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NATIONAL BORDERS, TRADE AND MIGRATION

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ABSTRACT

The paper first extends and reconciles recent estimates of the strikingly large effect of national borders on trade patterns. Estimates comparing trade among Canadian provinces with that between Canadian provinces and U.S. states show interprovincial trade in 1988-90 to have been more than twenty times as dense as that between provinces and states, with some evidence of a downward trend since, due to the post-FTA growth in trade between Canada and the United States. Using approximate data for the volumes and distances of internal trade in OECD countries, the 1988-92 border effect for unrelated OECD countries is estimated to exceed 12. Both types of data confirm substantial border effects, even after accounting for common borders and language, with the directly-measured data for interprovincial and province-state trade producing higher estimates.

Initial estimates from a census-based gravity model of interprovincial and international migration show a much higher border effect for migration, with interprovincial migration among the Anglophone provinces almost 100 times as dense as that from U.S. states to Canadian provinces. Effects of migration on subsequent trade patterns are found for international but not for interprovincial trade, suggesting the existence of nationally-shared networks, norms and institutions as possible sources of the large national border effects for trade flows.

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National Borders, Trade and Migration

1. Introduction

This paper and its predecessor (Helliwell 1996b) were triggered by the startling evidence, first presented by McCallum (1995), that 1988 merchandise trade flows among Canadian provinces were twenty times as dense as those between Canadian provinces and U.S. states, after using a gravity model to control for the effects of size and distance. To see if similar results applied to other countries, Wei (1996) uses an imaginative method to generate approximate internal trade volumes and distances for OECD countries and finds for these countries a border effect that is statistically significant but far smaller than that found by McCallum. Head and Ries (1997) ask whether international migration may enable international trade opportunities to be better recognized and exploited. This paper is an attempt to build bridges between their research and the earlier findings[1].

To establish linkages with Wei's research, I shall try to assess the extent to which the apparent differences between his estimates and the ones based on Canada-U.S. data are due to differences in specification, to differences in the nature and quality of the underlying data, and to border effects that may be specific to Canada. This will be done, in section 2, through the joint use of OECD and Canada-U.S. data for identical sample years, using specifications and estimation methods that are as close as possible to being identical. To foreshadow the results, it would appear that specification, interpretation, and data all have important roles to play. Our most recent estimates for the border effect between unrelated OECD countries lie in the range between eleven and fifteen, somewhat less than the value of twenty estimated from the 1988-90 data on province-province and province-state trade. When the OECD results are adjusted to fit the special ties between the United States and Canada, however, the estimated border effect

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[1] The Wei and Head and Ries papers were both presented at the same January 1997 AEA session in New Orleans to which an earlier version of this paper was presented.

between these two countries is substantially smaller than the value implied by the province-state trade data. The likely sources of these differences, and the implications for further research, will be assessed in section 2 and in the concluding section.

To establish links with the Head and Ries paper, which shows that international migration increases trade between the source and recipient countries, I shall present preliminary results in section 3 from joint work with Zhihao Yu attempting to estimate the extent to which patterns of province-province and province-state migration are responsible for, or at least associated with, differences in the intensity of trade linkages. Our preliminary results suggest that patterns of migration among provinces are not linked with differences in trade densities, while those between provinces and states do help to predict the patterns of trade between provinces and states. If these results are confirmed, they support the idea that there are national institutions, norms and contacts that facilitate trade densities that are higher within than between countries. If these institutions are country-specific rather than province-specific, then interprovincial migration would not influence trade patterns, while international migration might. The paper also applies a gravity model to interprovincial migration, and finds strong results. Since there are no direct data for migration between specific provinces and states (although there are U.S. census data, by state of residence, that indicate state or country of birth, and Canadian census data, by province of residence, that indicate province or country of birth), we cannot assemble as strong a data set as was available for the trade flows between states and provinces. However, we do attempt an assessment based on migration from the United States to each of the Canadian provinces, in the context of the gravity model used for interprovincial migration. Our tentative results suggest that the border effects for migration are much greater than any of the estimates for merchandise trade.

Section 4 summarizes the results obtained and outlines plans for further research.

2. Reconciling the Canadian and OECD Results

McCallum's (1995) estimates of border effects made use of a simple gravity equation, wherein trade flows from an exporting region i to an importing region j are a loglinear function of real GDPs in the two regions and the distance between them:

$$(1)\ \ln S_{ij} = \alpha_0 + \alpha_1 \ln GDPX + \alpha_2 \ln GDPM + \alpha_3 \ln(dist) + \alpha_4 Border + \epsilon_{ij}$$

where, in the present application, shipments (S_{ij}), and the GDPs of exporters (GDPX) and importers (GDPM) are measured in million Canadian dollars[2], distance is measured between the principal cities in the respective states and provinces, and the error term ϵ_{ij} is assumed to be normally distributed. Border effects were estimated by adding a linear zero/one dummy variable taking the value of 1.0 for trade flows from one Canadian province to another, and zero for trade from Canadian provinces to U.S. states[3]. The border effect of twenty was obtained by taking the antilog of the Border coefficient α_4. Although a number of alternative specifications were tested, they did not alter the basic result that merchandise trade flows are twenty times greater among provinces than between provinces and states. Subsequent release of interprovincial trade data for 1989 and 1990 permitted the estimation of equations for three years, separately and as a system (Helliwell 1996b). Table 1 shows the basic specification estimated as a system, for 1988-1990, along with the analogous equations, using data for the

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[2] Purchasing power parities for GDP, taken from version 5.6 of the Penn World Table (Summers and Heston 1991) are used to convert U.S. state GDPs to Canadian dollars. In McCallum (1995) an exchange rate of .85 $US/$C was used to convert provincial GDPs to US dollars, and the state GDPs were left in their original published form. Here we use PPPs, in terms of $C/$US, of 1.2090, 1.2087, and 1.2074 for 1988, 1989, and 1990.

[3] There are no data for bilateral trade among U.S. states, so his sample includes, for each year, 90 observations for trade among the ten Canadian provinces, 300 observations for exports from Canadian provinces to 30 U.S. states (all of the border states, plus the twenty remaining states with the largest levels of GDP) and 300 for shipments from the same states to Canadian provinces.

same three years, for OECD countries. The data for domestic sales in the OECD sample are obtained by subtracting merchandise exports from gross output of goods industries, based on input-output data assembled by the OECD and the United Nations. If we use the same assumption employed by Wei for internal trade distances (generally one-half the distance from the domestic capital to the capital of the nearest international trading partner), the border effect for the OECD countries is shown in Table 1 to be just over half that estimated for the same years between Canadian provinces and US states. There are other aspects of the comparison that need to be adjusted, however, and some of these increase the gap between the estimates.

First, it is possible to use the Wei procedure to estimate provincial as well as national boundary effects, and hence to show two types of border effect. The Canadian input-output data provide direct estimates for goods sales within each province, so that part is easy. If we then adopt the Wei procedure for estimating inter-provincial trade distances (one-half of the distance to the nearest partner province), it is possible to add ten observations to the data matrix reflecting each province's sales to itself, and to insert a dummy variable (PROV) that takes a value of 1.0 for each of these additional observations. As with the national effects, if the coefficient on this variable is zero, there is no border effect, while a higher value suggests a preference for trading within the province rather than with other provinces or other countries. The provincial border effect is then the antilog of this coefficient. The total border effect reflecting how much Canadians trade with each other compared to how much they trade with U.S. states of similar size and distance is the antilog of the sum of the national border effect and a fraction of the provincial border coefficient[4]. The results are shown in equation (iii) of Table 1. The interprovincial effect is almost significant, and the total national effect is thereby increased. We are not placing full confidence in these results for provincial border effects, as we have no direct measures of internal trade distances, and much hangs on how much trade is within the major metropolitan areas rather than between country and city, or

[4] The fraction equals total within-province sales divided by total domestic sales. The average value across all provinces for 1990 is .77, and this value is used in the calculation of the combined border effect.

between cities. If much of the trade is within the major metropolitan areas, then the actual average internal trade distance may be much smaller than is assumed by the Wei procedure. If this is the case, then the correct provincial border effect will be less than that shown in equation (iii). However, shorter internal trade distances at the national level would deepen the puzzle posed by any difference between the OECD and the province-state results, since shorter internal trade distances would reduce the Wei estimates of OECD border effects, and thus increase the gap between the OECD and province-state estimates of national border effects. But this is getting ahead of the game. First it is necessary to make a more systematic comparison and reconciliation of the differences in specification and national characteristics to permit a comparison of the extent to which the OECD and province-state results are different.

This is done in stages. First we consider the remoteness variables that Wei (1996) thought to be responsible for his results being different from and preferable to those in McCallum (1995) and Helliwell (1996b). Our first reaction to this contention was that since all provinces and states lie at roughly similar distances from overseas markets, the differences among them in foreign market opportunities are not likely to be important. Further reflection suggested that there might nevertheless be parallel effects arising from states and provinces being at different distances from states and provinces other than the bilateral partner under consideration. So we developed analogous measures of exporter and importer remoteness to those employed by Wei in his estimation. Neither Wei nor we made allowances for differing degrees of remoteness from potential trading partners outside those in the sample. In the case of provinces and states, these other trading partners generally lie across oceans, and at comparable distances, so that the remoteness of these other countries will be broadly similar for all states and provinces, and hence is not likely to bias the estimates of the border effects between provinces and states. The Wei remoteness measures, when applied to the provinces and states, slightly improved the goodness of fit of the system of equations, and slightly lowered the estimated border effect, as shown in equation (iv) of Table 1.

While applying Wei's measure to the province-state data, we noticed a potentially important difference between Wei's empirical remoteness measures and the functional form that is indicated by theoretical requirements. We now think that there are better ways of defining the economic remoteness of alternative markets. Bilateral trade equations are simplified parts of a multilateral model where in principle each bilateral flow may be responsive to changes taking place anywhere else in the system. The trick is to find a parsimonious way of summarizing the salient aspects of changes in other markets that might be expected to have significant effects on bilateral flows. The essential feature of any aggregation procedure used to represent third-country effects is that it must account appropriately for the key determinants of trade in the gravity model: economic size and distance with inversely signed effects. These requirements are indeed respected by the theoretically derived measures in Wei (1996, section 2). These same requirements led Feder (1980) to propose a measure of the attractiveness of third country options, in the context of a gravity model of migration, that was a weighted sum of third-country incomes each divided by the distance between that third country and the country at the focus of a bilateral flow. In the context of bilateral trade flows, there need to be two such variables, one reflecting the third-country options for each of the two trading partners.

These requirements are met by the theoretically based remoteness measures derived in section 2 of Wei (1996), since his remoteness measures are weighted averages that depend positively on third country distance and negatively on third country GDP. However, the empirical measures he adopts for his main estimates, and on which he bases his conclusions about border effects, are inconsistent with these requirements, as they involve GDP and distance constrained to enter with the same sign. He does make use of the theoretically derived remoteness measures for the purposes of making welfare evaluations, and in this context estimates his gravity equations with different assumptions about σ, the elasticity of substitution between domestic and foreign goods, as shown in Appendix Table A2 of Wei (1996). However, only one of the two remoteness variables is significant, and it takes a theoretically incorrect sign, with country j's remoteness from third countries decreasing its imports from country i. So there is a double problem: the remoteness measures on which Wei relies for his empirical measures are inconsistent with the theoretical requirements of a multilateral gravity model of trade, while his theoretically appropriate variable takes the wrong sign. To us, this suggested the need for a more appropriate way of capturing third country effects.

Fortunately, there appears to be a formulation that possesses the required theoretical consistency while also improving the empirical results. Joel Bruneau and I noted that the Wei index of exporter remoteness is equivalent to the Feder index if distances are measured absolutely (rather than as shares) in the Feder index, and if σ is set equal to 1.0 in Wei's measure. Expressing the index as a measure of remoteness, with distances entering positively and GDPs negatively, as required to be consistent with the theory of the generalized gravity model gives the following index, which has separate values for the exporter and the importer for any bilateral trading relation:

(2) $Rem_j = \sum_i (Dist_{ij}/GDP_i)$

where $dist_{ij}$ is the bilateral distance between country i and the country j for which the remoteness measure is constructed, the summation is over all trading partners of country j. Our results using this form of index show that it improves the goodness of fit as well as the theoretical consistency of the bilateral gravity equations estimated using data for trade flows between provinces and states[5]. The results are shown in equation (v) of Table 1, which fits better than equation (iv) and shows much less evidence of year-to-year variability of parameter estimates[6]

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[5] The goodness of fit of the equations worsens if higher values of σ are assumed. In this sense our results are consistent with those of Wei, since his equation became less well-fitting as higher values of σ were assumed. He only considered values of σ in the range from 2.0 to 20.0.

[6] As shown by the P-values at the bottom of the Table, the restrictions of parameter constancy from year to year are rejected in equations (iv), but accepted in the case of equation (v), which uses the revised measure. The P values in the lower line show that for equation (iv) the importer remoteness variable is the principal source of parameter instability. We have also

Further extensions are shown in Table 2. Here all the results relate to 1990, since, as will be shown here and in Table 3, there are only very slight changes in estimated coefficients from year to year. The year 1990 has the additional advantage of being one of the years used by Wei in his study. Equation (i) repeats the specification of equation (ii) of Table 1, with two small differences in estimation. First, it relates to 1990 rather than to the panel comprising 19988, 1989 and 1990. Second, it uses instrumental variables to check if there is a simultaneous cyclical feedback from contemporaneous trade to GDP that is biasing the income and possibly the border effects. A priori, the risk seems to be greatest for exporter GDP, where there may be positive bias, since a stochastic shock to exports will be expected to induce a sympathetic movement in GDP in the same direction. We use GDP from 1988 as an instrument, since two years is about half of the period of postwar business cycles, and hence should be sufficient to reduce the risks of contamination from cyclical or other temporary disturbances to exports[7]. As can be seen from the results, the net effect of the two differences is minimal, and subsidiary tests show that this is not due to offsetting effects. The estimated border effects for 1990 are smaller than for any other year in the period running from 1988 through 1992, as shown in Table 3.

Equation (ii) of Table 2 adds the remoteness variables emphasized by Wei (1996) as a likely reason for his estimation to be preferable to and different from that shown in equation (i). There is an increase in the goodness of fit, and a drop in the size of the border effect, from

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considered an alternative form of remoteness variable attaching different weights to trading partners on the other side of the border. However, using the estimated border effects to weight the components of the remoteness variable (by converting the border effect into a distance equivalent, as illustrated by Engel and Rogers 1996) reduces the goodness of fit of the equation, so we continue to use the simpler form in the results reported in this paper.

[7] Tests have been run using GDP from one, two, three and four years previously as instruments, and show no impact on the estimated border effects. The equation actually fits slightly better as longer lags are used for the instrument. This suggests that using average values of a number of earlier years might provide even more efficient measures of the average sizes of the trading partners.

8.5 to 4.8. The earlier version of this paper used Wei's remoteness measures, for better comparability with his results. In this version, however, we use the corrected definition already employed for the province-state results. This does not alter the results significantly, but has the advantage of theoretical consistency and more complete comparability between the OECD and the province-state results.

Equation (iii) of Table 2 adds three variables found to be important by Wei in his earlier work: adjacency, the use of a common language, and membership of the European Community. There is an important difference between the way in which these three variables are defined in this paper and the way they are defined by Wei, although with care the different definitions can be almost completely reconciled. In this paper, a value of 1.0 is assigned to the language and border variables for any bilateral trade flow between two countries sharing a common language or border, respectively, while Wei also gives these variables values of 1.0 for each country's sales to itself. Wei's border effect thus answers the following question: How much more intensely does a country trade with itself than with another country with which it shares a common border and a common language? The border effect in this paper answers the question: How much more intensely does a country trade with itself than with another unrelated country? To make our estimates comparable with those of Wei, it is possible to subtract the adjacency and common language coefficients from the border coefficient and then take the antilog to get the remaining border effect for trade between a country and adjacent neighbours with which it shares a common language. This is done at the bottom of Table 3.

I have a preference for defining the language and adjacency effects to include only those observations covering trade flows between two countries which both possess the characteristics in question, for two reasons. One is that the straightforward estimate of the border effect covers trade between unrelated countries, and these trade pairs are very much in the majority. For example, in our OECD sample, only 14 of the 465 country pairs used in estimation share borders and a language, the condition that Wei's procedure takes to be the base case.

A second reason for preferring our procedure is that the lack of common borders and common languages is perhaps best regarded as part of the explanation for trade to be more intense within than between countries. If trade is more prevalent within national borders, to an extent greater than can be accounted for by transport costs and the conventionally measured tariff and border-tax costs of doing international business, then this is likely to be due to some form of preference for dealing within a shared context of knowledge, norms and institutions. Such shared experiences provide contacts of a sort that create knowledge of trade opportunities and confidence about what needs to be done to make trade happen without unexpected costs and nasty surprises. Gould (1994), Head and Ries (1997) and others have presented evidence that international migration may help to form and to distribute shared knowledge and values of a sort that facilitates trade. Common borders and common languages are likely to be even more important in this regard. A common land border facilitates casual and temporary visits, including transborder employment, of a sort that naturally contributes to knowledge of the other country's mores and markets. A common language provides evidence of common cultural roots, shared literature and lore, and even shared codes of law. For example, Quebec and France share a language and the Civil Code of law, while the anglophone provinces use the English Common Law. Where there is a common language there is also likely to be greater sharing of literature, radio and television communications, and even educational exchanges, and with all of these come greater knowledge of institutions, networks and individuals of a sort likely to forge tighter economic ties.

Seen in this context, the strong language effects found by Wei, and replicated in Table 2, are part and parcel of the explanation of strong border effects. However, while the introduction of language and adjacency effects does help to explain part of the border effect in the OECD sample, it does not help to explain the differences between the results estimated using national data and those flowing from the Canadian data for trade between provinces and states. The reason for this, of course, is that Canada and the United States share a common border and their principal language. This means that the estimated U.S.-Canada border effect, as derived from the OECD equation, is equal to that for unrelated countries plus adjustments for adjacency and a common language. Both of these adjustments reduce the border effect, as can be seen by comparing the bottom line of Table 2 with the calculations shown above for unrelated countries. The simplest such comparison is for equation (iii), which is the first to add the language and adjacency effects.

Moving across Table 2 other variables are added. Equation (iv) adds an interactive distance effect equal to the distance variable multiplied by a variable taking the value 1.0 for any trade flow involving shipment across a major ocean. It was anticipated that this variable might take a negative sign, given the economies (per-kilometre-tonne) inherent in long ocean transport. The negative coefficient taken by the variable shows that long ocean voyages are more trade destroying than trade creating, for given distances, perhaps reflecting high port and trans-shipment costs, but also perhaps a differing mix of trade among and within continents.

A second variable reflects a result first evident in Figure 1 of Wei (1996), that border effects are on average smaller for richer countries. The variable is equal to the product of the border variable and a variable equal to the difference, in logarithmic form, between a country's GDP per capita and the average for the entire sample of countries. This variable naturally takes non-zero values only for observations relating to a country's internal trade, and among those countries it has a positive value for countries that are richer than average and a negative value for poorer countries. The coefficient on the linear border variable thus reflects the border effect for a country of average income per capita. Border effects for other countries are calculated by adjusting for the extent to which that country's income differs from the sample average, as illustrated in the notes to Table 2. From equation (v) onwards, the border effects for Canada are adjusted in this way, making them still lower than those for countries of average incomes per capita[8].

Finally, equation (vi) adds the logarithms of importer and exporter populations to the equation. The purpose here is to test whether the elasticities of bilateral trade are equal for population and for GDP per capita, as is assumed in the basic gravity model. Evidently they are not, especially for exporters. Putting together the elasticities for exporter GDP and population, the implied elasticities are 1.18 for GDP per capita and .73 for population. The fact that trade grows less than proportionately with national population supports a conjecture by Charles Schultz that economies of scale make producers in smaller countries more heavily dependent on export markets than are producers in larger countries, on the assumption that there is a trade-off between the gains from increasing scale and the costs of increasing penetration into foreign markets. Under this hypothesis, firms producing differentiated goods will set a larger target for exports as a share of total sales if the national market is smaller. This hypothesis is compatible with the evidence that trading relations are less dense across national boundaries than within countries, implying that costs are higher for foreign than for domestic sales. For importers, this effect has the same sign, but is small and insignificant.

Equation (vi) represents the final specification resulting from the current stage of our research with OECD data, and is used as the basis for annual estimation for each of the years from 1988 through 1992, as shown in Table 3. There are bilateral trade data available for years after 1992, but the data for domestic sales are generally not available yet, rendering suspect any estimation of border effects post-1992. For the 1988 through 1992 period, there is no evident trend in the border effects. The border effect for trade between unrelated countries drops from 14.7 in 1988 to 12.4 in 1990, and then rises again to 14.8 in 1992.

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[8] When the sample is enlarged to include a number of developing countries, average border effects will be expected to rise, but, as long as the same structure continues to apply, the estimated border effect for any particular country will remain unaffected, after the allowance is made for the change in sample average per capita incomes.

Equations (vii) and (viii) make use of equation (vi) as a test bed to assess the effects of alternative treatments of the EC effect (in equation vii) and to search for a trade bloc effect for the United States and Canada (in equation viii). The most significant difference of definitions between this paper and Wei (1996) lies in the treatment of trading blocs. This will be illustrated by the treatment of the variable defining membership in the European Community (EC). In this paper, the EC variable is given the value of 1.0 for any bilateral trade flow from one EC member to another EC member, and zero otherwise. Wei, however, also gives this variable a value of 1.0 for the observations relating to EC members' shipments within their own borders. This has the implication that a country joining the EC not only increases its trade with other EC countries but also increases its internal trade correspondingly. This in turn implies that EC and non-EC countries have different border effects with respect to trade with non-EC countries, by an amount that is exactly the same as the EC effect on bilateral trade between EC members. It is not clear why this should be a reasonable constraint.

If EC and non-EC members are permitted to have separately estimated border effects, then the difference between the Wei definitions and the definitions proposed in this paper on other coefficients cab be eliminated, and careful interpretation of the results can reconcile the two sets of estimates. Equation (vii) estimates this more general model directly, permitting us to test equation (iv) of Table 2 and Wei's basic specification as special cases nested within the more general model. The own-country-EC effect, which is assumed by Wei to be of the same sign and size as the cross-border EC effect, actually has the opposite sign. The specification adopted in this paper assumes this additional own-country effect for EC members to be zero. Using a Wald test, the probability of the restriction imposed in this paper is .12, while the probability of the Wei restriction is .01. Given these results, and the lack of a theoretical rationale for linking specific additional third-country border effects to EC membership, I think it is appropriate to proceed using the simpler assumption that variables relating to membership in trade blocs apply to trade from one bloc member to another bloc member, and not to sales within the member's own national territory.

The final model can then be used to derive a forecast of the border effect for trade between Canada and the United States, compared to domestic sales within Canada. The accuracy of this forecast, and the assessment of whether there is any net effect on U.S.-Canada trade of the long-standing Auto Pact and the 1988 Free trade Agreement between the two countries is then assessed in equation (viii), which adds an FTA variable covering the two observations for bilateral trade between the United States and Canada. The coefficient on this variable is negative, suggesting that trade linkages between Canada and the United States, after adjusting for the effects of economic size, distance, common language and high per capita incomes, are slightly less than those among OECD countries as a whole, even without making any special allowance for the apparent trade-creating effects of the 1964 Canada-U.S. Auto Pact[9], and the further trade expanding effects of the Canada-U.S. FTA, which were only starting to become evident in 1990. The estimated negative coefficient on the Canada-U.S. bilateral trade variable is both tiny and insignificant, however, showing that the model estimated using the OECD data fits the Canada-U.S. bilateral trading relation very well. The 'special relationship' may be special in many ways, but on average it does not lead to any denser trade links than would be forecast from a gravity model fitted to data for the industrial countries as a whole and applied to the Canadian-U.S. trade flows with due account taken of economic size, distance, the high levels of average incomes in the two countries, a common border and linguistic similarities.

What are the implications of the current results for the size of the border effects, and how closely can these new results be reconciled with the earlier estimates based on trade between provinces and states? When the Wei-type equation is estimated using OECD data, and used to calculate border effects for Canada-U.S. trade, the estimated border effects range from 3.9 to 6.0, depending on the number and nature of other variables included in the equation.

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[9] Anderson and Smith (1996) find, somewhat surprisingly, that the 1990 border effect for transport equipment was significantly higher than for other merchandise trade, even though the Auto Pact providing free trade, at least for the producers, had been in effect for twenty-five years.

The best-fitting equation implies a border effect of six. This is substantially lower than the 20 estimated for the difference between province-province and province-state trade. As already noted, the implied border effect for Canadian internal sales as a whole relative to sales to U.S. states is even higher, since there is some indication that trade linkages are denser within than among provinces. Further work will be required to see what best explains the differences between the estimates based on the different sorts of data. The data for province-state trade provide the most direct test, since it is possible to use similar procedures to treat distances between provinces and between provinces and states. This is in contrast to the OECD results, where there is so far nothing much but assumption available to determine the likely length of internal trade distances. However, I believe that both sorts of result are important and deserve further research.

Although the estimated border effects from the OECD and province-state data samples are different, they are both very large relative to previous beliefs. If either estimate of the border effect is compared to the survey of previous beliefs reported in Helliwell (1996), it is well outside the sample range.

3. Borders, Migration and Trade

This section attempts to build two bridges between national borders and migration. First, an assessment will be made of the extent to which the border effects for trade are mitigated by migration. This will also involve a test of whether interprovincial and international migration are equally important in generating trade. Second, preliminary estimation results will be presented for a gravity model of migration estimated as comparably as possible to the province-state model of trade flows. This will permit some evaluation of the extent to which border effects for migration differ from those for merchandise trade. First we present results for the effects of migration on trade flows, and then for the effects of national borders on migration.

Table 4 shows initial estimates of the effects of stocks of migrants on bilateral trade flows among provinces and between provinces and states. Equation (i) contains just the sample of 90 interprovincial trade flows, while equation (ii) models the 588 trade flows between the provinces and U.S. states, and equation (iii) includes all 678 observations. There are two migration variables. The emigrants variable measures, for exporter jurisdiction i, the share of importer j's population that was born in i. The immigrants variable measures the share of exporter i's population that was born in j. The data come from the 1991 Canadian census and the 1990 U.S. census. The biggest problem with the data is that the Canadian census only says that someone was born in the United States, and not in which state. By contrast, all those born in Canada are shown by province of birth as well as province of current residence. Similarly, the U.S. census shows state of birth for the U.S.-born respondents, but only 'born in Canada' for the Canadian born. For a starting point, we have used population as the sole basis for spreading the international migrants among states and provinces. In our future research, as explained below, we hope to use the results of a gravity model of migration to develop more appropriate measures of bilateral migration between provinces and states.

There results in Table 4 are thus very preliminary, and provide at best only a rough indication of what we might expect to find in future research. The current results suggest that interprovincial migration, for which the data are good, does not appear to have a significant correlation with interprovincial trading patterns. Using the less reliable but more numerous data relating to trade between provinces and states, a state or province with a larger share of its population born in the other country appears to import more intensively from the other country. If subsequent research supports the importance of migration for international but not for interprovincial trade, it will provide further indirect support for the idea that there are national norms and institutions which are known and shared across provinces, but not across national boundaries. Under these circumstances, a migrant across provincial boundaries carries less of trade-creating value, since his or her knowledge of where he or she has come from will be mostly old hat to those already there. As Keith Head has suggested, there may also be deceasing returns to migration. If so, then the much greater relative intensity of interprovincial migration, which will be documented below, may mean that additional migrants may trip over their predecessors when they attempt to make use of any special knowledge they brought with them about conditions back where they were born.

Now we turn to some preliminary estimates of the border effects for migration. There are two main reasons for wanting to estimate gravity models for migration in the form already used for merchandise flows, first to provide a benchmark against which to evaluate the border results for goods, and second to provide a better basis for the estimating the effects of province-state migration on province-state trade flows. The migration results can provide a benchmark for the merchandise trade results because there is every reason to expect border effects to be higher for migration than for merchandise trade. If estimates of the effects for migration are very far below the value of 20 estimated for goods, then this would lead us to be less confident in the results for goods. On the other hand, if the effect for migration is as far above that for goods as might be expected, it would provide indirect support for the merchandise trade result. The two results would then be consistent pieces of an overall picture in which the economic structure of the nation state could be seen to be much tighter, relative to global linkages, than had previously been thought.

I have not run a survey of the perceived border effect for migration, but expect that it is generally thought to be much greater than 1.0. Whether it is thought to be as large as twenty may depend on whether the respondent has seen and believed the factor of twenty estimated for trade flows. Whatever the respondent believes about merchandise trade, I would expect his or her estimate for migration to be much greater, reflecting a century of experience in which migration has become more restricted and trade less so. During the 1850s the population of Australia trebled, as one in every fifty residents of Great Britain migrated there, a degree of mobility not likely to have been matched by merchandise trade. There are still periodic mass migrations, but nothing to match the movements in the nineteenth century, when border formalities were few and mobility high.

A second reason for estimating gravity models for migration is to permit the construction of consistent instrumental variables for the numbers of people born in each U.S. state and now living in specific Canadian provinces, and for the numbers born in each Canadian province and now resident in specific U.S. states. As we have already seen, there are direct Canadian census data, by province of current residence, showing the province of birth, if born in Canada, and the country of birth otherwise. The U.S. census provides parallel information, by state of current residence, of the state of birth, if in the United States, or otherwise the country of birth. If we are able to use these data to fit a fairly robust gravity model with significant effects for population, income differentials, distance and border effects, even with the truncated data of available data, then this model can be used, in conjunction with the known data for population, incomes, and distances for states and provinces, to predict estimates of the bilateral cumulative migratory flows between states and provinces. These data can then in turn be used for a fresh round of estimates of the effects of migration on province-province and province-state trade flows.

Is it legitimate to use constructed data of this sort in the absence of measured series for bilateral migration between states and provinces? I would argue not only that it is legitimate, but also that a case can be made for using data constructed in this way as instrumental variables even if the directly measured series were available. Why might one prefer to use the constructed series? The problem with actual data for bilateral migration and trade flows is that they may both be determined by the same set of unmeasured historical accidents that caused bunching of migration and trade flows. A gravity model estimating bilateral migration flows based solely on incomes, distances and populations will not capture these sources of joint variance in trade and migration, and will hence not be so liable to cause migration to receive false credit for creating trade that was in fact due to a common excluded factor. There remains the problem that the determinants of the migration model are similar to those of the trade model, and the differences in functional form may not be sufficient to allow precise estimates of the separate effects of migration on trade. To some extent this is an empirical matter, depending on how well the migration model fits the available data, and how similar the migration equations are to the trade equations. This will be the subject of future work. For now, the object is to present some initial migration results.

This paper starts with results based on Canadian census data for 1991. The dependent variable is a measure of cumulative immigration: the number of residents in each province split by place of birth: the same province, each of the other provinces, or the United States (as an aggregate, since data for the source states are not available). In future work, we may disaggregate this by age group, and plan to include migration from other countries. For the moment, residents of all ages are treated together. There are no data on when the migration took place, only that it occurred at some time between the date of birth and the census date. The independent variables, following the basic structure of the gravity model, are the logs of population in the source and destination jurisdictions, the log of distance between the two, and finally, to capture the economic incentive for migration, the average (taken 1961 to 1989) log per capita real personal incomes in the source and destination jurisdictions:

$$\text{(3)} \qquad \ln MIG_{ij} = \alpha_0 + \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j + \alpha_3 \ln(dist_{ij}) + \alpha_4 Border + \alpha_5 Y_i + \alpha_6 Y_j + \epsilon_{ij}$$

For the first experiments, we have not included measures of the attractiveness of alternative destinations of the sort proposed by Feder (1980) and Foot and Milne (1984) and tested earlier in the context of gravity models for trade. Initial results of adding long averages of unemployment rates did not reveal any improvement in the explanation based solely on differentials in per capita personal incomes, despite the evidence from net interprovincial migration equations (Helliwell 1996a) that per capita incomes and relative unemployment rates both have significant roles to play.

The results are shown in Table 5. Equations (i) and (ii) show the results for the 90 observations on interprovincial migration, and equations (iii) and (iv) show the effect of adding migration from the United States to each of the ten Canadian provinces. Equations (ii) and (iv) add a dummy variable covering all migration to and from Quebec. Adding this variable materially improves the overall fit of the model, because there is apparently much less migration to and from Quebec than is true for the other provinces. To see whether this was equally true for immigration and emigration, and for interprovincial and international migration, the Quebec variable was split into its three component parts, and a test was run to see if the coefficients were equal. The P-value of the equality restriction was .47, so the evidence seems to indicate that language differences have an equally strong role in all migratory flows involving Quebec. The explanatory power of the gravity model of migration is high, the coefficients are all of the right sign and highly significant, and the implied border effect is as shown at the bottom of the table. In equation (iv), the border effect answers the following question: For every resident in a Canadian province who was born in a U.S. state, how many will you meet who were born in some other Canadian province (excluding Quebec) of similar size, distance, and personal income per capita? The current answer appears to be close to 100. These border effects for migration are high enough to be consistent with high border effects for goods, and high enough also to make it even more reasonable to suppose that at the margin interprovincial migration is much less likely than is international migration to open new doors for trade.

The gravity model for migration also fits well enough to encourage our current efforts to develop a parallel migration model for the United States, and to implement our plans to use simulated bilateral province-state migration flows as instrumental variables in equations estimating the effects of migration on province-state trade flows.

4. Conclusions and Directions for Further Research

This paper has attempted to refine and reconcile the estimates of border effects on trade flows, to make comparable estimates of the effects of national borders on migration, and to assess the possible linkages between migration and trade. On the border effects of trade, the province-state results are still of the order of 20 for 1988-1990, although likely to be dropping during the 1990s in the aftermath of post-FTA increases in North-South trade volumes[10]. There is also some evidence of preference for trade within provinces compared to trade between provinces. Data at a lower level of aggregation, with an attempted concordance between the trade categories used for international and for interprovincial trade classification, should permit investigation of which industries have larger border effects. Finally, attempts are being made to make the international and interprovincial data more consistent and accurate in their recording of the provinces and states of origin and destination[11]. All of these developments should increase the reliance that can be placed on the results based on trade among provinces and between provinces and states.

As for the border effects among a larger sample of countries, making use of input-output data for domestic sales of goods, and guesses about internal trade distances, our results suggest border effects of about 13 for countries of OECD-average per capita incomes and not sharing a common language or a common border. For trade between Canada and the United States, high-income countries sharing a common language and a common border, the estimated effect is reduced substantially, to about half the value for unrelated countries. Future research is planned to extend the sample to include twelve developing countries, making use of UN data for gross output of goods. Our extended sample will include only those countries for which it is possible to estimate gross output in manufacturing, mining and agriculture, thus ensuring a fairly high level of data consistency among all countries in the expanded sample.

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[10] At the end of December, 1996, interprovincial trade data for 1991-1995 were released. Extension of the Table 1(i) equation to include data for 1991 through 1995 shows the 1991 border effect to be higher than in 1990, with a significant downward trend thereafter, reaching 15 in 1994 before rising to 18 in 1995.

[11] Preliminary evidence of two sorts suggest that these revisions are not likely to materially lower the size of the estimated border effect. Anderson and Smith (1997) have used data for total merchandise trade between each province and the United States as a whole to enable definitional concepts to be aligned, and find only a small reduction in the estimated border effect. Second, a preliminary compilation by Statistics Canada of the reconciled data for 1990 provides equation results very similar to those reported in this paper.

The preliminary results for the effects of migration on trade suggest that these effects are likely to be larger and more significant for international than for interprovincial migration. This is consistent with our findings of large national border effects for both trade and migration, presuming that part of the reason for these effects is the existence of national norms and institutions that facilitate trade and migration within the country and which are to a substantial extent known country-wide. These results are very preliminary, and suffer from the current lack of bilateral migration data between provinces and states. Future work based on instruments derived from our migration equations should provide a better basis for conclusions.

Direct estimation of a gravity model of migration was possible for interprovincial migration plus migration from the United States to Canada, and work is underway to match this with a model of interstate plus international immigration for the United States. It should also be possible to extend the Canadian equation to include immigration from a larger sample of countries. The current results provide strong support for the gravity model of migration, supplemented by relative income and national border effects. Our preliminary estimates of border effects for migration show interprovincial migration among provinces outside Quebec to be almost 100 times as likely as migration to these provinces from the United States, after using the gravity model to allow for the effects of income differentials, population size, and distance.

REFERENCES

Anderson, Michael A., and Stephen L. Smith (1996) "Do National Borders Really Matter? A Reconsideration of Canada-US Regional Trade." (Paper presented to the Conference of the Southern Economics Association, Washington, DC, November 1996)

Anderson, Michael A., and Stephen L. Smith (1997) "Canadian Provinces in World Trade: Engagement and Detachment." (Lexington: Washington and Lee University, January 1997)

Engel, C., and J.H. Rogers (1996) "How Wide is the Border?" **American Economic Review 86**: 1112-1125.

Feder, G. (1980) "Alternative Opportunities and Migration: Evidence From Korea." **Annals of Regional Science 14**: 1-11.

Foot, D.K. and W.J. Milne (1984) "Net Migration Estimation in an Extended, Multiregional Gravity Model." **Journal of Regional Science 24**(1): 119-33.

Gould, David M. (1994) "Immigrant Links to the Home Country." **Review of Economics and Statistics 76**(2) (May 1994): 302-16.

Head, K. and J. Ries (1997) "Immigration and Trade Creation: Evidence From Canada." **Canadian Journal of Economics 30** (forthcoming).

Helliwell, John F. (1996a) "Convergence and Migration Among Canadian Provinces." **Canadian Journal of Economics 29** (Proceedings Issue: April):S324-S330.

Helliwell, John F. (1996b) "Do National Boundaries Matter For Quebec's Trade?." **Canadian Journal of Economics 29**(3)(August 1996): 507-22.

Helpman, E (1984) "Increasing Returns, Imperfect Markets, and Trade Theory." In R. Jones and P. Kenen, eds., **Handbook of International Trade** (Amsterdam: North-Holland) Volume 1, 325-65.

McCallum, John (1995) "National Borders Matter: Canada-U.S. Regional Trade Patterns" **American Economic Review 85** (June 1995): 615-23.

Rauch, J.E. (1996) "Networks Versus Markets in International Trade." **NBER Working Paper** No. 5617 (Cambridge: National Bureau of Economic Research).

Taylor, Alan M. (1995) "Growth and Convergence in the Asia-Pacific Region: On the Role of Openness, Trade and Migration." **NBER Working Paper** No. 5276. (Cambridge: National Bureau of Economic Research).

Wei, Shang-Jin (1996) "Intra-national Versus International Trade: How Stubborn Are Nations in Global Integration?" **NBER Working Paper** No. 5531. (Cambridge: National Bureau of Economic Research)

Table 1
Comparing Canadian and OECD Border Effects, 1988-90

Equation	**(i) Canada**	**(ii) OECD**	**(iii) Canada**	**(iv) Canada**	**(v) Canada**
Observations	3x678	3x465	3x688	3x678	3x678
Estimation Method	SUR	SUR	SUR	SUR	SUR
Dependent Variable Log(ship)	prov-state 1988-90	OECD 1988-90	prov-state 1988-90	prov-state 1988-90	prov-state 1988-90
Constant	-4.6,-4.7,-4.9	5.1,5.1,4.9	-4.3,-4.4,-4.5	-11,-11,-12	-2.6,-2.7,-2.9
	(7.0,7.2,7.4)	(17,17,16)	(6.5,6.6,6.9)	(5.3,5.3,5.4)	(3.8,3.9,4.1)
lnGDPX	1.20	.770	1.19	1.25	1.14
	(40.9)	(32.5)	(40.5)	(37.4)	(39.0)
lnGDPM	1.05	.779	1.03	1.06	1.02
	(36.1)	(33.4)	(35.8)	(31.8)	(35.1)
ln(dist)	-1.38	-.870	-1.38	-1.47	-1.61
	(23.5)	(28.4)	(23.5)	(22.7)	(25.0)
Border	3.05	2.15	3.03	2.93	3.05
	(25.1)	(9.6)	(24.8)	(23.3)	(26.2)
Prov Border			.74		
			(1.9)		
Remotex				.63	.88
				(3.5)	(7.6)
Remotei				.32	.42
				(1.7)	(3.6)
$\bar{R}^2$	.81,.80,.79	.87,.87,.87	.82,.81,.80	.81,.80,.79	.82,.81,.80
S.E.E.	1.09,1.12,1.2	.80,.79,.78	1.09,1.12,1.2	1.08,1.11,1.17	1.05,1.08,1.14
	P restr=.11	P restr=.25	P rest=.21	Prest=.00001	Prest=.084
				P=.06 excl remi	P=.12 excl remi
Border Effect	21.1	8.6	prov 2.1 combined 36.5	18.8	21.0

Notes: Absolute values of t statistics are in parentheses. In equations (i) and (iii)-(v), the dependent variable is the log of total shipments of goods from province or state i to province or state j, with lnGDPX being the logarithm of i's GDP and lnGDPM of j's GDP. For equation (ii), the data refer to merchandise shipments from one OECD country to another. Border takes the value 1.0 for each observation recording trade from one province to another, or, in equation (ii), or for shipments within the same country. The coefficient on Border in equation (ii) is based on the 16 countries for which 1988-90 gross output data are available.

Table 2
Reconciling Alternative Estimates of Border Effects, 1990

Estimated by Instrumental variables with 465 observations, dependent variable ln(ship)

Equation	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**	**(vii)**	**(viii)**
Constant	4.78	.906	1.82	1.29	1.56	2.21	2.39	2.22
	(15.6)	(1.0)	(2.1)	(1.4)	(1.7)	(2.5)	(2.6)	(2.5)
lnGDPX	.795	.783	.774	.774	.778	1.18	1.18	1.18
	(31.8)	(31.4)	(31.7)	(31.8)	(32.2)	(16.7)	(16.6)	(16.6)
lnGDPM	.790	.761	.752	.753	.756	.824	.822	.824
	(32.1)	(31.1)	(31.4)	(31.5)	(31.8)	(11.8)	(11.8)	(11.8)
ln(dist)	-.866	-1.03	-.918	-.801	-.830	-.752	-.752	-.752
	(28.0)	(22.2)	(15.9)	(9.7)	(10.0)	(9.2)	(9.2)	(9.2)
ln(dist)*ocean				-.033	-.026	-.036	-.035	-.036
				(2.3)	(1.6)	(2.2)	(2.1)	(2.2)
EC members			.259	.237	.230	.413	.408	.414
			(2.5)	(2.3)	(2.2)	(3.8)	(3.8)	(3.8)
Adjacent countries			.146	.191	.168	.189	.188	.186
			(0.9)	(1.2)	(1.1)	(1.3)	(1.2)	(1.2)
Common Language			.580	.615	.612	.611	.614	.608
			(5.0)	(5.2)	(5.2)	(5.4)	(5.4)	(5.3)
ln(remotex)		.247	.115	.096	.088	.234	.216	.234
		(2.5)	(1.2)	(0.9)	(0.9)	(2.4)	(2.2)	(2.4)
ln(remotei)		.507	.377	.358	.352	.366	.349	.365
		(5.3)	(3.9)	(3.7)	(3.6)	(3.8)	(3.6)	(3.8)
Border	2.14	1.57	2.09	2.36	2.28	2.55	2.77	2.54
	(9.5)	(6.2)	(7.3)	(7.5)	(7.3)	(8.2)	(8.1)	(8.2)
Border*ln(gdp/pop)					-.769	-1.13	-1.18	-1.13
					(2.7)	(3.9)	(4.1)	(3.9)
ln(popx)						-.448	-.446	-.447
						(6.1)	(6.1)	(6.1)
ln(popm)						-.076	-.066	-.075
						(1.1)	(0.9)	(1.0)
Own-country for EC (vii), US-Canada FTA (viii)							-.580	-.079
							(1.5)	(0.1)
$\bar{R}^2$	.872	.879	.886	.887	.889	.895	.895	.895
S.E.E.	.786	.764	.740	.738	.733	.710	.709	.711
Border Effects:								
unrelated, av size	8.5	4.8	8.1	10.6	9.8	12.7	15.9	12.7
+common language			4.5	5.7	5.3	6.9	8.6	6.9
+adjacent			3.9	4.7	4.5	5.7	7.1	5.8
+EC members			3.0	3.7	3.6	3.8	2.7	3.8
Canada-US			3.9	4.7	4.0	4.9	6.0	4.5

Table 3
External and Internal Goods Trade of OECD Countries, 1988-1992

Equation	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**
Observations	465	465	465	465	465
Estimation Method	OLS	OLS	OLS	OLS	OLS
Dependent Variable	ln(ship) 1988	ln(ship) 1989	ln(ship) 1990	ln(ship) 1991	ln(ship) 1992
Constant	2.69	2.81	2.14	2.08	1.55
	(2.9)	(3.1)	(2.4)	(2.4)	(1.8)
lnGDPX	1.10	1.13	1.14	1.23	1.30
	(17.1)	(16.8)	(16.2)	(16.5)	(16.8)
lnGDPM	.856	.854	.806	.848	.827
	(13.5)	(13.0)	(11.6)	(11.6)	(10.9)
ln(dist)	-.719	-.729	-.760	-.720	-.678
	(8.5)	(8.9)	(9.3)	(9.0)	(8.6)
ln(dist)*ocean	-.049	-.045	-.035	-.048	-.059
	(2.9)	(2.8)	(2.1)	(3.0)	(3.8)
EC members	.394	.438	.396	.428	.392
	(3.6)	(4.0)	(3.7)	(4.1)	(3.8)
Adjacent countries	.198	.201	.191	.256	.247
	(1.3)	(1.3)	(1.3)	(1.7)	(1.7)
Common Language	.651	.624	.611	.571	.626
	(5.6)	(5.5)	(5.4)	(5.2)	(5.8)
ln(remotex)	.216	.181	.226	.315	.369
	(2.2)	(1.9)	(2.3)	(3.3)	(3.9)
ln(remotei)	.282	.335	.362	.336	.382
	(2.9)	(3.5)	(3.7)	(3.5)	(4.0)
Border	2.69	2.60	2.52	2.60	2.70
	(8.4)	(8.4)	(8.1)	(8.6)	(9.0)
Border*ln(gdp/pop)	-1.22	-1.16	-1.09	-1.00	-.93
	(4.2)	(4.0)	(3.8)	(3.6)	(3.4)
ln(popx)	-.371	-.405	-.411	-.519	-.613
	(5.6)	(5.8)	(5.6)	(6.7)	(7.5)
ln(popm)	-.106	-.103	-.057	-.105	-.098
	(1.6)	(1.5)	(0.8)	(1.4)	(1.2)
$\bar{R}^2$	.890	.895	.895	.900	.903
S.E.E.	.730	.713	.710	.695	.682
Border Effect for trade between unrelated countries	14.7	13.5	12.4	13.4	14.8

Notes to Tables 2 and 3

Absolute values of t-statistics are shown in parentheses below each coefficient.

The dependent variable is the logarithm of merchandise trade shipments from country i to country j. Data are in US dollars, from the IMF Direction of Trade, except when i=j, where shipments are OECD data for gross output of goods, converted to US dollars, minus the DOT figure for total merchandise exports. The model is fitted to data for 22 countries, but the estimation of the border effect is based on 16 countries for which there are directly measured data for gross output of goods. The sixteen countries are the United States, Japan, Germany, France, Canada, Austria, Denmark, Finland, Iceland, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, and Sweden. The remaining six countries are Australia, Belgium, Ireland, Italy, Switzerland, and the United Kingdom. Estimates based on all 22 countries give similar results, but are not used because the methods employed to approximate values for gross output of goods require assumptions to be made that imply some of the structure that is to be estimated. Data for exporter i's and importer j's GDPs are from OECD data, converted to US dollars using the same exchange rate used in constructing the DOT data.

The international distance data are from Shang-Jin Wei (1996), and are generally based on the distances between capital cities. The estimated internal trade distances are generally taken to be (following Wei 1996) one-quarter of the distance from a country to its nearest international trading partner. The Canadian internal trade distance is based on more detailed data, and the same value is used for Australia and the United States. The variable ln(dist) is the logarithm of the mileage, and ln(dist)*ocean is the same variable multiplied by a variable that equals 1.0 for any trading pair involving a long ocean crossing.

EC takes the value 1.0 when countries i and j are both members of the European Community. The variable for adjacency takes the value 1.0 for shipments across a land border to an adjacent country.

The two remoteness variables are equal to the logarithms of the distances separating countries i and j from all their trading partners with weights based on the inverse of GDPs, as described in the text.

The border variable takes the value 1.0 for internal shipments. The antilog of this coefficient gives the border effect at the bottom of the table, showing the ratio of internal to external trade after allowing for the estimated effects of differences in estimated shipments over estimated distances. The second border variable is the first border variable multiplied by logarithm of the ratio of the country's GDP per capita relative to the average for all countries. The basic border effect shows the value for a country of average GDP per capita. The estimated border effect is smaller for richer countries, and greater for poorer ones. For the United States, for example, with a per capita income 19% above the sample average (measured at the market exchange rates used to compute the sample data), the 1988 border effect, based on equation (vi), is approximately exp(2.55-1.13*.19)=10.3.

Table 4
Effects of Migration on 1990 Trade

Equation	**(i) Canada**	**(ii) Can-US**	**(iii) Full sample**
Observations	90	588	678
Estimation Method	OLS	OLS	OLS
Dependent Variable Log(ship)	prov-prov 1990	prov-state 1990	both 1990
Constant	-.34	-.93	-1.98
	(0.4)	(0.6)	(1.6)
lnGDPX	1.22	.88	1.00
	(18.6)	(12.5)	(17.5)
lnGDPM	.88	1.20	1.12
	(13.3)	(20.0)	(22.5)
ln(dist)	-1.25	1.28	1.27
	(10.0)	(16.5)	(18.6)
Border			1.91
			(5.6)
ln(emigrants)	.03	.34	.24
	(0.4)	(6.0)	(5.2)
ln(immigrants)	.12	.06	.01
	(1.5)	(1.0)	(0.3)
$\bar{R}^2$	.915	.769	.792
SEE	.671	1.21	1.17

Table 5
Border Effects for Migration

Equation	**(i)**	**(ii)**	**(iii)**	**(iv)**
	Canada	**Canada**	**Can+US**	**Can+US**
Observations	90	90	100	100
Estimation Method	OLS	OLS	OLS	OLS
Dependent Variable Log(migration)	prov-prov	prov-prov	prov+US	prov+US
Constant	4.11	-1.87	.97	-6.58
	(2.7)	(1.4)	(0.5)	(4.1)
lnPOPX	.588	1.00	.592	.994
	(5.4)	(10.8)	(5.6)	(10.7)
lnPOPM	.200	.617	.223	.625
	(1.8)	(6.6)	(2.2)	(7.0)
ln(dist)	-.937	-.992	-.922	-.977
	(11.2)	(16.2)	(11.3)	(15.9)
ln(yrelx)	-.01	-2.00	-.05	-1.98
	(0.0)	(3.5)	(0.1)	(3.5)
ln(yrelm)	6.39	4.40	6.11	4.18
	(8.9)	(7.7)	(9.2)	(7.6)
Quebec		-1.42		-1.37
		(8.6)		(8.5)
Border			2.79	4.58
			(5.8)	(11.0)
$\bar{R}^2$	.854	.922	.854	.917
SEE	.649	.474	.636	.477
Border Effect			16.2	97.1