB) for inter-provincial (domestic) exports. Constructed Foreign Bias (CFB) is defined for each province and sector as the predicted volume of international export trade relative to the hypothetical frictionless volume of trade, both for given sales and expenditures. Constructed Domestic Bias (CDB) is analogously defined as the ratio of fitted to frictionless inter-provincial export trade, excluding internal trade. CFB and CDB complement CHB by focusing on that part of

non-internal trade that is respectively outside and inside Canada.

Formally, let F and $D(i)$ denote the set of Foreign and Domestic destinations other than i, respectively. Constructed Foreign Bias and Domestic Bias are defined for a generic service for region i as

$$CFB_i \equiv \frac{\sum_{j\in F}\hat{X}_{ij}}{Y_i E_F/Y}; CDB_i \equiv \frac{\sum_{j\in D(i)}\hat{X}_{ij}}{Y_i E_{D(i)}/Y}. \tag{6}$$

Here, $E_F = \sum_{j\in F} E_j, E_D(i) = \sum_{j\in D(i)} E_j$. Define the (average) sellers' incidence in province i on a subset S of its sales:

$$\widehat{\Pi}_{iS}^{1-\sigma} \equiv \sum_{j\in S}(\hat{t}_{ij}/\widehat{P}_j)^{1-\sigma}\frac{E_j}{E_S}; S = F, D(i). \tag{7}$$

The predicted value of bilateral trade is given by the right hand side of (1), hence using (7) implies that CFB_i, CDB_i can be rewritten as

$$CFB_i = \frac{\widehat{\Pi}_{iF}^{1-\sigma}}{\widehat{\Pi}_i^{1-\sigma}}, CDB_i = \frac{\widehat{\Pi}_{iD}^{1-\sigma}}{\widehat{\Pi}_i^{1-\sigma}}. \tag{8}$$

Expression (8) is intuitively appealing: CFB is determined by the ratio of sellers' average incidence externally to sellers' average incidence overall, and analogously for CDB. Notice that we can explain the time series behavior of the CFB's decomposed into external and overall sellers' incidence (in power transforms), and further decompose the changes in the (power transforms of) sellers' incidence into that due to border thickening vs. other changes (such as expenditure and supply changes over time). The constructed bias indexes below use (2)-(3) to calculate multilateral resistances and then use (7) to calculated the sellers' resistance on the subset of trades, all as inputs into the right hand sides of (4), (8).

All the Constructed Bias indexes strictly and properly capture the effect of cross-border trade costs on trade patterns *given the location of activity — sales and expenditures.* They do not speak to the reverse causality from trade costs to location of activity, while in the econometric applications below the potential reverse causality is controlled for with origin and destination region fixed effects. Related to this, the results of this paper take as given the choice to trade as opposed to, for example, setting up a foreign subsidiary behind the border.

The ratio CFB_i/CDB_i measures the deflection of international relative to domestic trade

induced by the full effects of gravity, directly and indirectly. Using (8) and (7) yields

$$\frac{CFB_i}{CDB_i} = \frac{\widehat{\Pi}_{iF}^{1-\sigma}}{\widehat{\Pi}_{iD}^{1-\sigma}}. \tag{9}$$

Here Π_{iF}/Π_{iD} is interpreted the average sellers incidence surcharge on selling to foreigners as opposed to domestically. CFB/CDB is the $1-\sigma$ power transform of this incidence surcharge.

CFB_i/CDB_i is a useful addition to analytic economic geography, complementing the partial equilibrium effect of the border on foreign relative to domestic trade that is inferred directly from the gravity model. CFB_i/CDB_i is potentially useful in describing dual economies because it can quantify the qualitative notion that some dual economies have developed regions that are more integrated with foreign economies than with their backward regions. In practice we find no such pattern for Canada's provinces.

Substitutability among the Constructed Bias indexes is guaranteed because the adding up condition implies that a weighted average of CHB, CFB and CDB must always equal 1,

$$CHB_iE_i/E + CDB_iE_{D(i)}/E + CFB_iE_{\bar{C}}/E = 1. \tag{10}$$

Nevertheless, because both the weights and the constructed bias indexes vary considerably by region, no strict relationship among any pair is expected.

Two properties of Constructed Bias indexes are very appealing: (i) independence of the normalization needed to solve system (2)-(3);[5] and (ii) independence of the elasticity of substitution σ, because they are constructed using the $1-\sigma_k$ power transforms of t's, Π's and P's.

Aggregation of constructed bias across sectors or regions is convenient for describing results below. Consistent aggregation of CHBs across regions in sector k is illustrated,

$$CHB^k = \sum_i \widehat{X}_{ii}^k / \sum_i (Y_i^k E_i^k / Y^k) = \sum_i \left(\frac{\hat{t}_{ii}^k}{\widehat{\Pi}_i^k \widehat{P}_i^k} \right)^{1-\sigma_k} \frac{Y_i^k E_i^k}{\sum_i Y_i^k E_i^k}.$$

[5]Note that (2)-(3) solves for $\{\Pi_i^k, P_j^k\}$ only up to a scalar. If $\{\Pi_i^0, P_j^0\}$ is a solution then so is $\{\lambda\Pi_i^0, P_j^0/\lambda\}$. Therefore, in the empirical section, we need to impose a normalization in order to solve for the multilateral resistances. CHB and CFB are independent of this normalization.

For aggregation across sectors in region i

$$CHB_i = \sum_k \widehat{X}_{ii}^k / \sum_k (Y_i^k E_i^k / Y^k) = \sum_k \left(\frac{\hat{t}_{ii}^k}{\widehat{\Pi}_i^k \widehat{P}_i^k} \right)^{1-\sigma_k} \frac{Y_i^k E_i^k}{\sum_i Y_i^k E_i^k}.$$

Both aggregates are weighted averages of the region-sector CHBs of (4). Aggregation of CFBs and CDBs has the same simple structure as aggregation of CHBs.

2 Empirical Analysis

2.1 Econometric Specification

The econometric specification of the theoretical gravity equation (1) is completed in several steps. The first step is to control for the unobservable multilateral resistances Π_i^k and P_j^k with exporter and importer region fixed effects x_i, m_j that also control for the sales and expenditure variables Y_i^k and E_j^k. Thus (1) becomes

$$X_{ij}^k = c x_i m_j t_{ij}^{1-\sigma}. \tag{11}$$

Second, the unobservable bilateral trade costs t_{ij}^k are proxied with a set of observable variables reflecting the specific features of Canadian trade and geography. For a generic service category, we specify:

$$\begin{aligned} t_{ij}^{1-\sigma} \quad = \quad & e^{\gamma_1 DISTANCE_{ij} + \gamma_2 CONTIG\_PR\_PR_{ij} + \gamma_3 CONTIG\_PR\_ST_{ij} + \gamma_4 SAME\_REGION_{ij}} \times \\ & e^{\gamma_5 BRDR\_CA\_US + \gamma_6 BRDR\_US\_CA + \gamma_7 BRDR\_ROW\_CA + \gamma_8 BRDR\_ROW\_US} \times \\ & e^{\gamma_9 THICK\_CA\_US + \gamma_{10} THICK\_US\_CA}. \end{aligned} \tag{12}$$

The emprirical gravity specification substitutes (12) for the power transform of t_{ij} in (11). The list of trade cost proxies is headed by $DISTANCE_{ij}$, the logarithm of bilateral distance between trading partners i and j. $CONTIG\_PR\_PR_{ij}$ takes a value of one when two provinces share a common border and is set to zero otherwise. $CONTIG\_PR\_ST_{ij}$ is equal to one when

a Canadian province neighbors a US state.[6]

$SAME\_REGION_{ij}$ takes a value of one when $i = j$ and it is equal to zero otherwise. Our use of this variable and of internal trade is critical to our purposes and somewhat unusual.[7] $SAME\_REGION$ and its coefficient estimate are key components (along with internal distance) of internal trade costs, the t_{ii}'s, which are needed for meaningful and consistent calculation of the multilateral resistances and the constructed bias (CB) indexes. Including $SAME\_REGION_{ij}$ implies that the estimates of all other border coefficients are deviations from interprovincial trade.

$BRDR\_CA\_US$ takes a value of one for Canadian exports to US and $BRDR\_US\_CA$ equals to one when US exports to Canada.[8] The interpretation of the estimates on $BRDR\_CA\_US$ and $BRDR\_US\_CA$ can differ (even be opposite) between services and merchandise. Take Health for example, where a negative coefficient estimate $\hat{\gamma}_6$ on the effect of $BRDR\_US\_CA$ for US exports to Canada will mostly account for the obstacles faced by Canadian patients going to US to obtain health care, hence represent a *US* border effect. In contrast, a negative estimate of γ_6 for trade in Health merchandise is interpreted as a *Canadian* border effect.[9]

The broad implication is that the characteristics of the main services in a given category (a detailed description of each category is in Appendix A) condition the interpretation of the gravity border estimates. Aggregation bias contaminates all gravity estimates to some degree (Anderson and van Wincoop, 2004) but for some services it blurs interpretation.

$BRDR\_ROW\_CA$ and $BRDR\_ROW\_US$ capture border effects between Canada and ROW and between US and ROW, respectively. Directional border effects with ROW are possible in

[6]Previous gravity studies investigating non-service trade suggest that trade between contiguous provinces and states is much larger as compared to interprovincial trade, while there is little evidence for significant differences in the volume of bilateral trade between contiguous provinces as compared to interprovincial trade in general. We test this predictions for services.

[7]The few gravity studies that include some variant of $SAME\_REGION_{ij}$ obtain large, positive and significant coefficient estimates. For example, Wolf (2000) finds evidence of US state border effects. Anderson and Yotov (2010) find that internal provincial trade is higher than interprovincial and international trade in the case of Canadian commodity trade. Finally, Jensen and Yotov (2011) and Anderson and Yotov (2011) confirm a significant $SAME\_REGION$ impact for important agricultural commodities and for world manufacturing, respectively.

[8]Previous studies employing aggregate data, e.g. Brown and Anderson (2002), and disaggregated manufacturing data, e.g. Anderson and Yotov (2010), find that the border between Canada and US is asymmetric. We test for asymmetric services border by splitting the Canada-US border dummy into its directional components.

[9]Furthermore, the broad category of Health services also includes the visits of Canadian doctors to perform important surgeries or to teach in the US. In that case, the interpretation of γ_6 would be similar for merchandise and services.

principle but the rich fixed effects structure of our empirical specification brings collinearity problems that preclude fully directional border dummies.

The estimates of γ_9 and γ_{10} on $THICK\_CA\_US$ and $THICK\_US\_CA$ pick up any post 9/11 'thickening' of the border between Canada and the US, with allowance for asymmetric (i.e., directional) thickening effects. $THICK\_CA\_US$ is an indicator variable that takes a value of one for post 9/11 Canadian service exports to US, and $THICK\_US\_CA$ is a dummy variable equal to one for post-9/11 US exports to Canada.

The econometric model is completed by expanding equation (11) with an error term, posing two challenges. First, to account for the presence of both zeros and heteroskedasticity in trade data, we use the the Poisson pseudo-maximum-likelihood (PPML) estimator of Santos-Silva and Tenreyro (2006). Second, the time dimension of the data (needed to gauge any thickening effects) requires *time-varying*, directional, country-specific fixed effects to account for the unobservable multilateral resistance terms.[10] This suggests a problem with the error structure because, "[f]ixed-effects estimations are sometimes criticized when applied to data pooled over consecutive years on the grounds that dependent and independent variables cannot fully adjust in a single year's time."(Cheng and Wall 2002, p.8). To avoid this critique, we use 2- and 3-year lags.[11]

In the end, for each service category in our sample, we use the PPML technique to estimate a panel version of (11) using (12) with time-varying, directional, country-specific fixed effects. We present the service gravity results after we describe our data.

[10]See Olivero and Yotov (2012) for formal discussion of the treatment of the MR terms in a panel setting. It should be noted that, in addition to controlling for the multilateral resistances, the fixed effects in our econometric specification will also absorb regional output and expenditures. See Anderson and Yotov (2012) for decomposition of the effects of the multilateral resistance vs. size components in the structural gravity terms.

[11]Trefler (2004) also criticizes trade estimations pooled over consecutive years. He uses three-year lags. Olivero and Yotov (2012) experiment with various lags to find that estimates obtained with 3-year and 5-year lags are very similar, but the yearly estimates produce suspicious gravity parameters. Given the relatively short time span of our sample (10 years), we limit our analysis to 2- and 3-year intervals, which produce similar results, but we favor the estimates from the 2-year lagged sample as more efficient.

2.2 Data Description

We put significant effort into the construction of a comprehensive and reliable data set for the Canadian provincial service trade at the sectoral level.[12] Our study covers trade in services for the period 1997-2007. Trading partners include all Canadian provinces and territories,[13] the United States (defined here as an aggregated region of all the fifty US states and the District of Columbia) and the rest of the world (ROW), which is an aggregated region consisting of all other countries in the world.[14] Data availability allowed us to investigate 9 services sectors.[15] We also obtain aggregate gravity estimates by combining all service categories.

In order to estimate gravity and to construct the trade cost indexes of interest in this study, we use data on bilateral trade flows, output and expenditures for each trading partner, all measured in current Canadian dollars for the corresponding year, consistent with the theory of Section 1. Trade data comes from two sources. Statistics Canada is the major one. It provides data on intra- and inter-provincial trade flows as well as province-World and province-US bilateral trade flows. Data on US-World bilateral trade flows are from the US Bureau of Economic Analysis (BEA). We construct trade between ROW and US as the difference between US-World trade and US-Canada trade and trade between ROW and Canada as the difference between Canada-World trade and Canada-US trade. Finally, internal trade for each of the two aggregate regions (US and ROW) is obtained as the difference between output for that region

[12]We are extremely grateful to Denis Caron at Statistics Canada without whose assistance with the data this project would not have been possible.

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

[14]Data for province-state service trade flows were not available, so we could not fully implement the technique used in Anderson and Yotov (2010) for goods trade. This may create aggregation biases. On the one hand, the technique used for measuring bilateral distance is robust to aggregation (see discussion of the construction of bilateral distance below) while both the distance coefficient and the international border coefficient in services appear likely to apply uniformly across province-state pairs as our model assumes. Then estimation should be robust to aggregation. On the other hand, experiments with aggregating across states using the goods trade data of Anderson and Yotov (2010) reveal aggregation bias, more so in the border coefficient than in the distance coefficient. The bilateral trade costs constructed from the coefficients estimated with the two aggregation methods are nevertheless highly correlated.

[15]The services sectors selection was 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: November 3, 2010). The 9 services categories include (Abbreviated labeling used throughout the text is in parentheses): Transportation and Storage Services, including transportation margins (Transportation); Communication Services (Communication); Wholesale Services, including Wholesale Margins (Wholesale); Finance, Insurance and Real Estate services (Finance); Professional, Scientific, Technical, Computer, Administrative, Support, and Related Services (Business); Education Services (Education); Health Care and Social Assistance Services (Health); Accommodation Services and Meals (Accommodation); and, Miscellaneous Services (Other). A detailed description of each of the service categories in our sample is presented in the Appendix A.

and total exports.

We need production data for two reasons. First, as indicated above, we use production data in order to construct internal trade for each of the regions in our sample. Second, more importantly, we need output data to calculate the multilateral resistance terms and to construct the Constructed Bias indexes. Statistics Canada provides provincial service outputs. The US Bureau of Economic Analysis is our source for US service production data. Finally, we construct output for ROW from the Global Trade Analysis Project (GTAP) database built by Purdue University. GTAP has two limitations: First, data are only available for 2004 and 2007. This predetermined the years for which we will construct and analyze the Constructed Bias indexes.[16] Second, the GTAP service classification is more aggregated as compared to ours. In particular, GTAP aggregates the categories of Wholesale and Accommodation as well as those of Health and Education. Given the nature and the importance of each of these subcategories, we split the GTAP data in order to study them separately. To do this, we use actual output levels for US and Canada and we assume homogeneity, resulting in constant expenditure shares.[17]

Given the specific geography and relationships among the regions in our study, we are only able to include two of the standard gravity covariates in our estimations: bilateral distance and contiguity. We calculate bilateral distances as population-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.[18] To calculate population weights, we take the biggest 30 agglomerations (in terms of population) in each trading partner when the partner is a province or a territory, the 300 biggest cities when the partner is US, and the biggest 100 cities when the partner is ROW.[19] Finally, d_{kl} is the distance

[16] We experiment by interpolating and extrapolating the GTAP data to cover the whole period of investigation. This adds a single sectoral observation for each year in our sample. While our sensitivity experiments reveal that the gravity estimates are not sensitive to whether we use ROW data for 2004 and 2007 only, or ROW data for the whole period, we find that the constructed bias numbers are quite sensitive to the interpolation procedures. Therefore, we limit our CB analysis to the years of 2004 and 2007, for which we do have actual data.

[17] As will become clear from our gravity estimates below, it is particularly important to separate Health and Education because the post 9/11 border response for these two categories is quite heterogeneous.

[18] This is the procedure of Mayer and Zignago (2006), which is based on Head and Mayer (2000). The most appealing argument for the use of this particular approach in constructing bilateral distance is that the same procedure obtains consistent measures of internal distances and bilateral distances for each pair of regions, including ROW. The population weights proxy for city service activity weights that, while theoretically more appropriate, are not available in the data and, in addition, would present very difficult simultaneity issues that are avoided by instrumenting with city populations.

[19] In the few instances when data were not available for 30 agglomerations within a single trading partner

between agglomeration k and agglomeration l, measured in kilometers, and calculated by the Great Circle Distance Formula.[20] All data on latitude, longitude, and population are from the World Gazetteer web page.

We also generate a series of indicator variables that pick up contiguity ($CONTIG\_PR\_PR_{ij}$ and $CONTIG\_PR\_ST_{ij}$), regional borders ($BRDR\_CA\_US$, $BRDR\_US\_CA$, $BRDR\_ROW\_CA$ and $BRDR\_ROW\_US$), internal trade ($SAME\_REGION_{ij}$), and directional post-9/11 thickening of the Canada-US borders ($THICK\_CA\_US$ and $THICK\_US\_CA$).

2.3 Gravity Estimation Results

Panel PPML gravity estimates are reported in Table 1. The first column, TOTAL, presents aggregate estimates for all services, and the next nine columns report results at the sectoral level. To allow for trade adjustment, while at the same time keeping the number of degrees of freedom sufficiently large, we use 2-year lags.[21] All results are obtained with time-varying, directional, region-specific fixed effects (not reported).

Our main focus is on the direct effect of borders as measured by the gravity coefficients, but in passing we note that, as it is the case for goods, distance is a significant impediment to trade in services and distance elasticity estimates vary across the service sectors in an intuitive fashion. Contiguity matters, but only on the international border. See the working paper version of this paper (Anderson, Milot and Yotov, 2011) for a more detailed discussion of the estimates on the standard gravity variables.

Border effects are big and vary across sectors. The barriers vary on internal trade and on international trade by direction and to some extent across the 9/11 divide. We discuss the internal and international trade results separately, and then discuss the pre- and post-9/11 shift.

Internal Trade. Given the structure of the border dummies employed in our estimations, the coefficient estimate on $SAME\_REGION$ should be interpreted as deviation from inter-provincial trade. In volume terms, the coefficient of 1.4 (std.err 0.629) on $SAME\_REGION$

(NT, PE and YT, for example), we included all the cities for which data were available.

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

[21] Estimates obtained with 3-year lags, available upon request, are virtually identical to the ones presented and discussed here.

for total services, for example, implies that internal regional trade is about 4.06 (exp(1.4)) times larger than interprovincial trade, ceteris paribus. The implied border tax factor is equal to $\exp[-1.4/(1-\sigma)]$ for σ evaluated at 10 and 6, yielding 1.17 and 1.32, a tax rate between 17% and 32%.

The largest internal trade estimates are for Health, Communication, Other Services and Education. Possible explanations in the cases of Health and Education include locally issued and managed health insurance and education credential recognition, while Communications may reflect the local nature of broadcasting and newspapers.[22] The category of Other Services includes the subcategories of beauty and personal care, funeral, child care, household, automobile repairs to recreation, all strongly locally biased because of their personalized nature. On average, the internal trade estimates are higher in services than for goods as reported in Anderson and Yotov (2010).[23]

International Borders. The point estimates of the coefficients on $BRDR\_CA\_US$ and $BRDR\_US\_CA$, capturing directional Canadian borders with US, and $BRDR\_ROW\_CA$, standing for Canadian border with the rest of the world, are economically large, negative and statistically significant at any level for every service category. The trade cost factor implied by the border coefficients is exemplified by the point estimate of $BRDR\_CA\_US$ for all services in column (1) of Table 1. The implied border tax factor is equal to $\exp[-3.744/(1-\sigma)]$ for σ evaluated at 10 and 6, yielding 1.52 and 2.11, a tax rate between 52% and 111%. In volume terms, the estimate of -3.744 (std.err 0.295) on $BRDR\_CA\_US$ for total services implies that Canadian exports to US are about 42 (exp(3.744)) times smaller than interprovincial trade, ceteris paribus.

The estimated magnitude of the Canadian-US border effect on services is larger (in absolute

[22]In Canada, provincial regulations must follow the Canadian Radio-television and Telecommunication Commission (CRTC), which is the independent public organization that regulates and supervises the Canadian broadcasting and telecommunications systems. Several provinces operate public broadcasters and their programs are only available in their province of origin. For example, we find TFO in Ontario, Tele-Quebec in Quebec and KNOWLEDGE in British Columbia.

[23]Business is the only category with a small and not statistically significant estimate. Even though the estimate for Business as a whole is insignificant, it is possible that intra-regional trade is different than interprovincial trade for some of heterogeneous services (Professional, Scientific, Technical, Computer, Administrative, etc.) included in this category. This points to the potential benefits and need for analysis based on more disaggregated services data. Overall, the internal trade estimates for services presented in this section are in accordance with the findings from several recent studies, described in footnote 12, and our results reinforce the need and importance of accounting for internal trade in gravity-type estimations.

value) on average than those for goods in Anderson and Yotov (2010). Canadian border effects with the rest of the world are similar in magnitude, slightly smaller for most categories.[24] Finally, we estimate the border between US and the rest of the world to be significantly smaller for each service category, even insignificant in the case of Education. The latter reflects the large numbers of foreign students and scholars in US.

The estimates of the trade reducing effects of the Canada-US border vary significantly by sector. Accommodation stands out with lower in absolute value (though still large and significant) CA-US border estimates in each direction, reflecting international tourism and business travel. In contrast, Wholesale has the largest in absolute value CA-US border estimates, perhaps reflecting close coordination needs of retailers with wholesalers.

Comparison between the estimates on $BRDR\_CA\_US$ and $BRDR\_US\_CA$ reveals significant directional border differences for most service categories in our sample.[25] With the exception of Financial Services, all $BRDR\_US\_CA$ estimates are lower, in absolute value, compared to their $BRDR\_CA\_US$ counterparts. We offer two explanations for the differing border estimates for Financial Services. First, the highly regulated banking and financial system in Canada could prevent the penetration of its market by foreign firms. Second, the border security and other impediments to trade that apply to physical crossing of the border, as in the case of Health and Education Services for example, do not apply to most services included in the Finance category. In general, because of the different modes of services trade that are aggregated within each category in our sample, we note that our border results should be interpreted with caution as not necessarily indicative of *trade policy* differences.

To illustrate, consider the case of Health Services. Canadian exports of Health Services consist mostly of US patients going to Canada. Thus, a larger $BRDR\_CA\_US$ estimate (as compared to $BRDR\_US\_CA$ estimate) suggests that it is significantly harder for a US citizen to cross the border in order to obtain health care in Canada. This result is intuitive, given the differences between the health systems in the two economies. Canadian import of health services is partly due to Canada's own supply congestion, with substantial waiting time for non-

[24]Financial Services are a notable exception, where the CA-ROW border is significantly lower as compared to the CA-US border.

[25]Note that the TOTAL estimates from column one do not capture any asymmetries. This points to (i) aggregation bias in the total service estimates, and (ii) the need for even more disaggregated service data.

life threatening surgeries and for access to most new technologies, combined with limited access to specialists (which is only by referral and may take months). Canadians in response look for alternatives to the services offered by their provincial health systems. Given its proximity and high quality, the US health system offers both an attractive substitute and a complement. In contrast, as noted by the Bureau of Consular Affairs, U.S. Department of State, Canada's medical care is of a high standard but government-controlled and rationed. Access to ongoing medical care is very difficult for anyone who is not a member of the government-run, provincial health care plans, and no Canadian health care provider would accept U.S. domestic health insurance.

Overall, the estimates from this section suggest that there are large and significant international borders in services trade therefore leading to opportunities for substantial globalization gains in services. The border effects presented here vary across sectors intuitively for most categories, but our results also point to the importance of understanding the specific nature of a service sector when analyzing its trade. More disaggregated data will allow for better understanding of the main causes behind the large border effects in services trade and will guide policy makers in their decisions on shaping services trade policy and trade liberalization.

Post 9/11 Thickening. Many business owners, especially on the Canadian side, have indicated that the CA-US border has 'thickened' as a result of stricter post 9/11 security-related measures. Our estimates provide reasonable empirical evidence that the US border facing Canadian exporters has indeed thickened for some services in the post 9/11 period while in contrast it has thinned for some US exporters to Canada.

We obtain negative and significant coefficient estimates on $THICK\_US\_CA$ for five of the nine service categories in our sample, which add up to a negative and significant TOTAL estimate on $THICK\_US\_CA$ for services trade (see column 1 of Table 1). The opposite is true on the Canadian side, where we estimate positive border for four of the nine services in our sample and a positive overall for all services.[26]

[26]Similar to the corresponding directional border indexes, the estimates on $THICK\_US\_CA$ and $THICK\_US\_CA$ should be interpreted with caution due to the nature of services trade, where often services exports in one direction are associated with physical border crossing in the opposite direction. In the case of Health Services, for example, we interpret the negative and significant estimate on $THICK\_US\_CA$ (capturing US exports to Canada) as thickening of the US border. The reason is that we believe that it mostly accounts for the obstacles faced by Canadian patients going to US to obtain health care, hence represent a *US* border effect. However, we also recognize that the broad category of Health Services contains the visits

Education and Finance are the only two categories for which our estimates suggest thinning of the US border and thickening of the Canadian border after 2001. There are two explanations for the negative and significant estimate on $THICK\_CA\_US$ for Education. First, it may reflect that the new security measures render the admission process harder (or less attractive) for American students to obtain higher education in a Canadian University. Second, it may be driven by the fact that Canadian scholars working temporarily (less than 1 year) in the US face additional security requirements imposed since 2001 on all foreigners entering the US. The positive estimate on $THICK\_US\_CA$ suggests that, all else equal, it is easier for American scholars to provide services on Canadian soil and/or that it is easier for Canadian students to obtain Education services in the US after 2001. The latter reflects an overall trend of relatively easier access for foreign students, as compared to any other constituencies, to the US.[27]

We attribute our findings for Financial Services (thinning on the US side and thickening on the Canadian side) to (i) the disproportionate progress in the provision of these services that was made in the US over the past decade, ii) the highly regulated Canadian banking and financial institutions and iii) the fact that border security and other impediments to trade that apply to physical crossing of the border, as in the case of Health and Education Services for example, do not apply to most services included in the Finance category.

We view our results as modest support of the claims of Canadian business persons for significant increase in the efforts to cross the US border,[28] and we attribute the small thickening estimates to both unilateral and coordinated efforts on behalf of the US and the Canadian governments in response to the need for increased security while facilitating bilateral trade in the post 9/11 context. Examples of unilateral efforts on each side of the border include the

of US doctors to practice or to teach in Canada. In that case, the interpretation of the negative estimate on $THICK\_US\_CA$ will be thickening of the Canadian border. Thus, our estimates should be interpreted depending on the sectoral composition of modes of delivery for each specific service category.

[27] According to the Bureau of Consular Affairs, U.S. Department of State, before applying for visa, all student applicants are required to be accepted and approved for their program. When accepted, educational institutions and program sponsors provide each applicant the necessary approval documentation for the visa. This process significantly reduces the additional security requirements and impediments faced by foreign students entering the US. In addition, the Student and Exchange Visitor Information System (SEVIS) was created in 2003 as a web-accessible database used by the Department of Homeland Security to collect, track and monitor information regarding exchange visitors, international students and scholars who enter the United States on visas. This further simplified the application and entering process for foreign students in the US.

[28] The category of Transportation Services (rail, bus, truck and air), where trade only takes place through one mode of supply, *cross border supply*, is a good representative example with an insignificant thickening estimate of -0.076 (std.err 0.064) on the Canadian side and a statistically significant but economically small estimate of -0.134 (std.err 0.054) on the US side.

creation of the US Homeland Security in 2002 and the Canadian Border Services Agency in 2003 and the imposition of new border measures such as the U.S. Customs and Border Protection's cargo enforcement strategy. Joint programs include the Container Security Initiative (CSI), the Customs-Trade Partnership Against Terrorism (C-TPAT)/ Partners in Protection and the Nexus program.[29]

2.4 Constructed Bias Results

All three provincial CB indexes are useful to understand the economic effects of Canadian political and geographic structure as they illustrate the deviation of provincial, domestic and international trade from their expected value in a world without trade frictions. In summary, CHB is large for all sectors and provinces while CFB is very small. CDB is above 1 (except for Fuels) but much smaller than CHB.

Services trade has some 7 times smaller CFB on average across sectors and provinces than goods trade (the latter based on new calculations for this paper from the data used in Anderson and Yotov, 2010). In contrast, the CHBs for goods and services trade are broadly similar because services' higher CDBs than in goods trade offset their lower CFBs. This means that the lower CFB in services relative to goods trade is not due to greater localization forces in services. The pair of equations in (8) imply that the results are due to differences in the direct and indirect effects of trade costs on sellers incidence on inter-provincial (Π_{iC}) as compared to international trade ($\Pi_{i\bar{C}}$). We show below that the incidence difference is mainly due to direct effects of differences between services and goods in the estimated coefficients for $SAME\_REGION$ (home bias) and CA_US_BORDER (the international border barrier). Finally, services CDBs have smaller variation across provinces than CHBs, localization is damped within the Canadian confederation.

[29]CSI was set up, based on reciprocity between partners, shortly after 9/11 to address threats posed by a potential terrorist use of a maritime container to deliver a weapon. C-TPAT/PIP are partnerships between the American and the Canadian governments, respectively, and the private sector to protect supply chains from concealment of terrorist weapons. Finally, the Nexus program is a collaboration of the CBSA and the Custom and Border Protection in order to simplify the border-crossing process for members while enhancing security.

2.4.1 Constructed Home Bias (CHB)

Table 2 presents constructed home bias indexes and their evolution over time for each region and each service category in our sample. Standard errors are suppressed for brevity, but due to the precision of gravity coefficients they are sufficiently small to ensure that all indexes and relationships discussed in this section are statistically significant.[30] Sectoral CHB indexes are presented in columns (1)-(9) of Table 2, while column (10) reports CHB numbers for all services. Regional CHB numbers for 2004, the year for which these indexes are constructed, are reported in the rows labeled '2004'. CHB percentage changes over the period 2004-2007 are in rows '%Δ04/07'.[31] Toward the bottom of the table (row 'All'), we aggregate CHBs across all regions for each category to obtain constructed home biases for the world. Finally, the last two rows of Table 2 report aggregate Canadian CHBs and their percentage changes, respectively.

Overall, we find significant home biases in services trade. The CHB indexes vary across regions and across service categories in a sensible way. Several clear patterns stand out. Most prominently, we estimate massive home biases for each province and territory and each service category in our sample. The implication is that internal provincial trade is significantly larger when compared to the theoretical value of internal trade in a frictionless world. At the province-service level, the CHB numbers vary between 40.8, for Wholesale Services in the case of Ontario, and 163,852, for Health Services in the case of the Yukon Territories. As compared to the provincial indexes, the estimates for US and ROW are significantly smaller (varying between 1.2 and 5.8), and much more homogeneous across the sectors. These differences are due to size (outward multilateral resistance falls and thus CHB falls with size on average; see Anderson and Yotov, 2010) and aggregation (the US states and the ROW are very large composites relative to any of Canada's provinces).

There is large, but intuitive, variation of the CHB numbers across the Canadian provinces and territories. The remote regions of the Yukon Territories (YT), the Northwest Territories

[30] Extended tables, including standard errors (SEs) for each of the CB indexes reported in Tables 2-4, are available by request. The SEs are obtained from one hundred bootstraps of the PPML gravity estimates. See Anderson and Yotov (2010) for further details.

[31] The reason for choosing the period 2004-2007 to construct and to analyze the CB numbers is that 2004 and 2007 are the only two years for which we have actual output data for the rest of the world. As discussed in the data section, our gravity estimates are not at all sensitive to interpolating and extrapolating the ROW data, needed to construct internal trade in order to obtain a complete trade data set. However, the general equilibrium indexes (MRs and CBs) showed significant sensitivity (probably due to the large size of the ROW region) and, therefore, we decided to only use the years for which we have actual ROW data.

and Nunavut (NT) and Newfoundland and Labrador (NL), and the small region of Prince Edward Island (PE), with overall CHB estimates ranging from 1685 (for NL) to 8897 (for YT), are the four regions with the largest CHB numbers. See column (10) of Table 2, where we aggregate CHBs across all sectors for each province or territory. On the opposite side of the CHB spectrum, we find the central, most industrialized and economically diversified regions of Ontario (ON) and Quebec (QC). These are the two provinces with the lowest CHB numbers of 75 for Ontario and 145 for Quebec (see column 10), revealing the least, but still very large, deviation of predicted internal trade from predicted frictionless internal trade.

Our CHB indexes for services as a whole are close to the results from Anderson and Yotov (2010), who construct provincial CHB indexes for the resource and manufacturing sectors of the Canadian economy. On average, provincial home bias is around 9% larger for services (with much of this difference due to the outlying provinces) while the correlation of services and goods CHBs across provinces is 0.95. The somewhat surprisingly small difference between services and goods CHBs arises because some gravity coefficient estimates are larger in absolute value for goods (distance, contiguity between province and state) while others are smaller for goods (provincial border, international border). In the calculations of CHBs the differing distribution of sales and expenditure shares also plays a role.

CHB variation across service categories is large but intuitive. As expected, we estimate the largest home biases for Health and for Education Services. As can be seen from the last panel of Table 2,[32] we obtain an overall, across all provinces, CHB index of 367 for Education and a corresponding number of 732 for Health. The explanation is in the nature of these services (personalized and credential related) and could be due to province-based regulations (such as health insurance and learning curriculum). Wholesale is the service category with the smallest CHB estimates for each province, which translate into an overall index of 60 for Canada. Transportation Services follow closely with low provincial estimates and an overall CHB number of 129. The fact that the regulations for Wholesale and for Transportation Services are mostly nationally (as opposed to locally) imposed, combined with significant international interdependence, coordination and regulation in these sectors, may explain our findings.

[32]It should be noted that the average indexes in panel CAN are heavily driven by Ontario, whose trade, production and expenditure shares are between 1/3 (for Transportation) and 1/2 (for Business, Education and Finance) of the total values for Canada.

Most service sectors experience falls in CHB over the 2004-2007 period. Accommodation, Finance and Health Services are the categories with the largest overall CHB decreases of 33.3% , 10.4% and 10.1%, respectively, across all Canadian regions. See the last row of Table 2. Since the main gravity coefficients are constant (and the border thickening for Canadian services exports is offset by border thinning for Canadian imports), the CHB changes are due to reallocation of shipment and expenditure shares. As in Anderson and Yotov (2010) these have shifted consistently with lowering the overall trade cost bill.

Wholesale is the only category with CHB rises in each province, which translate into an overall rise of 26.3% for Canada as a whole. This suggests that the Wholesale industry has not been subject to the intense 'globalization' forces experienced in other industries. A contributing factor is the large CHB increase for the US, which is the main Canadian trading partner.

At the provincial aggregate level, CHB changes over the period 2004-2007 are relatively small according to rows '%Δ04/07' of column 10. One explanation is that the period of investigation is too short to reflect larger effects in a period when there were no major changes in the Canadian economy nor in its main trading partner, the United States.[33] Alberta (AB) and British Columbia (BC) are the two provinces that experience the largest overall CHB decreases of 11% and 6%, respectively. The economic growth of these regions may explain our findings. Newfoundland and Labrador (NL) and Nova Scotia (NS) are the two regions with the largest CHB increases. Notably, the most developed provinces, Ontario and Quebec, have the most stable CHB indexes. An interesting regional pattern is that Western provinces enjoy CHB decreases during the period 2004-2007, whereas the Eastern provinces see their CHBs increase.

The world as a whole enjoyed a CHB decrease in of the all service sectors but Accommodation and Finance. See panel 'All' of Table 2. Our results indicate that the increase in the case of Accommodation Services is driven by the index for the rest of the world, while the increase in Finance is due to the US.

[33]In contrast, Anderson and Yotov (2010) report larger drops in CHB but over a longer horizon, 1992-2003.

2.4.2 Constructed Foreign Bias (CFB)

Table 3 presents Constructed Foreign Bias indexes and their evolution over time for each region and each service category in our sample. Sectoral CFBs are presented in columns (1)-(9) of Table 3. Column (10) reports aggregate CFB numbers for all services. Regional indexes for 2004 are reported in the rows labeled '2004', and CFB percentage changes over the period 2004-2007 are presented in rows '%Δ04/07'. Toward the bottom of the table (row 'All'), we aggregate CFBs across all regions for each category to obtain constructed foreign biases for each service in the world. Finally, the last two rows of Table 3 report aggregate Canadian CFBs and their percentage changes, respectively.

Overall, our estimates suggest significant provincial biases in services trade that vary across regions and across service categories. Several patterns stand out. First, we obtain very small CFB numbers for each province and territory in each service category in our sample. The interpretation is that provincial international trade is much smaller than its frictionless value, i.e. much of the provincial international trade *is missing* in each service industry. At the province-service level, the CFB numbers vary between 0.001, for Health in the case of Quebec, and 0.586, for Accommodation in the case of the Yukon Territories.[34]

Our CFB indexes for services are on average around 7 times smaller overall than CFBs for the agricultural, mining and manufacturing sectors of the Canadian economy constructed from data in Anderson and Yotov (2010). The explanation is mainly in the direct effects of the differences in coefficient estimates: services have larger $SAME\_REGION$ and smaller (more negative) CA_US_BORDER coefficients. Use the definition of CFB[35] and the notation (G) and (S) to denote Goods and Services. Suppose (falsely) that all coefficients other than those affecting borders are equal for services and goods. Then $t_{ii}^{1-\sigma}(G)/t_{ii}^{1-\sigma}(S) = \exp\gamma_5(G)/\exp\gamma_5(S)$. Taking the arithmetic average of point estimates of γ_5 reported for goods in Anderson and Yotov (2010) and the average estimate for services reported here, $t_{ii}^{1-\sigma}(G)/t_{ii}^{1-\sigma}(S) = 1/4.8$. The empirical finding that $CHB(S) = 1.09CHB(G)$ implies that for a representative province and generic sector $1.09t_{ii}^{1-\sigma}(G)/t_{ii}^{1-\sigma}(S) = \Pi_i^{1-\sigma}(G)/\Pi_i^{1-\sigma}(S) = 1.09/4.8$. Turning to CFB, its

[34]The two aggregate regions in our sample (US and ROW) also register significant foreign biases.

[35]CFB is defined as the ratio of predicted international trade to hypothetical frictionless international trade. Repeating (8) for a generic sector and region i, $CFB_i = \Pi_{i\bar{C}}^{1-\sigma}/\Pi_i^{1-\sigma}$.

definition implies

$$\frac{CFB_i(G)}{CFB_i(S)} = \frac{\Pi_{i\bar{C}}^{1-\sigma}(G)}{\Pi_{i\bar{C}}^{1-\sigma}(S)} \frac{\Pi_i^{1-\sigma}(S)}{\Pi_i^{1-\sigma}(G)} = \frac{\Pi_{i\bar{C}}^{1-\sigma}(G)}{\Pi_{i\bar{C}}^{1-\sigma}(S)} \frac{4.8}{1.09}.$$

Attributing all difference in the sellers incidence on foreign sales to difference in the average estimated CA-US border coefficients (exponentiating as before to obtain 1.83 as the relative difference), the right hand side of the equation yields the value 8.06, close to the actual estimated value of around 7.

To focus on the variation across sectors, we construct overall CFBs by sector for Canada. As can be seen from the last panel 'CAN' of Table 3, Accommodation and Transportation are among the service sectors with the largest CFB estimates, which means the least reduction of international trade due to trade costs. Many of the Accommodation Services are sold to foreigners, who use various Transportation modes to come to Canada. On the other side of the CFB spectrum are Health and Wholesale Services with CFB estimates that are close to zero. Local consumption and government regulations explain our findings in the case of Health Services, and there is plenty of anecdotal evidence for huge price differences and price discrimination between Canada and US, for example, which are reflected in the low CFB index for Wholesale Services.

Sectoral CFBs have decreased (i.e., moved further below 1, decreasing foreign trade) for 6 out of 9 service categories in our sample during the period 2004-2007.[36] Accommodation Services, Other Services and Transportation Services experience the largest decreases of 27 percent, 24 percent and 18 percent, respectively. See the last row of Table 3. The main reason is that Accommodation, Other and Transportation were three of the industries for which we estimate significant 'thickening' on the US border.

Notably, Health and Education are the two service categories with the largest increases in CFB (i.e., the reduction in trade due to trade costs falls) of 16 percent and 14 percent, respectively, during the 2004-2007 period. While the increase in the Health CFB index is more or less homogeneous across provinces (Alberta is the only province suffering a CFB fall), the increase in the Canada-wide CFB for Education is driven almost exclusively by Ontario and Quebec. The general equilibrium effects of changing provincial market shares drive these

[36] A negative change in the CFB index, i.e. an algebraically smaller 2007 value, implies an increase in the anti-foreign trade bias.

results, since bilateral trade costs for these sectors are essentially constant. Market share changes shift the solution values of the multilateral resistances in (2)-(3)). The effect on CFB is given by changes in (7)-(8).

The last column of Table 3 focuses on CFB variation across provinces. The indexes for the more remote and the smaller provinces and territories are larger than the corresponding numbers for the more developed regions. For example, YT and NT are the territories with the largest CFB estimates of 16 percent and 12 percent, respectively. PE has the fourth largest index of 8 percent. Quebec is the province with the smallest CFB estimate of 3.8 percent, followed by Alberta, British Columbia and Ontario with 4.1 percent each. Combined with the CHB estimates from the previous section, the CFB findings from this section imply that the more developed regions are trading more actively with the rest of Canada, while the more remote regions are relatively more open to the rest of the world. As can be seen from the last column of Table 3, the more remote and the smaller regions experience further increase in CFB, while the more developed regions suffer CFB falls. Ontario is a notable exception with an overall increase in the CHB index of 5 percent, mainly due to the large increase in the Education index for this province.

For comparison, Tables 6 and 7 from Appendix B report CFBs for goods trade constructed using the data of Anderson and Yotov (2010). Goods CFBs are well below 1; foreign trade is less than in the frictionless benchmark equilibrium, but much larger than for services trade, by an average factor greater than 7 based on comparing the bottom right hand cells of the two tables. In other words, the services trade of Canada's provinces on the whole would be more than 7 times larger if it were to be only as biased against foreign trade as is Canada's goods trade. Moreover, over time the CFB indexes are rising considerably faster in goods trade as well, by a factor greater than 10 over a period only about 3 times longer.

Another interesting experiment is to break the provincial foreign biases into CFBs with the US and CFBs with ROW. Tables 8 and 9 from Appendix B report provincial CFBs and their percentage changes over the period 2004-2007 against the rest of the world and against US, respectively. Several findings stand out. First, the difference in the CFBs vary per product. As one would expect, the US indexes are larger (i.e. less foreign bias toward the US) for most services. The difference is most pronounced for Accommodation and Transportation. An

interesting result is that the CFB indexes for ROW are larger, i.e. the foreign bias to the rest of the world is smaller, for two categories, namely Finance and Education. Second, there is a pattern in the CFB differences across provinces. In particular, we find that the ROW CFB numbers are larger relative to the US CFBs for the more remote and the smaller regions, i.e. these regions are relatively more open to trade with the rest of the world. Finally, the difference in CFB changes also varies per product, but we do not find an overall pattern.[37]

Overall, the constructed foreign bias indexes, presented in this section, and the constructed home bias indexes, discussed in the previous section, reveal that geography (acting through the gravity coefficients) and the location of activity (acting on multilateral resistance) together create tremendous disparities in the trade biases of regions. Changes in the location of activity and in some sectors of the thickness of the border have also induced significant changes in the trade biases of regions.

2.4.3 Constructed Domestic Bias (CDB)

Domestic bias raises inter-provincial services trade in Canada to more than six times its frictionless benchmark value overall as revealed in our CDB results. Deflection of domestic, inter-provincial trade (measured by CDB), is much smaller in absolute value than both the deflection in intra-provincial trade (measured by CHB) and the deflection in international trade (measured by the foreign bias CFB).

Constructed Domestic Bias indexes along with their evolution over time are presented in Table 4 for each Canadian province and territory and each service category in our sample. Sectoral CDBs are presented in columns (1)-(9) of Table 4. Column (10) reports aggregate CDB numbers for all services. Provincial indexes for 2004 are reported in the rows labeled '2004', and CDB percentage changes over the period 2004-2007 are presented in rows '%Δ04/07'. In the last two rows of the table report aggregate CDBs for Canada and their percentage changes, respectively.

The considerable variation of CDB across provinces in column (10) of Table 4 is not due to direct inter-provincial barriers (our gravity estimates find no province-province contiguity

[37]For example, the foreign bias against the US has risen faster for Transportation, Finance and Communication, and has fallen slower for Health. The foreign bias against ROW increased by more for Communication and decreased by less for Business.

effects) but to the other direct influences of geography along with general equilibrium effects that affect provinces differently. Some remote (e.g. YT) and small (e.g. PE) provinces are the regions with the highest domestic bias. They are also the regions with the highest home bias (CHB) by a much larger factor while their foreign bias (CFB) is algebraically higher (less in absolute value because closer to 1). This pattern still satisfies constraint (10) for large and small provinces because the weights for internal sales E_i/E are so much larger (while those for domestic sales $E_{D(i)}/E$ are so much smaller) for large provinces.[38]

Notably, CDB variation across provinces is much lower than is the variation of CHB, reflecting the force of localization. Compare column (10) of Table 4 with column (10) of Table 2. Over time, CDB has fallen for each of the provinces except NB, though overall considerably less than the fall in CHB (-2.6% vs. -7.2% using on the bottom right figures in Tables 2 and 4). Both changes reflect Canada's outward turn shown in the rise in overall CFB of 1.3%, the bottom right figure in Table 3.

Turning to variation across sectors, the aggregate sectoral indexes toward the bottom of Table 4 reveal that the ratio of predicted to frictionless inter-provincial trade ranges from Business and Communication on the upper bound with CDB estimates of 12 and 11.5 to Health at 1.9 on the lower bound. This is a much smaller range than for CHB reported above.

Constructed domestic bias fell for most service categories between 2004 and 2007. Wholesale and Education are the two exceptions, but while the increase in the Wholesale CDB is across all provinces, the increase in the average Canadian CDB index for Education is driven by Quebec and, especially, by Ontario. (Note that the CDBs for education have fallen for the rest of the Canadian provinces and territories). This result is consistent with the observation of Anderson and Yotov (2010) that larger shares tend to reduce sellers' incidence, hence.

Accommodation is the sector that experiences the largest aggregate fall of 36.6 percent, which is consistent across all provinces. Interestingly, Accommodation was the sector with the largest falls, across all provinces, of CHB and CFB. The simultaneous decrease in all CB indexes (i.e., CHB and CDB fall toward 1 indicating a decrease in bias while CFB falls further below 1 indicating an increase in the reduction of foreign trade) seems odd at first

[38]Intuition that constraint (10) implies that the CBs of a small province cannot all be larger than the CBs of a large province arises from inappropriately applying common weights: for a common weighting vector $w > 0, \iota' w = 1$, two vectors x, y such that w'x=1=w'y is inconsistent with $x > y$.

sight, because, as suggested by our theory, the weighted sum of the three bias indexes should always be equal to one for each province and for each service category.[39] What permits the puzzling pattern of changes is that the expenditure weights on the CBs moved significantly and in opposite directions between 2004 and 2007. As a check on calculations, we confirmed this restriction for each province-service combination. Table 5 shows this for Accommodation in the case of Ontario.[40] As can be seen from the table, Canadian expenditures and Ontario's own expenditures on Accommodation have risen during the period 2004-2007, but the rest of the world, including US, has spent significantly less on Accommodation Services. More weight is being shifted the larger Home and Domestic bias indexes and less weight to the smaller Foreign bias, offsetting the fall in all three indexes at constant weights. This is what makes the simultaneous decrease in all three constructed bias numbers possible and, at the same time, consistent with our theory.

2.4.4 CFB/CDB Results

Tables 3 and 4 imply very small ratios of CFB/CDB. For example, overall the ratio of foreign to interprovincial trade is 0.1% of its potential value if frictions acted neutrally, as in a frictionless world. Equation (9) implies that the sellers' incidence of trade costs on foreign sales greatly exceeds the same seller's incidence of trade costs on domestic sales. Using (8), solve for relative incidence as a function of CFB/CDB using elasticities of substitution σ ranging from 6 to 10. The results from column (10) of Tables 3 and 4 imply that overall services sellers' incidence on foreign sales $\Pi_{\bar{C}}$ is 2 to 4 times larger than sellers' incidence on domestic sales Π_C, equivalent to a sellers' incidence surcharge on foreign relative to interprovincial sales of 100% to 300%.

The relative sellers' incidence comparison $\Pi_{\bar{C}}/\Pi_C$ is a useful complement to the direct bilateral estimate of the international border effect inferred from the estimated gravity equation. Section 2.3 reports the trade cost factor equivalent of the border as ranging from 1.52 to 2.11. The difference between the two measures is attributable to the relative incidence measure (i) including relative distance and contiguity as components of bilateral relative trade costs and (ii) general equilibrium multilateral effects of trade costs.

[39] The structure of (5) and (8) makes clear that the movement of the three indexes reflects general equilibrium comparative static forces that allow for same sign movements of all three indexes when shares change.

[40] The numbers for the rest of the provinces are qualitatively identical.

3 Conclusion

This paper measures the major geographic impediments to Canadian service trade by sector and province during the period 1997-2007. Border fixed effects for local, interprovincial and international trade reflect differential treatment of outsiders by regulators as well as a host of other policy and non-policy barriers to trade. These and other geographic determinants deflect trade from its hypothetical frictionless benchmark, measured by Constructed Bias indexes defined using the structural gravity model.

We find significant and large border effects reducing service trade flows in each direction. We also provide evidence for changes (mostly thickening) in the border effects in the post 9/11 period. Finally, we see some directional asymmetries in both our border and thickening estimates. Some differences in directional border effects appear to be due to composition effects within the nine service categories in our sample. This points to the need for analysis of more disaggregated service data.

Methodologically we offer new Constructed Bias indexes incorporating general equilibrium third party effects on bilateral trade. The Constructed Bias indexes shed light on how trade barriers affect service trade patterns. Constructed Home Bias (CHB) is large for all services, but on the whole only slightly larger than for goods. Thus the lower CFB in services is not due to greater home bias (localization) at the provincial level. Constructed Foreign Bias (CFB) is some 7 times lower on average for services than for goods trade, quantifying the widely held qualitative judgment that the direct and indirect effects of barriers to trade in services are much larger than for goods.

The magnitude of services trade barriers found in our study suggests potential large gains from globalization over time, especially if speeded up by deliberate policy efforts to liberalize services trade. The similar CHBs of services and goods trade suggest the potential for CFBs to also be similar, implying a seven-fold potential rise in services trade across borders. Large welfare improvement for the Canadian economy would result from even a partial fall of the services border barrier toward that for goods.

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Table 1: PPML Panel Gravity Estimates, Services, 1997-2007

	(1) TOTAL	(2) TRANSP	(3) COMNCN	(4) WHLSALE	(5) FINNCE	(6) BUSINS	(7) EDUCTN	(8) HEALTH	(9) ACOMDN	(10) OTHER
DISTANCE	-0.671	-0.617	-0.297	-0.563	-0.678	-0.928	-1.010	-1.420	-0.927	-0.724
	(0.191)**	(0.160)**	(0.163)+	(0.162)**	(0.276)*	(0.226)**	(0.205)**	(0.187)**	(0.168)**	(0.168)**
CONTIG_PR_PR	-0.034	0.084	0.216	0.341	-0.328	-0.420	-0.394	-0.228	0.008	0.129
	(0.264)	(0.235)	(0.251)	(0.171)*	(0.401)	(0.337)	(0.278)	(0.295)	(0.246)	(0.248)
CONTIG_PR_ST	1.144	1.128	0.665	0.482	1.336	1.069	0.835	0.792	0.757	1.287
	(0.213)**	(0.267)**	(0.191)**	(0.283)+	(0.298)**	(0.235)**	(0.265)**	(0.307)**	(0.225)**	(0.172)**
SAME_REGION	1.405	1.044	2.377	1.199	1.653	0.333	1.823	2.536	1.134	1.886
	(0.629)*	(0.532)*	(0.551)**	(0.505)*	(0.944)+	(0.794)	(0.549)**	(0.586)**	(0.574)*	(0.541)**
BRDR_CA_US	-3.744	-3.569	-3.719	-5.302	-4.045	-3.777	-3.551	-5.099	-2.236	-2.893
	(0.295)**	(0.276)**	(0.221)**	(0.389)**	(0.460)**	(0.365)**	(0.344)**	(0.500)**	(0.215)**	(0.313)**
BRDR_US_CA	-3.416	-3.014	-3.013	-5.124	-4.351	-3.009	-2.409	-1.408	-1.878	-2.586
	(0.231)**	(0.279)**	(0.194)**	(0.344)**	(0.301)**	(0.270)**	(0.293)**	(0.338)**	(0.221)**	(0.231)**
BRDR_ROW_CA	-2.433	-2.786	-3.170	-4.839	-1.750	-2.648	-1.268	-3.233	-1.041	-2.212
	(0.279)**	(0.261)**	(0.217)**	(0.246)**	(0.323)**	(0.310)**	(0.343)**	(0.330)**	(0.227)**	(0.316)**
BRDR_ROW_US	-0.908	-0.676	-2.530	-0.041	-0.312	-1.705	0.297	-0.717	-0.865	-1.236
	(0.238)**	(0.204)**	(0.222)**	(0.181)	(0.334)	(0.314)**	(0.216)	(0.230)**	(0.220)**	(0.234)**
THICK_CA_US	0.161	-0.076	0.091	0.224	-0.175	0.306	-0.170	1.028	0.416	0.513
	(0.019)**	(0.064)	(0.075)	(0.197)	(0.046)**	(0.048)**	(0.037)**	(0.083)**	(0.049)**	(0.114)**
THICK_US_CA	-0.138	-0.134	0.023	-0.244	0.330	-0.348	0.390	-1.119	-0.502	-0.540
	(0.037)**	(0.054)*	(0.042)	(0.200)	(0.030)**	(0.096)**	(0.033)**	(0.078)**	(0.056)**	(0.113)**
_cons	6.241	4.094	0.584	3.172	4.789	6.211	2.635	6.724	5.236	4.565
	(1.746)**	(1.532)**	(1.835)	(1.608)*	(2.372)*	(2.026)**	(1.549)+	(1.237)**	(1.350)**	(1.393)**
N	1173	1173	1173	1173	1173	1173	1173	1173	1173	1173
ll	-259346.535	-36914.246	-14931.003	-150530.828	-80497.699	-53542.761	-3518.936	-3260.472	-25835.737	-28734.000

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 nominal trade. When estimating directional effects, we use CA_US to capture Canadian exports to US and US_CA to denote US exports to Canada. Each estimation is performed with directional (source and destination), time-varying fixed effects. Fixed effects estimates are omitted for brevity. The years employed in the estimations are 1997, 1999, 2001, 2003, 2005 and 2007. See main text for further details.

Table 2: Constructed Home Bias (CHB) Indexes and Their Evolution Over Time

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RGN	Year	TRANSP	COMNCN	WHLSALE	FINNCE	BUSINS	EDUCTN	HEALTH	ACOMDN	OTHER	ALL
AB	2004	178.2	384.6	123.6	264.2	367.4	851.4	1725.2	522	263.7	232.7
	%Δ04/07	-14.1	-16.7	7.3	-17.2	-16.3	-.7	-13.1	-39.5	-15.1	-11.1
BC	2004	187.8	363	135.6	229.1	468.1	664.8	1292.9	470.5	262.2	239.7
	%Δ04/07	-10.1	-11.8	18.5	-13.4	-15.1	-4.8	-13.8	-35.6	-10.3	-5.5
MB	2004	472	1030.9	322.8	873.2	1595.2	3235.7	5195.8	1767.7	1017.4	667.4
	%Δ04/07	-9.7	-11.3	19.9	-10.8	-9	-2.1	-7.1	-31	-7	-1.7
NB	2004	563.3	1305	338	1180.6	1265.1	3946.4	8651.1	1708.6	1215.5	811.4
	%Δ04/07	-5.2	-8.5	24.6	-9.1	-4	.3	-10.5	-27.9	-5	4.6
NL	2004	1268.5	1926.9	692.5	2370.6	3159.1	7552.3	13761.5	4017.6	2358.1	1685.2
	%Δ04/07	-6.4	.7	24.4	-11.3	-4.6	-2	-8.8	-27.3	-3.2	5
NS	2004	744.6	1265	398.5	1107.8	1596.8	2553.8	6553.2	1997.6	1169.2	910.7
	%Δ04/07	-3.8	-14.4	26.6	-9.2	-4.4	3.6	-12	-28.4	-1.2	5.8
NT	2004	1414.8	3586.8	969.2	4325.7	5140.4	28621.3	67085.3	5596.3	4803.3	2981.4
	%Δ04/07	-8.5	-7.2	16.7	-11.2	-12.7	-11	-11.5	-22.7	-2.3	-5.2
ON	2004	87.1	112.8	40.8	70.2	119.1	226.2	436	190.5	86.2	75.3
	%Δ04/07	-2.7	-9.2	26.1	-10.8	-8.5	-4.8	-10.4	-34.3	-4.9	1.3
PE	2004	2039.5	4063.6	1153.5	4231.6	4450.6	15990.8	40101.7	6774.4	5426.1	3739.7
	%Δ04/07	-6.2	-10.2	23.3	-10	-7.2	-4.4	-9.5	-25.2	-2.7	3.1
QC	2004	150.2	208.4	71.8	157.5	247.1	567.7	1016	359.8	159.5	144.7
	%Δ04/07	-4	-7	23.3	-10	-7.4	-3.8	-7	-30.9	-4.1	1.8
SK	2004	433.5	1078.7	297.3	902.4	1412.9	3268.2	6657.8	1600.1	977	609.8
	%Δ04/07	-6.2	-7.9	13.6	-15.4	-15.9	4	-11.9	-31.4	-13.4	-2.4
YT	2004	3774.3	6345.2	2753	10921.8	13836.8	89625.5	163852	13333.6	12479.3	8897.1
	%Δ04/07	-9.7	-9.4	17.7	-12.3	-11.6	-6.6	-13.9	-23.9	-7	-3.9
CAN	2004	129.4	167.7	60.2	107.7	177	366.9	732.4	293.6	134	161.8
	%Δ04/07	-3.8	-8.6	26.3	-10.4	-8	-5.3	-10.1	-33.3	-4.8	-7.2
USA	2004	5.2	2	2.9	1.6	4.1	5.8	5.6	5.4	5.7	2.5
	%Δ04/07	13	9.8	50.5	4.7	3.6	11.1	11.4	-20.5	12.5	7
ROW	2004	1.2	2	1.5	2.8	1.3	1.2	1.2	1.2	1.2	1.3
	%Δ04/07	-2.2	-8	-15	-6.7	-.9	-1.8	-2.1	6.6	-2	-2.2
All	2004	1.4	2.1	1.8	1.9	1.6	1.4	1.4	1.4	1.5	1.6
	%Δ04/07	-3.4	-.3	-17.3	3.3	-1	-2.8	-3.2	9.6	-3.1	-2

Notes: This table reports Constructed Home Bias (CHB) indexes by region and service sector in 2004. It also lists gross CHB percentage changes over the period 2004-2007. See text for description of the CHB index and discussion of results. An extended table, including standard errors for each of the CB indexes reported here, is available by request.

Table 3: Constructed Foreign Bias (CFB) Indexes and Their Evolution Over Time

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RGN	Year	TRANSP	COMNCN	WHLSALE	FINNCE	BUSINS	EDUCTN	HEALTH	ACOMDN	OTHER	ALL
AB	2004	.083	.05	.007	.034	.104	.07	.003	.222	.081	.041
	%Δ04/07	-15.2	-6.2	-3	-6	-13.6	-7.8	-3.9	-28.7	-27.7	-5.1
BC	2004	.095	.049	.007	.033	.124	.068	.002	.21	.072	.041
	%Δ04/07	-16.6	-13.3	1.8	-10.2	-2.2	-6.3	22.7	-18.3	-22.9	-4.1
MB	2004	.129	.087	.011	.065	.179	.107	.003	.276	.106	.065
	%Δ04/07	-18.5	-5.1	7.1	-9.1	-4.6	-7.5	1.6	-19.9	-24	-1.5
NB	2004	.158	.114	.013	.102	.259	.164	.004	.385	.162	.091
	%Δ04/07	-16.1	-6.3	9.4	-.8	-1	6.9	30.1	-18.1	-23.4	4.3
NL	2004	.12	.092	.012	.08	.173	.174	.002	.369	.11	.069
	%Δ04/07	-9.9	-3.7	19.1	-3.9	8	-7.1	27.8	-17.2	-20.7	7.8
NS	2004	.103	.072	.011	.064	.158	.106	.002	.313	.09	.058
	%Δ04/07	-12.7	-4.8	17.8	.3	4.8	4.3	33.1	-18.7	-24.3	7.9
NT	2004	.163	.127	.017	.149	.301	.407	.005	.583	.175	.123
	%Δ04/07	-11.2	-7.7	14.2	-3	-3.8	-8.1	27.8	-14.1	-15.9	1.7
ON	2004	.075	.043	.007	.04	.13	.053	.003	.137	.077	.041
	%Δ04/07	-20	-10	8.1	4.2	1.9	25.7	14	-32.4	-23.5	4.8
PE	2004	.128	.118	.014	.093	.179	.182	.002	.369	.156	.082
	%Δ04/07	-13.1	-5.8	16	.3	1.4	5	28.6	-16.6	-24.3	7.5
QC	2004	.081	.048	.006	.034	.122	.055	.001	.141	.07	.038
	%Δ04/07	-19.3	-5.7	9	-6.5	-.2	15.7	22.1	-21.3	-23.3	-.5
SK	2004	.135	.094	.012	.076	.2	.153	.004	.358	.127	.069
	%Δ04/07	-14.2	-8.3	2.7	-11.2	-9.1	-11.4	1.9	-19.2	-27.2	-3.7
YT	2004	.26	.194	.025	.203	.374	.404	.003	.586	.309	.164
	%Δ04/07	-14.5	-7.7	8.4	-6.2	-4.4	-9.1	5	-12.3	-18.8	3.8
CAN	2004	.084	.048	.007	.039	.127	.06	.002	.161	.077	.042
	%Δ04/07	-17.9	-8.8	6.7	-1.8	-1.4	13.9	16.3	-27.1	-23.9	1.3
USA	2004	.087	.01	.145	.067	.046	.093	.002	.045	.048	.057
	%Δ04/07	16.1	10	31	6	4.3	-4.3	0	33.3	6.3	8.2
ROW	2004	.111	.008	.127	.047	.024	.025	.007	.038	.01	.049
	%Δ04/07	-5.4	0	-4.7	-6.4	0	12	0	-26.3	10	8.9
All	2004	.107	.009	.13	.062	.028	.031	.005	.04	.013	.052
	%Δ04/07	-2.4	.3	-.7	.8	-.5	6.8	-1	-15.4	8	7.4

Notes: This table reports Constructed Foreign Bias (CFB) indexes by region and service sector in 2004. It also lists gross CFB percentage changes over the period 2004-2007. See text for description of the CFB index and discussion of results. An extended table, including standard errors for each of the CB indexes reported here, is available by request.

Table 4: Constructed Domestic Bias (CDB) Indexes and Their Evolution Over Time

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RGN	Year	TRANSP	COMNCN	WHLSALE	FINNCE	BUSINS	EDUCTN	HEALTH	ACOMDN	OTHER	ALL
AB	2004	9.456	10.413	5.985	3.467	9.575	3.955	2.186	10.353	4.569	5.743
	%Δ04/07	-3.4	-5.8	12.7	-10.2	-18.7	-10.3	-24.2	-38.3	-10.2	-4.3
BC	2004	9.37	9.369	4.862	3.029	9.763	3.526	.992	7.66	3.126	4.752
	%Δ04/07	-5.8	-15.6	22	-15.5	-3	-7.4	5.7	-25.3	-3	-5.4
MB	2004	14.564	18.469	8.901	6.941	16.78	6.545	1.806	12.706	5.422	9.604
	%Δ04/07	-8.3	-6.2	23.9	-14.5	-8.2	-11	-17.9	-28.4	-5.8	-1.2
NB	2004	20.553	25.619	12.797	12.326	31.323	15.846	7.317	26.709	10.678	15.542
	%Δ04/07	-5	-8.5	21.6	-8.8	-11.9	-4.5	-4.8	-28.9	-6.2	.6
NL	2004	18.555	26.058	11.027	10.095	20.159	9.55	2.5	19.043	7.248	13.232
	%Δ04/07	-3.6	-9	22	-15.3	-2.6	-16.2	-12.6	-30.6	-3.6	-1.8
NS	2004	18.518	20.545	10.356	10.118	25.224	8.533	5.847	22.614	7.479	12.288
	%Δ04/07	-6.4	-9.6	22.1	-11.4	-6.2	-7.2	-8.9	-32.1	-8.2	-.4
NT	2004	25.872	39.273	17.261	17.288	30.849	16.207	3.868	26.245	11.519	21.158
	%Δ04/07	-5.9	-12.4	21.1	-13.1	-10.6	-13.1	-5.6	-27.6	3.1	-3.9
ON	2004	8.017	11.142	6.241	4.966	12.068	4.275	2.164	6.939	4.435	6.383
	%Δ04/07	-10.5	-12.8	22.5	-1.5	-7	17.4	-14.3	-43	-7.6	-.4
PE	2004	28.607	36.534	16.065	20.01	45.798	28.239	10.429	36.664	17.532	21.52
	%Δ04/07	-6.7	-10.7	21.1	-11.4	-10.9	-4.9	-12.7	-30	-7.9	-.4
QC	2004	10.638	11.457	6.485	3.69	12.721	4.866	1.3	9.959	4.537	6.163
	%Δ04/07	-8.2	-7.5	23.7	-15.1	-10.1	1.4	-7.6	-27.5	-6.8	-3.9
SK	2004	16.353	20.651	10.467	8.727	21.434	10.239	3.089	17.939	7.104	11.476
	%Δ04/07	-3.5	-10.4	21	-16.9	-12.8	-14.5	-16.2	-27.8	-10	-2.6
YT	2004	24.947	39.113	17.088	18.549	30.445	15.564	1.981	19.174	13.291	20.513
	%Δ04/07	-5.7	-9.5	20.9	-12.8	-8.1	-10.7	-19.4	-24.5	-.8	-.2
CAN	2004	9.59	11.5	6.394	4.464	12.076	4.546	1.894	8.529	4.465	6.362
	%Δ04/07	-7.6	-11.2	21.3	-8.1	-9.5	6.1	-11.6	-36.6	-7.5	-2.6

Notes: This table reports Constructed Domestic Bias (CDB) indexes by region and service sector in 2004. It also lists gross CDB percentage changes over the period 2004-2007. See text for description of the CDB index and discussion of results. An extended table, including standard errors for each of the CB indexes reported here, is available by request.

Table 5: CBs, Accommodation-Ontario

Index	Year	CB	Expenditures
CDB	2004	6.939	28096.36
	2007	3.957	34429.68
CFB	2004	.137	4447077
	2007	.092	3401265
CHB	2004	190.488	19383.64
	2007	125.121	24053.15

Appendix A: Service sectors description

Transportation and Storage Services: Air, water and rail passenger and freight transportation; Bus (including school), ambulance and truck transportation; Urban transit and taxi transportation; Pipeline transportation of natural gas and oil; Grain and other storage; Warehousing. *Communication Services:* Radio, television broadcasting; Cable programming; Telephone and telecommunication; Postal and courier. *Finance, insurance and real estate services:* Paid charges to financial institutions; commissions and investment banking; Mutual funds, Other securities and royalties; Real estate commissions; Life and non-life insurance; Pension funds; Paid residential and non-residential rent and lodging.*Professional Services*: Architect, engineering, scientific, accounting, legal, advertising and other professional services; software, computer lease, data processing and other information services; Investigation and security services; Other administrative and personal services. *Education Services*: Elementary, Secondary, College and University fees and tuition. Other education fees. *Health care and Social assistance Services*: Private hospital, private residential care and other health and social services; Child care outside the home; Laboratory, physician and dental services; Other health practitioner services. *Accommodation Services and Meals*: Hotel, motel and other accommodation; Meals outside the home; Board paid. *Wholesale Services*: Wholesale trade and wholesaling margins. *Miscellaneous Services*: Beauty and other personal care services; Funeral services; Child care in the home; Private household services; Photographic, laundry and dry cleaning, services to building and dwellings; Automotive and other repair and maintenance; Rental of office, machinery, equipment, automobile and truck; Trade union and other membership organization dues and political parties contribution; Motion picture production, exhibition and distribution; Lottery, gambling and other recreation services.

Appendix B: Constructed Foreign Bias Goods

The data used to construct the goods CFB numbers from Tables 6 and 7 are from Anderson and Yotov (2010). Their study covers the period 1992-2003 for 19 commodities.[41], The trading

[41]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

partners in their sample include all Canadian provinces and territories, the fifty US states and the District of Columbia, and the rest of the world (ROW). See Appendix A from Anderson and Yotov (2010) for a detailed description of the data, the data sources, and the data procedures.

(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.

Table 6: Constructed Foreign Bias (CFB) Indexes and Their Evolution Over Time

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
AB	1996	.311	.805	.259	.071	.049	.025	.566	.104	.456	.003
	%Δ92/03	-57.7	187.7	-11.4	50.1	86.8	402.5	-26.6	-40.5	32.4	169.6
BC	1996	.306	.861	.318	.267	.108	.16	.706	.241	.737	.011
	%Δ92/03	7.2	716.7	38.3	146.3	153.4	697.8	-22.5	51.4	53.4	94.9
MB	1996	.411	.76	.31	.2	.067	.102	.562	.272	.495	.009
	%Δ92/03	-5.3	240.5	-6.4	117.8	88.4	756.4	-23.5	8.1	42.7	208.5
NB	1996	.35	.47	.386	.24	.114	.111	.582	.27	.607	.011
	%Δ92/03	-7.4	191.1	-16.8	143.6	64.5	649.5	-39.6	-45.3	34.3	228.8
NL	1996	.619	.337	.478	.213	.099	.043	.692	.294	.671	.014
	%Δ92/03	1	126.6	-14.2	99.2	60.3	338.4	-26.6	-52	48.6	244.6
NS	1996	.352	.388	.365	.144	.063	.036	.563	.18	.52	.008
	%Δ92/03	-14.5	173.2	-23.3	87.4	52.8	269.4	-25.1	-37.3	28.8	215
NT	1996	.879	.682	.575	.285	.128	.049	.805	.499	.795	.025
	%Δ92/03	3.2	178.2	.3	140.5	63.3	513.3	-23	-65.1	58.9	209
ON	1996	.116	.553	.218	.198	.071	.101	.413	.312	.452	.009
	%Δ92/03	7.5	400.4	-2.3	184.6	123.1	735.2	-9.5	-.1	29.5	183.1
PE	1996	.405	.057	.427	.127	.057	.041	.576	.195	.435	.009
	%Δ92/03	-21.3	77.4	-32	62.3	24.4	176.9	-26.1	-47.2	9.4	182
QC	1996	.109	.562	.213	.158	.067	.155	.437	.261	.495	.009
	%Δ92/03	-6.6	324.4	-.1	133.6	124.9	581.2	-24.4	-32.4	24	172.9
SK	1996	.505	.711	.349	.125	.067	.078	.618	.137	.529	.006
	%Δ92/03	-25.3	166.9	-10.6	89.3	54.4	741.7	-28.5	-10.9	45.1	174
YT	1996	.817	.76	.623	.387	.153	.123	.799	.356	.74	.022
	%Δ92/03	1.6	176.6	2.5	179.2	78.9	831.2	-51.3	-76.8	44.6	163.3
CAN	1996	.195	.792	.241	.186	.069	.131	.577	.28	.527	.009
	%Δ92/03	-15.3	259.2	-.7	161.2	124.7	648	-27.9	-6.5	29.7	152.2
USA	1996	.278	.022	.387	.224	.471	.619	.277	.091	.249	.204
	%Δ92/03	-9.2	2.8	-34.7	6	55.1	74.4	-52.5	-82	47.8	153.2
ROW	1996	.057	.348	.296	.331	.426	.738	.187	.194	.089	.176
	%Δ92/03	30.9	115.6	-6.8	245.4	103.1	1229	92.5	75.4	58	136.3
All	1996	.091	.03	.31	.299	.423	.701	.227	.137	.165	.181
	%Δ92/03	29.9	43.5	-11.5	78	89.4	500.4	-10.6	-58.4	91.1	129.5

Notes: This table reports Constructed Foreign Bias (CFB) indexes by region and commodity in 1996 It also lists the CFB percentage changes over the period 1992-2003. See text for description of the CFB index and discussion of results.

Table 7: Constructed Foreign Bias (CFB) Indexes and Their Evolution Over Time

		(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
AB	1996	.178	.036	.047	.072	.231	.094	.4	.23	.012	.295
	%Δ92/03	-12.6	-1.4	86.6	-12.9	-49.3	-51.1	-53.8	-52.7	69.6	9.6
BC	1996	.364	.154	.146	.307	.471	.456	.792	.348	.03	.58
	%Δ92/03	32.5	67.7	276.8	90.6	-15.3	46.8	14.8	-34.1	251.1	34.4
MB	1996	.368	.118	.17	.312	.419	.258	.436	.255	.028	.32
	%Δ92/03	28.6	19.1	105.5	29.5	-37.7	-34.2	-20.4	-36.7	76	10.2
NB	1996	.505	.196	.148	.301	.422	.317	.54	.261	.054	.493
	%Δ92/03	38.7	29.1	61.8	-13.7	-28.2	20.4	21.3	-51.4	71.5	8.4
NL	1996	.618	.178	.228	.319	.503	.362	.293	.428	.063	.481
	%Δ92/03	74.2	-23.1	-22.1	-51	-58.5	-46.7	-27.4	-65.2	4.9	-39
NS	1996	.518	.11	.096	.171	.363	.198	.153	.215	.039	.34
	%Δ92/03	46.3	-10.9	29	-40	-44.6	-32.2	-23.6	-64.1	9	2.4
NT	1996	.564	.294	.354	.383	.597	.54	.652	.612	.115	.537
	%Δ92/03	84.6	-33.4	-37.7	-49.2	-58.5	-23.9	-42.6	-49.5	-16.8	41.1
ON	1996	.325	.133	.091	.299	.317	.257	.325	.19	.018	.244
	%Δ92/03	18.9	39.9	255.2	10.7	-4.9	18.8	-33.3	-54.2	290	10.8
PE	1996	.584	.122	.152	.191	.4	.128	.107	.173	.054	.403
	%Δ92/03	33.6	-21.5	-28.2	-45.3	-59.5	-25.8	-8.2	-61.2	-32.7	-26.5
QC	1996	.337	.14	.067	.266	.409	.238	.449	.167	.027	.278
	%Δ92/03	25.7	34.1	251.1	6	17	19.5	20.3	-58.2	207.1	27.8
SK	1996	.269	.08	.101	.197	.361	.169	.502	.266	.027	.415
	%Δ92/03	13.2	14.6	118.9	25.2	-50.7	-40.1	-10	-45.2	53.8	.4
YT	1996	.622	.245	.334	.432	.565	.535	.757	.624	.109	.548
	%Δ92/03	53.6	-16	-55.2	-28.3	-69.4	67	30.4	6.3	5.8	-9.2
CAN	1996	.326	.126	.088	.293	.354	.266	.419	.194	.021	.31
	%Δ92/03	20.5	39.7	237.1	12.5	1.4	15.5	-13.3	-54.6	250.4	16.7
USA	1996	.171	.166	.148	.112	.319	.094	.376	.235	.066	.262
	%Δ92/03	26.9	-54.9	-78.3	-43.8	-43.6	-47.4	-31.2	-59.5	-60.6	-23.5
ROW	1996	.252	.127	.197	.196	.403	.16	.069	.089	.221	.253
	%Δ92/03	158.2	18.1	95.8	69.6	-9.2	112.9	-77.9	5.4	319.7	42.8
All	1996	.232	.145	.171	.163	.377	.132	.146	.14	.089	.257
	%Δ92/03	114.2	-28.7	-27.1	.1	-32.8	-14.4	-5.7	-22.1	-27.9	3.1

Notes: This table reports Constructed Foreign Bias (CFB) indexes by region and commodity in 1996 It also lists the CFB percentage changes over the period 1992-2003. See text for description of the CFB index and discussion of results.

Table 8: Constructed Foreign Bias (CFB) against ROW

RGN	Year	TRANSP	COMNCN	WHLSALE	FINNCE	BUSINS	EDUCTN	HEALTH	ACOMDN	OTHER
AB	2004	.043	.038	.005	.055	.066	.074	.001	.15	.049
	%Δ04/07	-9.2	-4.9	4.5	-8	-12.8	-9.7	7.8	-18.9	-28.3
BC	2004	.046	.036	.004	.051	.071	.071	.001	.13	.041
	%Δ04/07	-10.3	-11.8	11	-11.8	-1.2	-8.2	39	-6.5	-23.4
MB	2004	.063	.064	.007	.1	.104	.111	.001	.172	.06
	%Δ04/07	-12.4	-3.5	16.8	-10.7	-3.6	-9.4	15.1	-8.2	-24.6
NB	2004	.081	.086	.009	.161	.158	.174	.001	.252	.096
	%Δ04/07	-10	-4.9	18.4	-2.8	-.1	4.7	46.5	-6.6	-24
NL	2004	.11	.106	.011	.194	.181	.2	.001	.357	.11
	%Δ04/07	-8.7	-5.5	17.8	-9.6	7.7	-8.8	34.4	-9.5	-22.1
NS	2004	.091	.081	.009	.151	.159	.121	.001	.289	.088
	%Δ04/07	-11.1	-6.3	18.2	-5.4	4.6	2.3	42.2	-10.6	-25.6
NT	2004	.152	.148	.016	.363	.32	.47	.003	.572	.177
	%Δ04/07	-10.2	-9.4	12.4	-8.8	-4.1	-9.8	33.8	-6.3	-17.5
ON	2004	.031	.029	.004	.053	.059	.052	0	.069	.037
	%Δ04/07	-13	-8.1	21.3	3.3	3.3	22.9	31.5	-21.3	-23.9
PE	2004	.111	.13	.012	.217	.175	.206	.001	.331	.15
	%Δ04/07	-11.3	-7.1	17.3	-5.2	1.3	3	38.5	-7.9	-25.5
QC	2004	.036	.034	.004	.048	.062	.056	0	.078	.036
	%Δ04/07	-12.7	-3.9	20.8	-7.6	1	13.2	39.9	-9	-23.8
SK	2004	.069	.071	.008	.12	.122	.162	.001	.234	.075
	%Δ04/07	-8	-6.9	11.1	-13	-8.3	-13.3	14.7	-7.8	-27.8
YT	2004	.162	.163	.019	.375	.297	.45	.002	.477	.223
	%Δ04/07	-9.8	-7	12.5	-9.2	-4	-10.9	13.9	-2.1	-19.7

Notes: This table reports provincial Constructed Foreign Bias (CFB) indexes, and the corresponding percentage changes 2004-2007, against the rest of the world.

Table 9: Constructed Foreign Bias (CFB) against US

RGN	Year	TRANSP	COMNCN	WHLSALE	FINNCE	BUSINS	EDUCTN	HEALTH	ACOMDN	OTHER
AB	2004	.257	.061	.012	.022	.225	.046	.01	.556	.233
	%Δ04/07	-10.3	-3.8	22.1	-9.4	-12.1	4.3	1	-48.3	-19.8
BC	2004	.308	.062	.012	.023	.291	.053	.008	.574	.221
	%Δ04/07	-11.3	-10.8	29.7	-13.1	-.4	6	30.2	-40.4	-14.4
MB	2004	.421	.109	.019	.046	.421	.084	.011	.756	.326
	%Δ04/07	-13.4	-2.3	36.5	-12.1	-2.8	4.6	7.8	-41.5	-15.7
NB	2004	.501	.142	.023	.068	.581	.117	.016	1	.479
	%Δ04/07	-11.1	-3.8	38.4	-4.3	.7	20.9	37.2	-40.5	-15
NL	2004	.164	.078	.014	.015	.145	.036	.004	.422	.107
	%Δ04/07	-9.8	-4.3	37.7	-10.9	8.6	5.3	25.9	-42.4	-12.9
NS	2004	.155	.064	.013	.014	.157	.027	.005	.423	.101
	%Δ04/07	-12.2	-5.1	38.2	-6.8	5.5	18.1	33.2	-43.1	-16.8
NT	2004	.216	.106	.019	.027	.239	.078	.009	.634	.163
	%Δ04/07	-11.2	-8.3	31.4	-10.1	-3.3	4.1	25.3	-40.3	-7.7
ON	2004	.269	.056	.013	.032	.356	.059	.013	.447	.269
	%Δ04/07	-14.1	-7	41.7	1.8	4.1	41.9	23.3	-49.9	-14.9
PE	2004	.206	.106	.018	.022	.195	.053	.005	.546	.188
	%Δ04/07	-12.3	-6	37.1	-6.6	2.1	19	29.8	-41.3	-16.8
QC	2004	.279	.062	.012	.025	.314	.053	.006	.427	.234
	%Δ04/07	-13.7	-2.8	41.2	-9	1.9	30.7	31	-42.1	-14.8
SK	2004	.427	.117	.02	.051	.448	.108	.016	.927	.375
	%Δ04/07	-9.1	-5.8	29.9	-14.3	-7.5	.2	7.5	-41.3	-19.3
YT	2004	.693	.225	.036	.105	.622	.164	.01	1.084	.722
	%Δ04/07	-10.8	-5.8	31.5	-10.6	-3.2	2.9	6.7	-37.7	-10.2

Notes: This table reports provincial Constructed Foreign Bias (CFB) indexes, and the corresponding percentage changes 2004-2007, against US.