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There is a well-established literature finding that the Canada-U.S. border has a large dampening effect on trade, is asymmetric, and differs across provinces. In this paper, I demonstrate that the standard gravity model used to obtain these results provides biased estimates of the volume of trade. I attribute this to heterogeneity bias and reestimate the effects of the border using a gravity model that allows for heterogeneous gravity equations. Doing so does not alter the general results of existing studies, although it does yield a border effect that is 40 percent larger, reverses the border's asymmetry, and indicates very different provincial effects. (JEL F14, F15, R10)

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The United States and Canada are each others' largest trading partners, and the volume of trade between them is the greatest between any two countries in the world. In 1999, Canada imported C$215 billion of merchandise from the U.S., which accounted for more than 2/3 of total Canadian merchandise imports, and 23% of total U.S. merchandise exports. In the same year, Canada exported C$286 billion of merchandise to the U.S., which accounted for 87% of total Canadian merchandise exports, and 19% of total U.S. merchandise imports. Typically, the U.S. trades about as much with Canada as it does with all 15 countries of the European Union combined, and its trade with Ontario alone exceeds its trade with Japan.

This volume of trade is perhaps not surprising when one considers that the two countries share many economic and cultural similarities, that nearly 90% of the Canadian population lives within 100 miles (161 km) of the U.S. border, and that the border between Canada and the 48 contiguous states stretches for almost 4000 miles (over 6400 km). Also, starting with the 1965 Auto Pact, there has been an almost uninterrupted trend towards freer bilateral trade, culminating in the 1988 Canada-U.S. Free Trade Agreement, subsequently deepened and broadened by the North American Free Trade Agreement (NAFTA).

What is surprising about Canada-U.S. trade is not how large it is compared to trade between other international trading partners, but how small it is compared with the level of trade within the two countries. As an illustration of this, refer to table 1, which summarizes the volume of trade between British Columbia and other Canadian provinces relative to its trade with comparable U.S. states. The left side of the table provides for six provinces their total trade with British Columbia as a share of their GDP. The right side of the table provides the same information for a state that is a comparable distance from British Columbia. If the two countries were truly integrated, and the international border between them did not matter, then these two numbers would be roughly the same. However, in all cases the province is a far more important a trading partner than is the corresponding state, usually by an order of magnitude. Because this arises despite the amount of trade between the two countries, it provides a nearly ideal real-world laboratory for estimating the extent of 'home bias', a measure of the degree to which markets are segmented by international borders.

In an influential paper, John McCallum (1995) used a gravity model to estimate that in 1988, trade between provinces within Canada was 22 times the expected amount of trade between the provinces and the states of the U.S..[1] McCallum's model has been subsequently refined and extended, with the border found to be: (i) asymmetric, with its trade-reducing effect greater for U.S. exports to Canada than for Canadian exports to the U.S. (Anderson and Smith, 1999a); (ii) heterogeneous across the provinces (Helliwell, 1996 and 1998; and Anderson and Smith, 1999b); and (iii) asymmetric and heterogeneous (Anderson and Smith, 1999b). In the lone study using post-NAFTA data, Helliwell (1998) finds that the home bias ratio had declined to about 12 for the period 1994-96.

Evidence of home bias has not been restricted to Canada-U.S. trade, as it has been found to be significant at the level of U.S. states by Wolf (2000), and OECD countries by Wei (1996).

[1] Further evidence of the extent to which the U.S. and Canadian markets are segmented was found by Engel and Rogers (1995). They estimate that the effect of the Canada-U.S. border on price dispersion is the same as adding 1780 miles (2870 km) to the distance between two cities within the same country.

Helliwell (1998) examines Intra- and Inter-OECD trade, finding significant home biases for capital mobility, migration, and knowledge diffusion. Also, Anderson and Smith (1999a and b) estimate Canadian and provincial border effects for trade with countries other than the U.S.. These widespread findings of large border effects have led Maurice Obstfeld and Kenneth Rogoff to label the home bias in trade as one of the "six major puzzles in international macroeconomics".

With the existence of large home biases firmly established, the search for explanations has begun. Evans (2000) finds little support for the hypothesis that the home bias is not due to the border itself but instead to inherent differences in domestic and foreign goods; Obstfeld and Rogoff (2000) argue that empirically reasonable trade costs can explain much of the home bias; and Anderson (2000) points to information costs and imperfect contract enforcement as worthwhile avenues of inquiry.

As the search for explanations proceeds apace, there is still some significant empirical work that needs to be done to obtain accurate estimates of the sizes and orderings of the various home bias ratios. The most important reason for this is that the standard gravity model, on which all existing estimates are based, tends to provide biased estimates (Mátyás, 1997; Bayoumi and Eichengreen, 1997; and Cheng and Wall, 1999). In particular, Cheng and Wall (1999) show that the gravity model as usually specified suffers from heterogeneity bias, tending to overpredict trade between low-volume traders, and to underpredict it between high-volume traders. This has clear implications in the present context because the Canada-U.S. home bias is a measure of predicted intra-provincial trade relative to predicted international trade. Because actual trade between provinces tends to exceed actual trade between states, a standard gravity model should, on average, *underestimate* the home bias ratios.

As I demonstrate below, all existing results are affected a great deal when home bias ratios are obtained with a model that controls for heterogeneity bias. Specifically, the home bias ratios are generally higher, and many of the relative comparisons are reversed: (i) the analogue to the McCallum home bias ratio increases by over 40 percent; (ii) the home bias on flows from the U.S. to Canada becomes *smaller* than that on flows from Canada to the U.S.; and (iii) the largest province-specific home biases are for Ontario and Quebec, rather than for the Maritimes, as previous work finds.

In section 1 I use post-NAFTA data for 1994-96 to estimate home bias ratios for four different versions of the border, obtaining results that are more or less consistent with the existing literature. I then demonstrate that the residuals of even the most general of these estimates are positively related to the volume of exports, which I attribute to heterogeneity bias. I reestimate the home bias ratios in section 2 using the same four versions of the border, but with a gravity model that does not have the same cross-trading-pair restrictions as the standard gravity model. Section 3 concludes.

1. A standard gravity model

Gravity models were first applied to international trade by Tinbergen (1962) and Pöyhönen (1963), who proposed that the volume of trade could be estimated as an increasing function of the national incomes of the trading partners, and a decreasing function of the distance between them. Although the gravity model became popular because of its perceived empirical success, it was also criticized because it lacked theoretical foundations. These foundations were subsequently developed by, among others, Anderson (1979) and Bergstrand (1985), who derived gravity models from models of monopolistic competition, and Deardorff (1998), who demonstrated that the gravity model can be derived within Ricardian and Heckscher-Ohlin frameworks.

1.1. The empirical model

Existing estimates of the effect of the Canada-U.S. border have been obtained using the simplest form of the gravity model:

$$\ln(1 + x_{ijt}) = \alpha + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \delta \ln D_{ij} + \boldsymbol{\gamma}\mathbf{B}'_{\mathbf{ij}} + \varepsilon_{ijt}; \tag{1}$$

where x_{ijt} is the volume of exports from location i to location j in year t, Y_{it} is the income of i in year t, Y_{jt} is the income of j in year t, D_{ij} is the distance between i and j, and $\mathbf{B}'_{\mathbf{ij}}$ is a vector of dummy variables specifying the Canada-U.S. border.[2]

As with the previous literature, my data set is based on a unique series collected by Statistics Canada of trade between Canadian provinces and between Canadian provinces and U.S. states. It is supplemented with Gross Provincial Product data from Statistics Canada, and Gross State Product data from the U.S. Bureau for Economic Analysis. All values are in real Canadian dollars. The distance measure is the great circle distance between the largest cities in each of the trading partners, although for some cases (such as California and Alberta) I use the

[2] I use $\ln(1{+}x_{ijt})$ as my dependent variable, rather than $\ln x_{ijt}$, allowing me to include observations of zero measurable trade, which others simply exclude from the data set. Note also that Helliwell (1998) includes a remoteness measure in addition to the distance measure.

midpoint between two large cities. I use data from all 10 provinces and all 50 states plus the District of Columbia, including cases where measured trade was zero. With three years of data (1994-96) I have 3330 observations.

Other than the years covered, this data set differs somewhat to those used previously. McCallum (1995) limited his 1988 data set to the 30 states that bordered Canada or had the largest populations, and, for comparability, Anderson and Smith (1999a and b) used McCallum's data set. Helliwell (1996, 1997, and 1998) also included only 30 states, but with slightly different selection criteria. Also, all of these studies deleted observations of zero measured trade. To avoid the possibility of sample selection bias I use the entire sample of states and observations. The results using McCallum's 30 states differ somewhat from the results below, and are available on request.

I estimate four versions of (1) using four different models of the Canada-U.S. border:

Border I: $\boldsymbol{\gamma}\mathbf{B}'_{\mathbf{ij}} \equiv \gamma B_{ij}$, (symmetric and homogeneous)

Border II: $\boldsymbol{\gamma}\mathbf{B}'_{\mathbf{ij}} \equiv \gamma^{SP} B_{ij}^{SP} + \gamma^{PS} B_{ij}^{PS}$, (asymmetric and homogeneous)

Border III: $\boldsymbol{\gamma}\mathbf{B}'_{\mathbf{ij}} \equiv \sum_{k=1}^{10} \gamma_k B_{ij}^{k}$, (symmetric and heterogeneous)

Border IV: $\boldsymbol{\gamma}\mathbf{B}'_{\mathbf{ij}} \equiv \sum_{k=1}^{10} (\gamma_k^{SP} B_{ij}^{SPk} + \gamma_k^{PS} B_{ij}^{PSk})$. (asymmetric and heterogeneous)

Border I is the original border as modeled by McCallum (1995) where B_{ij} equals 1 for all observations of trade between a province and a state, and zero for all observations of trade between provinces. The coefficient γ is then effect of the Canada-U.S. border on trade, relative to the effect of provincial borders. Border II allows the border effect to be different for trade from a state to a province and trade from a province to a state. B_{ij}^{SP} therefore is equal to one when *i* is a state and *j* is a province, and B_{ij}^{PS} is equal to one when *i* is a province and *j* is a state. Border III assumes the same border effect for the two directions of international trade, but allows it to differ across provinces. Thus, B_{ij}^{k} is equal to 1 when the observation is of province *k* trading with a state. Border IV combines the elements of borders II and III, allowing the border effect to differ across provinces and to depend on the direction of international trade.

1.2. Empirical results

The regression results for the pooled cross-section estimation of (1) are presented in table 2. The corresponding home bias ratios are provided by table 3. As these tables indicate, my results are largely consistent with the previous literature: On average, the home bias ratios are smaller than in the pre-NAFTA period, although they are still quite large. Border I yields a home bias ratio of 15, which is roughly the average of the heterogeneous home bias ratios under each of the other borders. As with Helliwell (1998) this indicates that NAFTA has increased the volume of Canada-U.S. trade relative to Canadian interprovincial trade, although this is larger than Helliwell's home bias ratio of 12. However, as noted above, the results are not directly comparable as the data and model specifications differ somewhat.

Under border II, the home bias for trade from the U.S. to Canada is larger than that for trade from Canada to the U.S.. This is consistent with Anderson and Smith (1999a), although they found that the U.S.-to-Canada home bias exceeded the Canada-to-U.S. home bias by about 26 percent, whereas I find a difference of 40 percent. Under border III, I find that Ontario and British Columbia have the smallest home biases, while the Maritime Provinces tend to have the largest. Also, the home bias ratios are quite diverse, with Nova Scotia's being nearly three times that of Ontario's. The dispersion of provincial home biases is not as large as found by Anderson and Smith (1999b) or Helliwell (1998), but this is partly due to the fact that their data sets include only 30 states. For example, reducing the data set to McCallum's 30 states yields more diverse provincial home biases.

The most general specification of the border is border IV, which combines the elements of borders II and III. Unsurprisingly, then, the home biases found under border IV have elements of the other two: (i) the provincial home biases tended to be higher for trade from the U.S. to the province than from the province to the U.S., although the opposite holds for Ontario and Manitoba; and (ii) the home biases tended to be higher for the Maritime Provinces and lower for British Columbia and Ontario. As with border III, it is difficult to compare these results to the previous literature because the more disaggregated the border effects are the more likely it is that differences in the data sets lead to differences in results.

As with the previous literature, the gravity model appears to fit the data pretty well, with $\overline{R}^2$s higher than 0.80 for all four specifications of the border. Also, the coefficients on the incomes and distance are typical for gravity models. However, a closer look at the predictive power of the model reveals that the high $\overline{R}^2$s do not tell the complete story. Figure 1 plots the residuals—actual minus predicted log of exports—of the standard gravity model with border IV, the most general specification. It is clear from the figure that the model provides biased estimates, underpredicting high levels of trade, and overpredicting low levels of trade. Because the home bias compares predicted interprovincial trade—which is relatively high—to predicted international trade, the home bias ratios reported above are, on average, biased downward.

2. A heterogeneous gravity model

The standard gravity model above is a restricted version of a general gravity model in that it assumes that the gravity equation is the same for all trading pairs, i.e. that the intercept and slope coefficients are homogeneous across all province-province and province-state combinations. However, there is certainly no reason to believe *a priori* that the relationship between trade volume and income levels should be the same for, say, trade between California and Saskatchewan and trade between Alabama and Prince Edward Island. If there are fixed factors that are correlated with the volume of trade and with the border dummies, then the standard gravity model will mistakenly attribute the effects of these factors to the international border. Because of this type of problem with the standard gravity model, Mátyás (1997), Bayoumi and Eichengreen (1997), and Cheng and Wall (1999) offer heterogeneous gravity models to control for such fixed effects.[3]

2.1. The empirical model

The simplest way to allow for heterogeneity is to remove the restriction that there is a single intercept that applies to all trading pairs. Specifically, I use least squares to estimate the following version of the gravity equation:

$$\ln(1 + x_{ijt}) = \alpha_{ij} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \delta \ln D_{ij} + \gamma \mathbf{B}'_{\mathbf{ij}} + \varepsilon_{ijt}; \qquad (2)$$

[3] Because Helliwell (1998) and Anderson and Smith (1999b) estimate separate standard gravity equations for each of the provinces, they allow for some heterogeneity. However, because these provincial gravity equations restrict the intercepts to equality, they nevertheless suffer from the same sort of heterogeneity bias illustrated by figure 1.

where α_{ij} is the trading-pair intercept, which is allowed to differ according the direction of trade, i.e. α_{ij} is allowed to differ from α_{ji}. If the trading-pair effects are correlated with the right-hand-side variables, then the coefficients on these variables will be biased when these trading-pair effects are not accounted for, as in (1).

Trading-pair specific intercepts allow for a province to trade different amounts with two states even if the two states have the same incomes and are equidistant from the province. This can be due to economic, historical, cultural, ethnic, political, or geographic factors that affect the level of trade. For example, some trading pairs may be better matched in terms of the goods that consumers in one location prefer and the goods in which the other has a comparative advantage—residents of Ontario may have a greater affinity for South Carolina peaches than do the residents of Nova Scotia. Or, perhaps because of Quebec's cultural differences, its volume of trade with, say Arizona, will differ from the volume of trade between Arizona and other provinces, all else equal.

Trading-pair heterogeneity may also manifest itself in the volumes of trade in intermediate goods. One obvious example is that because the North American auto industry is centered around the Great Lakes, the volume of trade between Michigan and Ontario may be out of proportion to their incomes and distance. This is further strengthened by the fact that there has been free trade in the auto industry since the 1965 Auto Pact. A second example is that the volume of trade between Washington and British Columbia may be out of proportion to their sizes because they both have large lumber and wood industries, meaning that the flow of intermediate products between them would be quite high.

Because the argument above is essentially that equation (1) does not include all of the things that account for the differences in trade volumes across trading-pairs, the problem of heterogeneity bias can be view simply as a problem of missing variables. If the relevant historical, cultural, and political variables themselves can be included in the regression equation, the problem would be resolved. However, cultural, historical, and political factors are often difficult to observe, let alone quantify, which is why they are instead controlled for by assuming that they are fixed over the sample period, allowing them to be captured by a dummy variable for each trading pair.

Notice that because they are fixed over time, the distance variable and the border dummies cannot at this stage be separated separately from trading-pair effect. This is because they are subsumed into a single fixed-effect that captures all variables that differ cross-sectionally but not serially: $\lambda_{ij} \equiv \alpha_{ij} + \delta \ln D_{ij} + \gamma \mathbf{B}'_{\mathbf{ij}}$. The effects of distance and the border are estimated in a second stage in which the estimated fixed effects are regressed on them. Specifically, in a second stage I use ordinary least squares to estimate

$$\hat{\lambda}_{ij} \equiv a + d \ln D_{ij} + \mathbf{c}\mathbf{B}'_{\mathbf{ij}} + \mu_{ij}; \tag{3}$$

where the $\hat{\lambda}_{ij}$s are the 1110 estimated fixed effects from the least squares estimation of (2).

2.2. Empirical results

The results for both stages of the estimation are summarized by table 4, which illustrates the significant differences between the heterogeneous and standard gravity models. First, a likelihood-ratio test easily rejects the restriction imposed in the standard model that the trading-pair intercepts are all equal.[4,5] Second, figure 2, which plots the residuals of the heterogeneous model, reveals a tighter fit and the disappearance of the bias illustrated by figure 1. And third, the estimated effects of the Canada-U.S. border are significantly different from what the standard model yields. The fact that these changes occur indicates that there are fixed factors other than the border which affect the volume of Canada-U.S. trade, and that these factors are also correlated with the border dummies. Because of this, standard gravity models mistakenly attribute the effects of these factors to the international border.

The differences in the estimated border effects are best illustrated by table 5, which provides the various home bias ratios. Consistent with expectations, the home bias ratios from the heterogeneous model are, on average, higher than those from the standard model. Under border I, the heterogeneous model yields a home bias ratio of 21.6, which is about 43 percent larger than yielded by the standard model. The differences in the average home biases under the other three borders are of the same order of magnitude.

Another important difference is that results from the heterogeneous model demonstrate that the effect of the border is greater for trade from Canada to the U.S. than on trade from the U.S. to Canada. Specifically, under border II, the home bias ratio on Canadian exports to the U.S. is about 55 percent larger than the home bias ratio on Canadian imports from the U.S.. This is in contrast with the 40 percent difference in the opposite direction that the standard model yields.

[4] This is with $\chi^2(1110) = 2(4363.74 - 212.28) = 8302.92$ comparing the heterogeneous model to the standard model with border IV.

[5] As a test of whether the heterogeneity is in the error term rather than in the intercepts, a Hausman test rejects the null hypothesis that the error terms from GLS estimation are uncorrelated with the right hand side variables [$\chi^2(4) = 5.83$]. Thus, the trading-pair effects are not random, and fixed effects, rather than random effects, estimation is the appropriate method for handling the trading-pair heterogeneity.

The ordering of the provincial home bias ratios is also different when the heterogeneous model is used. Under border III, it yields Quebec, Ontario, and Nova Scotia as the three provinces with the largest home bias ratios, whereas the standard model yields Nova Scotia, Newfoundland, and Prince Edward Island. Also, the heterogeneous model gives the provinces with the smallest home bias ratios as Prince Edward Island, Manitoba, and New Brunswick, whereas the standard model has British Columbia, Ontario, and Alberta. The heterogeneous model also has much more disperse provincial home bias ratios, with the largest being about 4.4 times the smallest, whereas the analogous number for the standard model is 2.8.

Under border IV, which has heterogeneous and asymmetric border effects, the results are richer than suggested by the results for borders II and III. The home bias ratios of only six of the provinces are consistent with border II. For the other four provinces—Alberta, British Columbia, Ontario, and Quebec—the border has much larger dampening effects on imports from the U.S. than on exports to the U.S..

Comparisons with the standard model once again demonstrate stark differences. In particular, for U.S.-to-Canada trade the heterogeneous and standard models have virtually nothing in common. The three largest home bias ratios from the heterogeneous model are for Quebec (69.7), Ontario (40.8), and Alberta (29.0); whereas from the standard model they are for Nova Scotia (41.5), Newfoundland (32.7), and Prince Edward Island (24.0). The three smallest are for Prince Edward Island (3.7), Manitoba (8.5) and New Brunswick (9.0); whereas from the standard model they are Ontario (8.3), Manitoba (10.4), and British Columbia (10.7).

Interestingly, the ranking of the Canada-to-U.S. home bias ratios are very similar for the two versions of the gravity model, although those from the heterogeneous model are in every case more than twice as large. In fact, for the five smallest home bias ratios, the ranking is identical in the two models, with the three smallest being for Alberta (17.4), British Columbia (18.2), and Prince Edward Island (23.9). Of course, the provinces with the five largest home bias ratios are also the same from the heterogeneous as from the standard model, although the third and fifth positions are reversed. The top three from the heterogeneous model are Nova Scotia (38.1), Newfoundland (37.9), and Manitoba (28.8).

3. Concluding remarks

Using a standard gravity model, previous studies have established that the Canada-U.S. border has a very large dampening effect on the volume of Canada-U.S. trade, and that its effect is asymmetric and differs significantly across provinces. My results using a heterogeneous gravity model do not alter these general results, although they do indicate that many of the detailed results of the previous literature should be reconsidered. Specifically, I found that when the standard gravity model is replaced with a heterogeneous gravity model: the home bias is 40 percent larger; the asymmetry of the border is reversed; and all of the provincial differences are altered significantly. The differences between these results and those from the previous literature should be important to anyone trying to explain the sources of the border effects.

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Table 1: British Columbia's Trade;
provinces vs. states, 1996

	total trade with BC as % of GDP		
Alberta	6.9	2.6	Washington
Manitoba	2.0	0.3	California
New Brunswick	2.3	0.2	Maine
Ontario	1.9	0.2	Ohio
Quebec	1.4	0.1	New York
Saskatchewan	2.4	1.0	Montana

Table 2: Regression Results; *Standard gravity model, 1994-96*

	Border I	*Border II*	*Border III*	*Border IV*
constant	-6.238 (0.304)	-6.238 (0.301)	-4.899 (0.355)	-4.899 (0.344)
log of origin GDP	0.933 (0.013)	0.977 (0.014)	0.855 (0.017)	0.934 (0.020)
log of destination GDP	1.007 (0.013)	0.964 (0.014)	0.928 (0.017)	0.849 (0.020)
1995 dummy	0.019 (0.041)	0.019 (0.041)	0.023 (0.039)	0.023 (0.038)
1996 dummy	0.021 (0.041)	0.021 (0.041)	0.028 (0.039)	0.028 (0.038)
log of distance	-1.155 (0.026)	-1.155 (0.026)	-1.121 (0.027)	-1.122 (0.026)
U.S. ↔ Canada border	-2.715 (0.063)			
U.S. → Canada border		-2.885 (0.066)		
Canada → U.S. border		-2.546 (0.066)		
U.S. → Alberta Alberta → U.S.			-2.359 (0.084)	-2.716 (0.096) -2.002 (0.096)
U.S. → British Columbia British Columbia → U.S.			-2.210 (0.085)	-2.370 (0.097) -2.049 (0.097)
U.S. → Manitoba Manitoba → U.S.			-2.420 (0.078)	-2.344 (0.094) -2.495 (0.094)
U.S. → New Brunswick New Brunswick → U.S.			-2.642 (0.078)	-2.763 (0.094) -2.521 (0.095)
U.S. → Newfoundland Newfoundland → U.S.			-3.129 (0.079)	-3.488 (0.098) -2.769 (0.098)
U.S. → Nova Scotia Nova Scotia → U.S.			-3.253 (0.078)	-3.725 (0.095) -2.780 (0.095)
U.S. → Ontario Ontario → U.S.			-2.267 (0.092)	-2.114 (0.104) -2.419 (0.104)
U.S. → PEI PEI → U.S.			-2.742 (0.071)	-3.177 (0.107) -2.307 (0.107)
U.S. → Quebec Quebec → U.S.			-2.708 (0.088)	-3.087 (0.100) -2.329 (0.100)
U.S. → Saskatchewan Saskatchewan → U.S.			-2.553 (0.079)	-2.624 (0.094) -2.482 (0.094)
$\overline{R}^2$	0.807	0.811	0.823	0.834
log-likelihood	-4621.69	-4588.66	-4472.88	-4363.74

Standard errors are in parentheses.

Table 3: Home-Bias Ratios, *Standard gravity model, 1994-96*

	Border I	*Border II*	*Border III*	*Border IV*	
				U.S. to Canada	*Canada to U.S.*
U.S. ↔ Canada	15.1				
U.S. → Canada		17.9			
Canada → U.S.		12.8			
Alberta			10.6	15.1	7.4
British Columbia			9.1	10.7	7.8
Manitoba			11.2	10.4	12.1
New Brunswick			14.0	15.8	12.4
Newfoundland			22.9	32.7	15.9
Nova Scotia			25.9	41.5	16.1
Ontario			9.7	8.3	11.2
PEI			15.5	24.0	10.0
Quebec			15.0	21.9	10.3
Saskatchewan			12.8	13.8	12.0

Table 4: Two-Stage Regression Results; *Heterogeneous gravity model, 1994-96*

Stage 1: Gravity equation with trading-pair intercepts				
log of origin GDP	0.931 (0.301)			
log of destination GDP	1.575 (0.301)			
1995 dummy	0.004 (0.017)			
1996 dummy	0.005 (0.024)			
$\overline{R}^2$	0.984			
log-likelihood	212.28			
Stage 2: Fixed effects regressed on distance and border specifications				
	Border I	*Border II*	*Border III*	*Border IV*
constant	-12.719 (0.431)	-12.719 (0.425)	-12.038 (0.442)	-12.038 (0.403)
log of distance	-1.048 (0.056)	-1.048 (0.055)	-1.140 (0.057)	-1.140 (0.052)
U.S. ↔ Canada border	-3.072 (0.134)			
U.S. → Canada border		-2.852 (0.137)		
Canada → U.S. border		-3.293 (0.137)		
U.S. → Alberta			-3.111 (0.168)	-3.367 (0.185)
Alberta → U.S.				-2.856 (0.185)
U.S. → British Columbia			-3.018 (0.169)	-3.315 (0.186)
British Columbia → U.S.				-2.901 (0.186)
U.S. → Manitoba			-2.751 (0.167)	-2.142 (0.184)
Manitoba → U.S.				-3.359 (0.184)
U.S. → New Brunswick			-2.789 (0.167)	-2.194 (0.184)
New Brunswick → U.S.				-3.356 (0.184)
U.S. → Newfoundland			-3.108 (0.171)	-2.593 (0.187)
Newfoundland → U.S.				-3.634 (0.187)
U.S. → Nova Scotia			-3.457 (0.167)	-3.273 (0.185)
Nova Scotia → U.S.				-3.640 (0.185)
U.S. → Ontario			-3.495 (0.168)	-3.708 (0.185)
Ontario → U.S.				-3.282 (0.185)
U.S. → PEI			-2.235 (0.167)	-1.300 (0.185)
PEI → U.S.				-3.172 (0.185)
U.S. → Quebec			-3.717 (0.167)	-4.244 (0.184)
Quebec → U.S.				-3.191 (0.184)
U.S. → Saskatchewan			-2.863 (0.167)	-2.384 (0.185)
Saskatchewan → U.S.				-3.342 (0.185)
$\overline{R}^2$	0.463	0.479	0.515	0.597
log-likelihood	-1787.01	-1769.81	-1726.96	-1618.84

Standard errors are in parentheses. For space considerations, the 1110 estimated fixed effects are suppressed.

Table 5: Home-Bias Ratios, *Heterogeneous gravity model, 1994-96*

	Border I	*Border II*	*Border III*	*Border IV*	
				U.S. to Canada	*Canada to U.S.*
U.S. ↔ Canada	21.6				
U.S. → Canada		17.3			
Canada → U.S.		26.9			
Alberta			22.4	29.0	17.4
British Columbia			20.5	27.5	18.2
Manitoba			15.7	8.5	28.8
New Brunswick			16.3	9.0	28.7
Newfoundland			22.4	13.4	37.9
Nova Scotia			31.7	26.4	38.1
Ontario			33.0	40.8	26.6
PEI			9.3	3.7	23.9
Quebec			41.1	69.7	24.3
Saskatchewan			17.5	10.8	28.3

Figure 1

Residuals from the Standard Gravity Model with Border IV

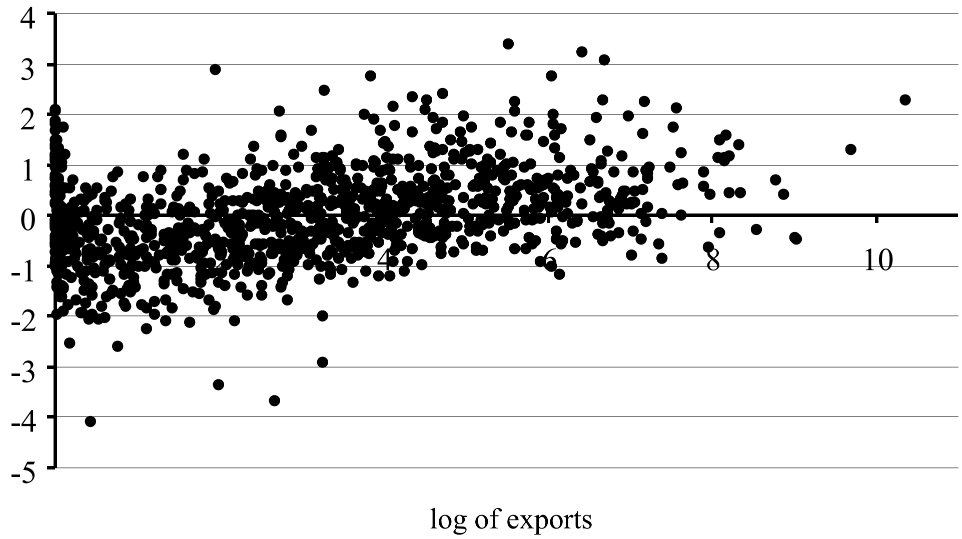

Figure 2

Residuals from Heterogeneous Gravity Model