The Economic Significance of National Border Effects

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Abstract

National borders diminish trade volumes, in many cases by a factor of ten to twenty. Although this effect has been widely documented, its economic significance remains unclear. Specifically, no previous study has conclusively linked this empirical phenomenon to underlying, economically meaningful issues, such as the presence of distortionary barriers to trade, the magnitude of any adverse welfare consequences, and the likelihood of a role for policy.

In order to address the economic significance of national border effects, this paper provides evidence on two questions which are fundamental to the issue: (1) Do large border effects arise because of high perceived-price wedges between foreign and domestic products, or because imports and domestic goods are very close substitutes?; and (2) If price wedges are important, do they reflect distortionary barriers to trade or do they arise from nondistortionary factors, such as differences in transactions costs or product characteristics?

To address the first question, I show that border effects are in fact lower for more differentiated (less elastic) products, so that the substitutability between domestic and foreign products is a large part of the reason why borders matter so much. Nevertheless, under the assumption of any reasonable elasticity of substitution, implied price wedges between imports and domestic goods are far higher than recognized tariff barriers.

Regarding the reasons for price wedges, I find that goods with higher information costs do not have higher border effects and that information costs are not a primary causal factor of the effects of borders on trade volumes. I also examine the importance of national product characteristics and of actual border barriers to trade. While inherent nationality differences are not an important reason for border effects, borders per se hold substantial explanatory power.

My results suggest that border effects may imply distortionary barriers to trade, welfare costs, and a role for policy. I conclude that national border effects have economic significance.

1 Introduction

National borders diminish trade volumes, in many cases by a factor of ten to twenty.[1] This empirical finding has proven robust to controlling for a number of alternative explanatory variables, including income, outside trading opportunities, and distance. Further, borders matter for country-pairs as closely linked as Canada and the U.S., as well as for less apparently integrated economies (see McCallum (1995) for the original U.S.-Canada result). Although an expanding literature has documented this effect across space and time, the economic significance of these findings remains unclear. Specifically, no previous study has conclusively linked this empirical phenomenon to underlying, economically meaningful issues, such as the presence of distortionary barriers to trade, the magnitude of any adverse welfare consequences, and the likelihood of a role for policy.

This lack of evidence on interpretation of the "border effect" rests in large part on its definition: the extent to which the volume of domestic trade exceeds the volume of international trade.[2] It is thus a comparison of two trade *volumes*. A number of factors could cause the volume of domestic trade to exceed that of international trade: tariffs, regulatory differences, information cost differences, the "nationality" of a product, a high elasticity of substitution between imports and domestic goods (together with a small barrier to trade). The volume measure alone does not provide information on the relative importance of the myriad of possible causal factors.

Consider, for example, a border effect of 2.65, so that trade between two locations within a country is 2.65 times higher than trade between two locations in different countries, after controlling for distance, income, and alternative trading opportunities. What could cause such an effect? Consider the following explanations, all of which generate a border effect of 2.65:

Scenario #1 The goods produced by the two different countries are virtually perfect substitutes, with an elasticity of substitution (σ) of 20. Imports are subject to a 5% tariff.

Scenario #2 Imports and domestic goods are imperfect substitutes ($\sigma = 2$). The costs of gathering information about a foreign product are 63% higher than are the costs of doing so for a domestic product.

Scenario #3 Imports and domestic goods are imperfect substitutes ($\sigma = 2$). There is a 63% tariff on imports.

Clearly, the economic implications of these three scenarios differ. In the first, the magnitude of the border effect is largely due to the high degree of similarity between imports and domestic goods. It implies neither unrecognized barriers to trade nor high welfare costs. In the second case, the barriers, welfare consequences and policy implications of border effects

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[1] McCallum (1995) first showed that trade between two Canadian provinces was more than twenty times larger than trade between a province and a U.S. state, after controlling for size and distance. This result was particularly shocking given that the U.S. and Canada share a common language, a long border, and low official barriers to trade. Subsequent work by Helliwell (1996, 1997, 1998), Wei (1996), and Anderson and Smith (1999a, 1999b) has confirmed and expanded upon such results, both for Canada and for OECD and non-OECD countries.

[2] The term "border effect" refers to the downward impact of national boundaries on the volume of trade, i.e. that two different countries trade far less with each other than do two locations in the same country, after controlling for factors such as income, alternative trading opportunities, and distance. In the context of estimating equation (2), it is the exponential of the coefficient on the *LOCAL* dummy variable, i.e. $\exp(\gamma)$.

are minimal because the price wedge giving rise to border effects reflects a transaction-cost differential. Only in the third case do border effects imply high distortionary barriers to trade, adverse welfare effects, and a potential role for policy.[3]

This example illustrates that the economic significance of border effects hinges on two crucial issues:

1. Do large border effects arise because of high perceived-price wedges between foreign and domestic products (Scenarios #2 or #3), or because imports and domestic goods are very close substitutes (Scenario #1)?

2. If price wedges are important, do they reflect distortionary barriers to trade (Scenario #3) or do they arise from nondistortionary factors, such as differences in transactions costs or product characteristics (Scenario #2)?[4]

This paper explores the economic significance of border effects by completing four exercises that address these two issues.

The exercises in Sections 3.1 and 3.2 directly address the first issue listed above: the relative importance of import-domestic price wedges, as opposed to a high elasticity of substitution between the two types of goods. The first exercise asks whether differentiated products (i.e., goods with lower elasticities) have higher border effects; this observable relationship between border effects and elasticities allows me to infer the relative importance of unobservable price wedges, as opposed to elasticities. Border effects are, in fact, lower for more differentiated products. This suggests that the substitutability between domestic and foreign products is an important part of the reason why borders matter so much. Nevertheless, as the second exercise shows in Section 3.2, under the assumption of any reasonable elasticity of substitution, implied price wedges between imports and domestic goods are far higher than recognized tariff barriers.

The exercises in Sections 4.1 and 4.2 then address the second issue listed above: the reasons for these price wedges. I first examine the role of transaction-cost-based differences between imports and domestic goods, focusing on information costs. Using industry characteristics, I find that goods with higher information costs do not have higher border effects. I conclude that information costs are not a primary causal factor of the effects of borders on trade volumes.

Finally, Section 4.2 examines the importance of national product characteristics and of actual border barriers to imported products. I ask a very basic question: Does the

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[3]Helliwell (1998) discusses the "correct" magnitude of border effects: "A typical economy with an "appropriate" amount of border effect would probably have ... unrestricted rights to travel and trade across national borders. Its equilibrium patterns of travel and trade may continue to show border effects of the sort in evidence among the OECD countries at the end of the 20th century. If so, it would be because the costs of information are such that local networks are more effective than global ones for meeting and responding to local changes in tastes or circumstances."

[4]Throughout this paper, I will use the term "price wedge" or "price difference" in order to refer generally to the differences between the prices of imports and domestic goods, as perceived by the consumer. For only the case of purely distortionary, policy-imposed differentials, however, I will use the term "barrier". Transaction-cost or product-characteristic based differences, on the other hand, will be incorporated in the broader category of price wedges. This distinction is not only semantic. Barriers may imply welfare costs and policy actions, while transaction-cost or product-characteristic based differences imply neither.

border, in and of itself, create a barrier to trade ("location"), or do imports inherently differ from domestic products so that consumers purchase them less readily ("nationality")? To isolate these two factors, I use data on the sales of U.S. multinationals producing in foreign countries, in addition to data on sales of domestic firms and imports. Comparison of imports from the U.S. and sales of U.S. foreign affiliates isolates the "location" effect, controlling for "nationality," while examination of U.S. foreign affiliate sales versus those of domestic goods highlights "nationality," controlling for "location". In fact, I find that borders per se rather than an inherent nationality difference hold more explanatory power.

Thus, my results suggest that border effects imply distortionary barriers to trade, welfare costs, and a role for policy. I conclude that national border effects have economic significance.

2   Theoretical and Empirical Framework

The empirical analysis is based on a gravity-type model of trade. A large number of studies document the empirical explanatory power of this model, which predicts that the aggregate volume of trade between two places will be determined by the income of the two countries and the distance between them.[5] The literature on the effects of national borders on trade flows has adopted this empirical model as a natural framework for exploring the relative volumes of internal and external trade.[6]

For this paper, I modify the gravity framework used in other studies by focusing on industry-level trade, rather than on aggregate flows.[7] I derive the estimating equation from a very standard model of trade in differentiated products, in which goods are differentiated by location of production.[8] Trade between locations may encounter both transport costs and barriers to trade.

Working through such a model, assuming that a good g has a price of 1 in its country of origin, and taking logs yield the following expression for shipments between a producer $c^{\cdot}$ and a consumer c:

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\begin{aligned}
\log SHIP^g_{cc'} &= \log Y_c + \log Y^g_{c'} + \log R^g_{c'} + \log R^g_c \\
&\quad - \sigma_g \log D^g_{cc'} - \sigma_g \log T^g_{cc'}
\end{aligned}
\tag{1}
$$

where $SHIP^g_{cc'}$ is total purchases of the g good by country c from a producer located in c', Y_c is the income of the importer, $Y^g_{c'}$ is the income of the producer derived from sales of good g, and $R^g_{c'}$ and R^g_c are measures of a country's remoteness, which measure the GDP-weighted distance of a given country from alternative trading partners.[9] σ_g is the

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[5]Some common references include Tinbergen (1962), Linneman (1966), and a large number of more recent papers.

[6]For example, McCallum (1995), Helliwell (1996, 1997, 1998), Wei (1996), and Anderson and Smith (1999a, 1999b).

[7]Helliwell (1998) does include some industry-level analysis. My specification differs from his, however, because I use production levels as explanatory variables, as dictated by the theoretical model described in Appendix B.

[8]Details on deriving the estimating equation are provided in the Theory Appendix. For additional discussion, see Helpman and Krugman (1985), Deardorff (1995).

[9]See appendix for exact functional form.

elasticity of substitution among varieties of good g, and $D^g_{cc'}$ and $T^g_{cc'}$ represent, respectively, transportation costs (either domestic or international) and other costs of international trade. These other costs of international trade could include a number of factors which would differentiate intra- and inter-national trade, including governmental barriers or differences in information costs. I assume that $T^g_{cc'} = 1$ for trade within a country, i.e. if $c' = c$. This variable $(T^g_{cc'})$ will capture differences between international and domestic trade. The border effect is the difference between local and international trade for two locations having identical values for all variables in the model other than $T^g_{cc'}$, i.e. $\sigma_g \log T^g_{cc'}$.[10]

This expression (Equation 1) is in the form of a gravity model of trade and will form the basis for the empirics. The estimating equation will be of the form:

$$\log SHIP^g_{cc'} = \alpha_0 + \beta_1 \log GDP_c + \beta_2 \log PROD^g_{c'} + \beta_3 \log DIST_{cc'} \quad (2)$$
$$+ \beta_4 \log R_{c'} + \beta_5 \log R_c + \gamma LOCAL$$

The dependent variable $(SHIP^g_{cc'})$ will be goods consumption by a country c of goods produced by producer c' in industry g. For the case of imports, I use bilateral industry-level import data. For a measure of "domestic trade", i.e. how much a country consumes of its own goods, I use data on national production (gross output) within an industry less total exports by that industry. For the case of foreign affiliates of U.S. multinationals, $SHIP^g_{cc'}$ is given by local sales of foreign affiliates.

The independent variables include production levels in the producing location $(PROD^g_{c'})$, which are given by data on industrial production (gross output for national production, total sales for foreign affiliates of U.S. multinationals), income (GDP_c), and the distance between the location of production and the location of consumption $(DIST_{cc'})$. The measure of bilateral distance is the great circle distance, generally from capital to capital, between the two trading countries. For trade within a country, own distances are calculated as $\frac{1}{4}$ of the distance to the nearest trading partner; for islands, own distance was calculated as $\frac{1}{2}$ of the minor radius of the country.[11]

Another independent variable is what has been termed the "remoteness" variable $(R_{c'}, R_c)$. Introduced to this literature by Wei (1996), it is intended to capture the distance of a given country (c, c') from alternative trading partners. My empirical proxy for remoteness is based on the specification of Helliwell (1997a):

$$R_c = \sum_{c'} \frac{DIST_{cc'}}{GDP_{c'}}$$

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[10] Note that in levels, rather than logs, it will be $\exp(\sigma_g \log T^g_{cc'})$.

[11] This measure of domestic distance was first suggested by Wei (1996). Although not ideal in the sense that it may not capture the exact distance over which domestic trade occurs, this measure should depict variation across countries in domestic transport costs. In fact, Helliwell (1997b) notes that for trade within Canada, this proxy produces measures very close to those calculated from data on interprovincial trade distances and some assumed distances for intra-provincial distances. Note that almost all of the results in this paper do not depend on the domestic distance proxy. Changes in the proxy affect only the scaling of the border effect coefficient, and most of my results do not depend on the magnitude of border effects. Nevertheless, all sections of this paper have been re-estimated using twice and one-half of the distance values used here. Although the magnitude of the effects of borders does change somewhat, the qualitative results and my conclusions remain the same.

where the countries c' are all of c's trading partners in the sample. Although not a direct translation of the theoretical definition of this term, this form captures the essential elements of the remoteness variable, since distance and GDP enter as, respectively, numerator and denominator.

Finally, the dummy variable $LOCAL$ captures the differences in consumption levels depending on the source of production. $LOCAL$ takes the value of 1 when the consumer and the producer are in the same location (i.e. country), and zero otherwise. Thus, the magnitude of the border effect $(\exp(\sigma_g \log T_{cc'}^g)$ in the theoretical model) will be $\exp(\gamma)$, where γ is the coefficient on the $LOCAL$ dummy variable.

The sources for these data are standard and are described in the Data Appendix, as are all other data used in the paper. The years and countries which I examine vary slightly across sections, depending on data relevance and availability, so Table 1 provides the details on the individual samples. Throughout the paper, I use instrumental variables techniques due to the endogeneity of production and GDP. Industry and year fixed effects and distance-industry interaction terms are included where appropriate. More specific information is provided in the individual sections.

3 Price Wedges or Elasticities?[12]

An issue crucial to the economic significance of border effects is the degree to which high border effects arise from high elasticities of substitution between imports and domestic goods, as opposed to from high price wedges between the two. It is impossible to address this issue by merely observing the magnitude of border effects. This point is illustrated by the definition of the border effect: $\exp(\sigma_g \log T_{cc'}^g)$. It is the combination of a price wedge $(T_{cc'}^g)$ and the elasticity of substitution (σ_g); thus, the magnitude of a given border effect in fact provides complete information on neither of these elements.

Two simple partial-equilibrium diagrams further illustrate why elasticities are so important for interpreting past results. In Figures 1 and 2,[13] $TV_{FT} - TV_B$ is the difference between the trade flow predicted to occur in the absence of barriers to international trade and the flow which actually does occur. This given reduction in trade volume is linked to both an "elastic" and an "inelastic" demand curve. In Figure 1, it is clear that a given reduction in trade volume could imply either a high (τ^i) or a low (τ^e) barrier, depending on the elasticity. Clearly, the implications of a given volume finding are more dire the lower the elasticity of the underlying demand curve. The magnitude of the welfare effect implied by a given volume impact similarly depends on the elasticity of substitution, as shown in Figure 2 (where the welfare effect is measured as the change in consumer surplus).

The exercise in Section 3.1 addresses this issue by asking whether less elastic (more differentiated) products have higher border effects. Section 3.2 then analyzes the height of barriers implied by measured industry-level border effects, in combination with a reasonable

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[12]In the context of the model presented in Section 2 and Appendix B, the term "elasticity" refers to σ_g, which in the model is both the elasticity of substitution between varieties of a particular good and the price elasticity of each individual variety, under common assumptions. See Helpman and Krugman (1985) for an explanation.

[13]Note that both figures do not incorporate the effects of a domestic supply.

elasticity of substitution. It also provides calculations of the elasticities required to explain completely the magnitude of border effects, if measured tariffs are the only barriers to trade. Together, these two exercises will provide an indication of the relative roles of elasticities and of import-domestic price wedges. As I will show, both factors play some role, but the magnitude of unexplained price wedges appears far larger than measured barriers to trade.

3.1 The Relation Between Elasticities and the Magnitude of Border Effects

3.1.1 Introduction[14]

In order to learn about the relative importance of elasticities and price wedges, it would be useful to know how elasticities are related to price wedges. More specifically, I would like to know whether a given aggregate border effect is due to high price differences on inelastic products or to lower differences on very elastic products, or to some combination thereof. Unfortunately, this relation is not directly observable.

Instead, I analyze the relationship between border effects and elasticities, which is observable. The border effect-elasticity relation is informative because border effects increase with a fall in the elasticity only when high price wedges on inelastic products are the primary cause of border effects. Thus, if the data show that border effects do not increase with a fall in elasticity, high price wedges on inelastic products are probably not important.

To explain the method, first note that certain price wedges between domestic and international trade may vary systematically with the degree of product differentiation or elasticity of substitution among varieties, either increasing or decreasing with a fall in elasticity (see Table 2). As an example of the former case, some have argued that informational costs should be higher for differentiated products.[15] On the other hand, import-domestic wedges may not vary systematically with differentiation, such as with tariffs and national legal institutions. These three possible correlations are listed in the second column of Table 2.

The relationship between border effects and elasticities will allow me to distinguish among these three cases, as shown in the third column of Table 2. If price wedges which increase systematically with lower elasticities are important, such as may be the case with information costs, then more differentiation (a lower elasticity) should be associated with higher border effects (Case 1). On the other hand, if price wedges are fairly constant across goods, any small price difference would have a much lower effect for products that are more highly differentiated (Case 2). Finally, if wedges are higher for more homogeneous (higher elasticity) products, more homogeneous products should have higher border effects (Case 3). Thus, only if higher price wedges on differentiated products have an effect outweighing any elasticity effect would higher border effects on more differentiated products be expected. In the contrary, if I do not observe this pattern, I should be able to reject that possibility.[16]

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[14]Evans (1999a) contains more extensive analysis of these issues.

[15]For example, Rauch (1999).

[16]Of course, the possibility exists that barriers increase slightly with a fall in elasticity, but that these effects are masked by the effects of barriers on the more elastic products. This case, however, would also indicate that barriers which increase with a decrease in the elasticity are not the major causal factor behind observed aggregate border effects and would not alter our final interpretation of the empirical result. A

Thus, exploring the relationship between border effects and elasticities is the primary goal of this section. This observable border effect-elasticity relation will then be used to infer the unobservable price wedge-elasticity relation.

3.1.2 Results

The data for this section are for eight OECD countries in 1990, across 12 industries. Several measures are used to proxy for differences across industries in elasticities/degree of differentiation among products. First, I consider intra-industry trade as a proportion of the total trade within an industry.[17] Although the link between product differentiation and the proportion of intra-industry trade does not follow directly from the standard theory of trade in differentiated products, several empirical studies have found the two to be positively associated with each other.[18]

Second, I utilize the measure of homogeneity of products proposed by Rauch (1999). I calculated for each of the industries the percent of trade in products which he characterizes as not having either an organized exchange or a reference price, i.e. the products likely to have lower elasticities. Thus, a higher "Rauch index" indicates a less homogeneous (more differentiated) product.

Third, I consider R&D spending as a share of sales, which may measure differentiation and the importance of information. Finally, I also consider the ratio of advertising to sales within an industry. Within the industrial organization literature, the ratio of advertising expenditure to total sales is a standard approach to capturing the role of product differentiation.[19]

Some of these individual measures may be open to question. Taken as a group, however, if I find consistent results across all measures, then it would be difficult to dispute the implied role of price wedges which fall systematically with a fall in product differentiation, as opposed to elasticities.

I use the estimating framework of equation 2, with the following potential trading relationships:

(1) purchase of domestic goods;

(2) bilateral imports from a sample of partner countries.

The $LOCAL$ variable is defined as one for purchases of domestic goods and zero for bilateral imports. To gauge the effect of the elasticity proxies on the impact of national borders, I include an interaction term, which is the $LOCAL$ variable multiplied by the measure of interest. All measures vary between 0 and 1, with a higher index associated with a higher degree of differentiation (a lower elasticity). Thus, for example, for an industry with 50% intra-industry trade, trade between two unrelated countries in the sample will have a border effect of $\exp(\beta_{LOCAL} + (\beta_{LOCAL*IIT} * .5))$, where β_{LOCAL} is the coefficient on the $LOCAL$

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similar conclusion would apply to the case in which barriers differ across products, but in no systematic relationship to elasticities.

[17] The proportion of intra-industry trade is calculated using the Grubel-Lloyd index as described in Hummels and Levinsohn (1993).

[18] For example, see Caves (1981), Loertscher and Wolter (1980), and Hansson (1991). Davis (1997) uses this index as a measure of product differentiation. Hansson (1991) also provides a theoretical model in which this relationship holds.

[19] See Scherer and Ross (1990), pp. 436-438.

dummy variable, and $\beta_{LOCAL*IIT}$ is the coefficient on the interaction term. A positive coefficient on the interaction term indicates that more differentiated (less elastic) products have higher border effects.

As shown in Table 3, the results for all measures indicate that a higher degree of product differentiation is actually associated with a lower border effect.[20] For example, the coefficient of -1.52 on the Rauch variable indicates that a perfectly homogeneous product (R=0) will have a border effect of $\exp(2.27) = 9.68$, while a product with R=.5 will have a border effect of $\exp(2.27 - (.5*1.52)) = 4.53$. The proportion of intra-industry trade, the Rauch index, and the R&D to sales ratio are significant at the 0.5%, 0.3%, and 0.9% levels, respectively. The advertising to sales ratio is significant at the 6.5% level.

Thus, all variables yield consistent results suggesting that border effects fall with a higher degree of product differentiation. This suggests that high border effects are partially attributable to the elasticity of substitution between domestic goods and imports, and that high border effects do not necessarily indicate large price wedges between domestic and foreign products. It also implies that price discrepancies that increase with a fall in elasticity are not likely to be an important explanation of aggregate border effects. Thus, product-specific information, in the sense described by Rauch (1999), probably does not play a major role. If such wedges do exist, their effects are outweighed by elasticity effects. (I will return to this point in section 4.1.)

3.2 The Magnitude of Implied Barriers to Trade and Elasticities

3.2.1 Introduction

The preceding results provide some support for the notion that border effects may be readily explained simply by elasticities in combination with widely-acknowledged existing barriers to trade. However, the analysis leaves unanswered the question of the magnitude of the price wedges required to explain completely the magnitude of observed border effects. In other words, I have shown that elasticities are a part of the explanation, but I have not yet provided an indication as to what extent elasticities alone are able to explain border effects. This section provides estimation and calculations to answer this question. It shows the extent to which observed border effects may be entirely explained by reasonable elasticities of substitution, together with acknowledged barriers to trade, i.e. tariffs.

In order to gauge to what degree elasticities and tariffs do indeed explain border effects, I first estimate industry border effects. I then calculate implied barriers to trade across the industries in the sample, based on the measured border effect and the assumption of a "reasonable" elasticity of substitution. Comparing these overall implied wedges to actual tariff data yields an indication of the "unexplained" price wedge.[21] I also calculate the

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[20] The estimation technique in this section is two-stage-least-squares with population and population-based remoteness measures as instruments for GDP and GDP-based remoteness measures. Following Harrigan (1995, 1996), several endowment measures are used as instruments for production levels. Measures of the log of the number of workers, the log of the capital stock, and the log of agricultural land are interacted with industry dummy variables to create a set of $12*3 = 36$ instruments for production. Industry-specific regressions of the log of production on the instruments yields R^2s ranging between 0.91 and 0.99. Industry fixed effects and distance-industry interaction terms are included.

[21] Based on the definition of the border effect, the implied barriers may be calculated as $T^m_{cc'} = \exp[\frac{\beta^g_H}{\sigma_g}] - 1$.

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elasticities required to explain the magnitude of border effects, if the only barriers to trade are measured tariffs.

3.2.2 Results

Table 4 provides the results for implied barriers to trade. In the second column is the border effect for non intra-E.U. trade for two non-adjacent countries for each industry in the sample, calculated as $\exp(\beta_L^g)$, where β_L^g is the coefficient on an industry–dummy-variable-$LOCAL$ interaction term.[22] The third column provides the average tariff for these countries in each industry. The subsequent columns provide the calculated ad valorem tariff equivalent price wedges for a range of elasticities, in order to provide a rough order of magnitude of implied and unexplained price wedges. Thus, if all goods have an elasticity of 2, total implied price wedges range between 96.66% (Other Manufacturing) and 553.99% (Petroleum Refineries and Products). To approximate a slightly more realistic case with variation in elasticity across industries, I calculate a range of elasticities based on the Rauch index. The derived elasticities range between 2 and 5. Total implied price differences range between 67.22% (Basic Metal Industries) and 227.67% (Non-metallic Mineral Products).[23]

Rather than focusing on specific magnitudes, I am interested in providing general ranges to compare to the actual tariff data in the third column. Clearly, these implied price differences are far larger. For example, while the average tariff in Wood Products and Furniture is 4.65%, the implied wedges range between 76.36% and 313.06%. More generally, with the elasticity ranging between 2 and 5, unexplained price wedges range between 62.33% and 221.12%. In other words, even after eliminating the effects of tariffs, the import-domestic price wedge may be as high as 221.12%.[24]

An alternative calculation is the elasticity implied by measured border effects and tariffs.[25] This is the elasticity which would be required to explain entirely the magnitude of border effects, if the only barriers to international trade were measured tariffs. As shown in Table 5, this exercise yields elasticities which range between 24 and 76, with a simple average of 43.

I subtract the tariff levels from the overall implied price wedge. See Lee and Swagel (1997) for a description of the tariff data.

[22] Full results for the regression are in Table A1. Dummy variables for trade between two European Union countries and for trade between two adjacent countries are included in order to calculate border effects for non-intra-EU trade for two non-adjacent countries.

[23] See data appendix for a description of calculation of these elasticities. The issue of an appropriate value for the elasticity of substitution between imports and domestic goods is a contentious one. Several older studies (such as Stern et al. (1976)) suggest that the aggregate number is between 1 and 2. At a disaggregated level, others have found that it ranges between 1 and 12, for imports from all countries to the U.S. (Shiells et al. (1986)). Feenstra (1994) suggests that these numbers may be too low for a number of methodological reasons. He finds disaggregated values that range between 2.96 (typewriters) and 42.9 (silver bullion). Hummels (1999) finds, for the U.S., New Zealand, Argentina, Brazil, Chile, and Paraguay, elasticities at the 2-digit SITC level largely between 3 and 8. Obviously, any single number conclusion on the magnitudes of implied differentials would rest on more precise estimation of these elasticities. In any case, my results may be interpreted as an indication of the order of magnitude of these differentials.

[24] One possible concern is that tariffs may be related to non-tariff barriers in such a way that industries with high tariffs tend to have high protection in general, leading to higher border effects than would be indicated by the tariff data alone. In fact, this does not appear to be the case.

[25] The implied elasticity is calculated as $\sigma_g = \frac{\beta_H^g}{\ln(T_{cc'}^m + 1)}$.

As detailed in footnote 23, these numbers far exceed most estimated elasticities, providing additional evidence that border effects result from price wedges which exceed the magnitude of tariffs.

Thus, although Section 3.1 showed that elasticities are indeed part of the story, perceived-price wedges not explained by tariffs must still be non-negligible. In the next sections, I consider possible reasons for these price differences.

4   The Reasons for Price Wedges

As illustrated above, implied price wedges between foreign and domestic products are far larger than would be suggested by recognized barriers to trade. This finding leads to the second crucial issue listed in the introduction: if price wedges are important, do they reflect distortionary barriers to trade or are they due to nondistortionary factors, such as differences in transaction costs or product characteristics? This section completes two exercises which will explore the importance of several possible causal factors. Section 4.1 focuses on information costs as a transaction-cost based explanation. Section 4.2 examines the roles of both nationality as a product characteristic and of borders per se as a barrier to trade.

4.1   Information Costs Within and Across Borders

4.1.1   Introduction

Differences in the costs of obtaining information about the quality or existence of a foreign versus a domestic product could partially explain border effects.[26] If it is indeed more costly to learn about a foreign product, this higher transaction cost could tend to reduce the quantities of foreign goods purchased. The relevance of information-cost differentials is important for drawing conclusions about the welfare consequences of border effects. If information costs are important, border effects do not necessarily arise from distortionary barriers, and may instead simply reflect different transaction costs.

The ease or difficulty of information transfer may be affected by industry-specific characteristics. For example, information transfer should be more difficult for complex products composed of a bundle of attributes than for simple, standardized goods. Other industry characteristics which should be associated with an important role for information transfer include the importance of information in purchasing and consuming a product and the degree of differentiation among varieties of a product. For products possessing these characteristics, domestic varieties may be purchased more readily than foreign ones if international information transfer is indeed more costly than domestic. Thus, if information cost differences between foreign and domestic products are a primary explanation for border effects, borders should matter more for industries where information transfer is more costly, difficult, and important.[27]

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[26]Helliwell (1997, 1998), Rauch (1999). Also see the *Journal of International Economics* (1999) for a number of papers on the related topic of the role of networks in international trade.

[27]This argument makes an implicit assumption about the link between industry characteristics and the foreign-domestic information cost differential. More specifically, I assume that (1) there is some difference

To capture variation in the need for information across industries, I first use a set of indicators on the importance and difficulty of information transfer, which comes from the results of a Conference Board survey of marketing activities (Bailey (1975)). As a first indicator, I use data on the frequency of sales or technical service. High frequency should indicate that information about the use of a product must be transferred subsequent to the original purchase. Second, a variable indicating whether a good is made to order, as opposed to being filled from stock, should indicate a need for information transfer regarding the buyer's particular needs and preferences. Third, I consider whether a particular product tends to be a major purchase for a buyer; as Bailey (1975) notes, major purchases often entail more negotiation and information-gathering. Finally, a variable describing infrequency of purchase should also provide some indication of the absence of experiential knowledge and thus the need for transfer of information. All of these indicators should be positively associated with the difficulty and/or importance of information transfer, so that border effects should be higher, for example, in industries where products are made to order and require frequent technical service if information costs are the major explanation of border effects.

I also ask how the degree of differentiation affects border effects, using the results of the previous section. If information costs are indeed important, border effects should be higher for more differentiated products.

4.1.2 Results

I continue to utilize the estimating framework of equation 2, with the following potential trading relationships:

(1) purchase of domestic goods;

(2) bilateral imports from a sample of countries.

The data are for 8 OECD countries in 1990, across 12 industries. The $LOCAL$ dummy variable is 1 for purchases of domestic goods and zero for bilateral imports.

The results for the Conference Board Data are in Table 6. To examine the effects of these industry characteristics on the border effect, I incorporate a variable composed of the interaction between the variable of interest and the $HOME$ dummy variable. This coefficient describes how variation in the variable affects the difference between national and international trade. Thus, a negative sign suggests that an increase in that variable tends to reduce the impact of borders. Due to data availability, I am forced to limit analysis to five of the twelve industries, so column (i) also provides a benchmark for this smaller sample. Column (ii) shows that border effects are in fact lower where products tend to be made to order, as opposed to filled from stock. They also tend to be lower where sales/technical service is more frequent (column (iii)). When purchases within an industry tend to be major

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between the information costs for imports and domestic goods, per unit of information; and (2) that information costs are higher in certain industries. Thus, in industries where information costs are higher, the difference in the per unit cost of information will lead to a higher overall difference between foreign and domestic information costs. For example, a very complex product requires me to learn about its many attributes, for each of which there is a foreign-domestic difference in the costs of information. Thus, if information costs are an important explanation for border effects, border effects should be higher in these high-information-cost industries.

purchases, border effects are also lower (column (iv)). The coefficient on the frequency of purchase is not significant. Three of the four indicators of the importance of information transfer thus suggest that border effects are lower where information transfer is likely to be more difficult and/or important.

The results for differentiation and information costs are indicated in Table 3, as discussed in Section 3.1: border effects are in fact lower for more differentiated products. Thus, product-specific information does not play a major role in the creation of border effects. The effects of such differentials are outweighed by elasticity effects.

Thus, the evidence on both product differentiation and industry characteristics suggests that product-specific information-transfer difficulties are not likely to be a major cause of border effects.

4.2   Nationality and Location

To continue the analysis of possible explanations of import-domestic price wedges, this section asks how much of the border effect is explained by borders per se and by nationality differences.[28]

4.2.1   Introduction

In the most general sense, when domestic goods are purchased more readily than imports, two types of differences between the two could exist:

(1) Barriers at the border, i.e. tariffs, non-tariff barriers, regulatory differences, etc. ("location").

(2) An inherent difference between domestic and foreign products ("nationality").

In terms of equation 1, the $T_{cc'}^g$ term may be composed of two elements, "border barriers" $(\tau_{cc'}^g)$ and differentials due to differences between domestic and foreign products $(C_{cc'}^g)$, such that $T_{cc'}^g = \tau_{cc'}^g * C_{cc'}^g$.[29] This distinction is important for reasons related to both the welfare implications and the policy relevance of border effects. If borders per se in fact create border effects, distortionary barriers, governments, and policy may play an important role. On the other hand, if domestic and foreign products are indeed "different," border effects could reflect simply an optimal response to these perceived differences. Welfare consequences of border effects should not be large, and the role of policy in the creation and alleviation of border effects may be minimal.

To address this issue, I utilize data on sales of U.S. multinationals producing in foreign countries, in addition to data on sales of domestic firms and imports.[30] Using this infor-

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[28] More extensive analysis of this issue is contained in Evans (1999b).

[29] An alternative interpretation may be derived from a model (such as the one in Appendix B) in which $\beta_{c'}^g$ differs across trading partners. In this interpretation, differences between domestic and foreign products arise from differences in this parameter of the utility function. The way that the differential enters into the equation is actually quite similar for the two cases. For an extensive discussion of this alternative approach, see Hummels (1999).

[30] There is one potential problem with the data used for this approach. The data on domestic production include activities for all multinationals producing within that country, so that the measure of domestic trade is not as "pure" as one might desire. In a separate Data Appendix, available from the author upon request, I provide analysis which addresses this issue by partially adjusting the data for the presence of multinationals.

mation allows me to isolate the two broad potential sources of differences between imports and domestic goods. Comparison of imports from the U.S. and sales of U.S. foreign affiliates isolates the "location" effect, controlling for "nationality." In terms of the model, this examination of consumption levels for products produced by foreign affiliates versus levels for imports will measure the $\tau^g_{cc'}$ element, while eliminating any differences due to the $C^g_{cc'}$ element. Thus, if nationality effects alone explain border effects, borders should not matter at all when comparing consumption levels from these two sources. On the other hand, examination of U.S. foreign affiliate sales versus those of domestic goods highlights "nationality," controlling for "location." In this case, if borders alone explain border effects, and nationality plays no role whatsoever, borders should matter to the same degree when comparing imports from the U.S. to either sales of foreign affiliates or to domestic sales.

4.2.2 Results

The form of the test will again be a standard gravity-type model, as in equation 2, with three potential trading relationships:

(1) a country purchasing goods from its own domestic firms;

(2) a country consuming the goods of U.S. foreign affiliates producing within its borders; and

(3) a country importing goods from the U.S.

The variable $LOCAL$ is a dummy variable which takes on the value of 1 when the producer and consumer are located in the same country, and 0 otherwise. Using imports as the benchmark, I examine the effects of consuming a domestic product and of consuming a good produced by a foreign affiliate located within national borders, with the variable $LOCAL$ measuring these effects for both cases.

Thus, the test consists of running two separate equations simultaneously in a three-stage-least-squares framework. The first equation contains data on imports from the U.S. and domestic sales; it measures the extent to which the volume of domestic trade exceeds international trade. The second contains data on imports from the U.S. and on the sales of the foreign affiliates of U.S. multinationals producing within the foreign country. It measures the degree to which foreign affiliates sales volume exceeds (or falls short of) the volume of imports from the U.S. This second equation thus measures the "location" effect. I then compare the results of the two different equations to derive the "nationality" effect.

Table 7 presents the results for these tests, for nine OECD countries in seven manufacturing industries between 1989 and 1994.[31] Column (i) shows that the coefficients for nearly all of the variables are quite similar whether I compare imports to domestic sales or to foreign affiliate sales. In particular, the coefficient on the $LOCAL$ variable is 2.38 for the domestic sales case and 2.35 for the foreign affiliate sales case. As shown by the p-value, I

Such adjustment does not substantially affect the results.

[31] In this section, I use a three-stage-least-squares estimation technique, with population and population-based remoteness measures as instruments for GDP and GDP-based remoteness measures. Following Harrigan (1995, 1996), several endowment measures are used as instruments for production levels. Measures of the log of the number of workers, the log of the capital stock, and the log of agricultural land are interacted with industry dummy variables to create a set of $7 * 3 = 21$ instruments for production. Industry-specific regressions of the log of production on the instruments yields R^2s ranging between 0.82 and 0.98. Industry and year fixed effects and distance-industry interaction terms are included.

am unable to reject the hypothesis that the two are equal. Thus, the effects of borders are very similar whether I compare imports to domestic producers or to affiliates of U.S. multinationals located in the country. In the table, I also provide a "border effect". This is the exponential of the coefficient on the $LOCAL$ dummy variable, and indicates by how many times domestic or foreign affiliate sales would exceed imports. Based on this estimation, we would expect foreign affiliates located overseas to sell about 10 times as much as would be imported, after controlling for the other variables in the model.[32] Column (ii) provides the breakdown by industry. Again, the coefficients for the $LOCAL$ dummy variable are quite similar across all industries, and I am unable to reject the hypothesis that they are equal for six of the seven industries. For the industry where foreign affiliate and domestic effects do indeed differ (Chemicals and Allied Products), the effects of borders per se remain larger than any difference between foreign affiliate and domestic effects.

The OLI theory of foreign direct investment presents one potential criticism of this analysis. It posits that multinationals develop affiliates overseas in order to exploit some proprietary asset of the parent company,[33] which would suggest that foreign affiliates may be fundamentally different from the other sources of production. If foreign affiliates do differ systematically from U.S. exporters through possession of some proprietary asset, then my analysis picks up the effects of such characteristics, in addition to those of borders per se. To explore this possibility, I utilize data on the level of proprietary assets for both U.S. exporters and for foreign affiliates.

Possession of a proprietary asset may affect the price perceived by consumers, either because of different costs of production or because of some ability to overcome barriers inherent to foreign products. To account directly for these effects, I first incorporate the level of a proprietary asset as a regressor, using a functional form of $ln(1 + PA)$,[34] where PA is the proxy for the level of proprietary assets, thus allowing me to ask about the effects of borders, holding constant this factor which could affect perceived prices.

Second, I also indirectly examine the price effects by measuring the impact of changes in the level of proprietary assets on border effects. If foreign affiliates indeed leverage proprietary assets in order to create advantages over exporters, we would expect that border effects are higher in the presence of proprietary assets. To test this hypothesis, I incorporate a term which is an interaction between the proprietary-asset proxy and the $LOCAL$ dummy variable. This coefficient represents the effects of changes in the level of the proprietary asset on the border effect.

Table 7 (Cont.) provides the results when controlling for proprietary assets as proxied by the R&D to sales ratio for foreign affiliates and for U.S. exporters (columns (iii) and (iv)). The ratio for the foreign affiliates captures the R&D performed for foreign affiliates, by both

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[32]Note that, as illustrated in equation 1 and discussed in Section 3, the magnitude of the border effect arises from the combination of a barriers and an elasticity, so that a given border effect cannot be linked to a given barrier without an assumption about the elasticity of substitution.

[33]"OLI": Ownership, Location, Internalization. For discussion of this theory, see Dunning (1988, 1993).

[34]The given functional form follows from a price specified as (for example) $p_{sr}^m = p_{rr}^m * \tau_{sr}^m * (\rho_{rr}^m)^{-1}$, where p_{rr}^m represents the price at the factory, τ_{sr}^m are barriers to trade, and ρ_{rr}^m represents the effects of the proprietary asset. Since a zero level of proprietary assets should leave the perceived price unchanged, I use the functional form of $1 + \frac{P.A. \Pr oxy}{Sales}$. The logarithmic form follows from the transformation of the import demand equation into logs.

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the foreign affiliate itself and by other entities. The ratio for exporters is represented by data for the U.S. as a whole. Controlling for this factor has little effect on the results, as illustrated by a comparison between Columns (i) and (iii).[35] With the interaction term included (column (iv)), I am comparing the border effect for imports and domestic goods to that for imports and foreign-affiliate goods where there is a zero level of proprietary assets present. By doing so, I eliminate any portion of the foreign-affiliate location effect due to the possession of proprietary assets. Again, the results do not change substantially.

Thus, for the most part, the "border effect" for foreign affiliates producing within a host country differs little from that for domestic firms. This result suggests that borders per se, rather than a nationality difference, are a more important part of the reason why borders matter.

5 Summary and Conclusions

The fact that national borders sharply reduce trade flows has received a great deal of attention, in large part because recent empirical findings could imply large barriers to trade, adverse welfare consequences, and a role for policy. As I discussed at the outset, however, no previous work has linked this empirical phenomenon to underlying, economically meaningful issues. To address the economic significance of national border effects, this paper provides evidence on two fundamental questions:

1. Do large border effects arise because of high perceived-price wedges between foreign and domestic products, or because imports and domestic goods are very close substitutes?

2. If price wedges are important, do they reflect distortionary barriers to trade or do they arise from nondistortionary factors, such as differences in transactions costs or product characteristics?

To address the first question, I showed that border effects are in fact lower for more differentiated (less elastic) products. This suggests that the substitutability between domestic and foreign products is a large part of the reason why borders matter so much. Nevertheless, under the assumption of any reasonable elasticity of substitution, implied price wedges between imports and domestic goods are far higher than recognized tariff barriers.

Regarding the reasons for price wedges, I found that goods with higher information costs do not have higher border effects and that information costs are not a primary causal factor of the effects of borders on trade volumes. I also examined the importance of national product characteristics and of actual border barriers to trade. While inherent nationality differences are not an important reason for border effects, borders per se hold substantial explanatory power. This finding, in particular, supports the proposition that distortionary

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[35]I have performed similar analysis using data on the royalties and license fees paid by foreign affiliates to their parent companies. These payments are an alternative indicator of the level of proprietary assets leveraged by a foreign affiliate. This link has also been highlighted by Caves and More (1994). I have also used advertising to sales in order to account for the possible advantages of a local presence in producing heavily branded products. The results do not change and are available from the author upon request.

barriers, governments, and policy play an important role in the existence and magnitude of border effects.

As an additional indicator of the economic significance of national border effects, Table 8 provides some very rough, back-of-the-envelope estimates of the welfare impact of national border effects.[36] The numbers in the table provide the percentage change in indirect utility caused by the elimination of the barriers implied by national border effects, for elasticities of substitution equal to 2, 5, or 10. I provide estimates for reducing barriers to zero, as well as for reducing barriers to the level of average tariffs for each country. The percentage change in indirect utility ranges between 8.5% and 17.6%, if the elasticity of substitution between imports and domestic goods is 5 and barriers are completely eliminated. If barriers instead drop to the level of average tariffs, gains in indirect utility range between 6.1% and 16.2%. Together with the results detailed elsewhere in this paper, these rough estimates support the notion that border effects are indeed economically significant.

My conclusions must be tempered by several caveats. First, some of the variables I use are at best proxies for the concepts I aim to capture and, thus, present certain limitations. Second, the actual magnitude of barriers to trade and welfare effects will ultimately be determined only after consensus is reached on an appropriate value for the elasticity of substitution. Finally, although I have provided evidence on some of the reasons that would downplay the economic significance of border effects, other similar explanations could also be important and deserve further investigation.

Finally, recall the three scenarios presented at the outset. Scenario #1, in which high border effects arise almost entirely from high elasticities of substitution, provides at best a partial explanation of this phenomenon. In Scenario #2, primarily transaction-cost based differences between foreign and domestic products create border effects; the data do not support this proposition. Thus, Scenario #3 remains; in this case, borders matter because of distortionary barriers at the border, and border effects indeed imply potentially high barriers, welfare costs, and a role for policy. The findings indicate that this case is an important part of the explanation of border effects. Further, my rough calculations suggest that the actual welfare impact of national border effects may not be small.

I conclude that national border effects have economic significance.

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[36] These calculations are made based on the expression for indirect utility in the theoretical model presented in Appendix B. They are based on country-level border effects for an aggregate national good, rather than on industry-level border effects. I hold constant income and the nontraded sector of the economy. The percentage change in indirect utility is the proportional change implied by a lowering of barriers from the level calculated from border effects to either 0 or to actual tariff barriers. Data sources and assumptions for the calculations are provided in Appendix A.

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A Data Appendix

A.1 Countries and Industries Included in Data Set

Countries Sections 3.1, 3.2, 4.1:Australia, Canada, Denmark, France, Germany, Japan, United Kingdom, United States

Section 4.2: Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Spain, United Kingdom

Industries Sections 3.1, 3.2: Non-manufactured products; Food, Beverages, and Tobacco; Textiles, Apparel, and Leather; Wood Products and Furniture; Paper Products and Printing; Chemicals and Drugs; Petroleum Refineries and Products; Rubber and Plastic Products; Non-metallic Mineral Products; Basic Metal Industries; Fabricated Metal Products, Machinery, and Equipment; Other Manufacturing; These categories are based on the ISIC sectoral division in the OECD Input-Output Database.

Section 4.1: Food, Beverages, and Tobacco; Textiles, Apparel, and Leather; Chemicals and Drugs; Rubber and Plastic Products; Basic Metal Industries; These categories are based on the ISIC sectoral division in the OECD Input-Output Database, but are limited by data availability.

Section 4.2: Chemicals and Allied Products; Electric and Electronic Equipment; Non-electric Machinery; Food and Kindred Products; Primary and Fabricated Metals; Transportation Equipment; and Other Manufacturing; These are the categories provided in the BEA publicly-available data.

A.2 Trade and Production Data

Sections 3.1, 3.2, 4.1 Data on OECD bilateral trade flows are taken from Feenstra, Lipsey, and Bowen (1997), with the original source as the Statistics Canada World Trade Database. The data are provided on an SITC basis; they were concorded to ISIC based on Maskus (1991). Feenstra et al. also provide the trade data according to the WBEA classification. These data were also concorded to an ISIC basis in order to confirm the original SITC-ISIC concordance. Results did not change substantially.

Domestic trade for manufactured goods is production (gross output) within each industry less exports from that industry. Non-manufacturing domestic trade is gross goods production less manufacturing production less non-manufacturing exports. The gross goods production data were provided by John Helliwell, with the original source as United Nations (1996) National Accounts Statistics: Main Aggregates and Detailed Tables. Non-manufacturing exports are calculated as total exports less manufacturing exports.

Production data are from the OECD Statistical Analysis Database. The production data were converted to U.S. dollars using the annual exchange rate in the Database.

Section 4.2 Data on exports from the U.S. to the countries in the sample are taken from Feenstra (1997), with the original sources as Bureau of the Census (1978-1988 and 1989-1994). They were converted from the SITC classification to the BEA classification using

the concordance in Feenstra, Lipsey, and Bowen (1997). Production (gross output) data within industries for the U.S. are from the OECD Statistical Analysis Database.

Domestic trade for manufactured goods is production (gross output) within each industry less exports from that industry. Domestic production, employment, and total export data are from the OECD Statistical Analysis Database. The production data were converted to U.S. dollars using the annual exchange rate in the Database.

Data on the activities of foreign affiliates of U.S. multinationals are from BEA (1985-1994), as provided in Feenstra (1997). Total sales and local sales by foreign affiliates are used as, respectively, production and consumption.

A.3   GDP, Population, Distance variables

The distance data were provided by John Helliwell. $DIST_{cc'}$ is the distance from exporter k to importer j. It is generally measured from capital to capital and calculated using Great Circle Distances from Latitude and Longitude given in *Direct Line Distances*, by Fitzpatrick (1986).

Own distances are calculated as $\frac{1}{4}$ of the distance to its nearest trading partner. For islands or countries with no trading partner in the sample group own distance was calculated as $\frac{1}{2}$ of the minor radius of the country. These internal distances are consistent with the formulation used by Wei (1996).

For Sections 3.1, 3.2, 4.1, GDP and population data are taken from the PENN World Tables. For Section 4.2, GDP data are taken from the OECD National Accounts Statistics; population data are from the PENN World Tables and the U.N. Demographic Yearbook.

A.4   Product Differentiation and Information Cost Variables

Advertising to sales ratio is from the COMPUSTAT database, as is the R&D to sales ratio. The original characterization of goods was provided by James Rauch and is further described in Rauch (1999). The method of aggregation is described in the text. Intra-industry trade as a proportion of total trade was calculated according to the Grubel-Lloyd index, as interpreted in Hummels and Levinsohn (1993). The data on information transfer across industries are from Bailey (1975) and are based on a survey of U.S. manufacturers. The data in the report are concorded to a U.S. SIC basis, aggregated using U.S. manufacturing output data for 1990, and then concorded to the ISIC categories. Data availability and concordance issues limit the data to five industries. Within these aggregated industries, the more disaggregated industries covered by the survey include between 70% and 100% of the aggregated total, based on 1990 U.S. production levels. It is assumed that the covered proportions are representative of the aggregate category.

A.5   Calculation of elasticities from Rauch index

The Rauch index values for the industries vary between 0.03 and 1.00. I set the two endpoints of the elasticity range (2 to 5) to the minimum and maximum Rauch index values, and used linear interpolation to assign elasticities to the intervening industries, based on their Rauch index values.

A.6　Other Variables

Data on research and development expenditures in Section 4.2 are from BEA(various issues) for foreign affiliates and for parent companies. For the U.S., the data are private expenditures on research and development as provided in National Science Foundation (1997).

Remoteness indices are calculated as $R_c = \sum_{c'} \frac{DIST_{c'c}}{GDP_{c'}}$, where the summation over c' is over country c's trading partners c' within the sample. Population is used instead of GDP for some of the analyses.

Endowment data used as instruments in Sections 3.1, 3.2, and 4.1 were provided by James Harrigan, with the original source as Penn World Tables (workers, capital stock) and World Bank World Development Indicators (agricultural land). Instruments for Section 4.2 are from OECD (1998) (labor force), World Bank World Development Indicators (agricultural land), and the Penn World Tables (capital stock). For the capital stock data, the last two years were extrapolated from a 1985 to 1992 series.

A.7　Variables for Calculation of Indirect Utility

The expression for indirect utility is in the theory appendix. For the calculations of the effects of a large change, as described in the text, I examine the proportional change in indirect utility associated with reducing the barriers implied by measured border effects. The details for the two scenarios are in the text. Each country's change in indirect utility is based on an estimated country-level border effect. The proportion of the traded goods in consumption (μ^g) are taken from the OECD Input-Output table. The measure of transport costs is based on Hummels (1999), Table 3, Panel 1. I used the estimated coefficients for the effects of distance on transport costs for the U.S. in order to calculate distance-based measures of transport costs for the bilateral pairs in my sample. I used the average value to weight for the U.S.. The estimates are quite reasonable, with the ad valorem transport cost factor ranging between 2% and 12%. β^g and p^g_{cc} are assumed to be 1. Y_c is the GDP of country c.

B　Theory Appendix

The model is a very standard representation of trade in differentiated products.[37] All countries c' produce and trade g differentiated products, which are distinguished by their country of origin. Assume identical technologies across countries and a two-tier utility function in country c with Cobb-Douglas upper-level and Spence-Dixit-Stiglitz lower-level utility.

$$
\begin{aligned}
U^c &= \Pi_g (X_c^g)^{\mu^g} \\
\sum_g \mu^g &= 1
\end{aligned}
$$

---

[37]Some references are Deardorff (1995) and Helpman and Krugman (1985).

$$X_c^g = [\sum_{c'} \beta_{c'}^g (x_{cc'}^g)^{\epsilon_g}]^{\frac{1}{\epsilon_g}}$$

$$\epsilon_g = \frac{\sigma_g - 1}{\sigma_g}$$

where σ_g is the elasticity of substitution between varieties of the good, u^g represent Cobb-Douglas shares, and X_c^g is an aggregator over available varieties.

The representative consumer optimizes subject to a budget constraint:

$$\sum_g [\sum_{c'} p_{cc'}^g x_{cc'}^g] = Y_c$$

I solve the model using a two-stage budgeting procedure.

Solving the lower-level optimization problem, I find that:

$$\frac{(x_{cc'}^g)^{\epsilon_g - 1}}{(x_{cc}^g)^{\epsilon_g - 1}} = \frac{p_{cc'}^g \beta_c^g}{p_{cc}^g \beta_{c'}^g}$$

so

$$x_{cc}^g = x_{cc'}^g (p_{cc}^g)^{\frac{-1}{1-\epsilon_g}} (p_{cc'}^g)^{\frac{1}{1-\epsilon_g}} (\beta_c^g)^{\frac{1}{1-\epsilon_g}} (\beta_{c'}^g)^{\frac{-1}{1-\epsilon_g}}$$

Substituting into the aggregator X_c^g and solving for $x_{cc'}^g$, I have:

$$x_{cc'}^g = \frac{(p_{cc'}^g)^{\frac{-1}{1-\epsilon_g}} (\beta_{c'}^g)^{\frac{1}{1-\epsilon_g}}}{[\sum_{c'} (\beta_{c'}^g)^{\frac{1}{1-\epsilon_g}} (p_{cc'}^g)^{\frac{\epsilon_g}{\epsilon_g - 1}}]^{\frac{1}{\epsilon_g}}} X_c^g$$

Define a price index:

$$G_c^g = [\sum_{c'} (\beta_{c'}^g)^{\frac{1}{1-\epsilon_g}} (p_{cc'}^g)^{\frac{\epsilon_g}{\epsilon_g - 1}}]^{\frac{\epsilon_g - 1}{\epsilon_g}}$$

$$= [\sum_{c'} (\beta_{c'}^g)^{\sigma_g} (p_{cc'}^g)^{1-\sigma_g}]^{\frac{1}{1-\sigma_g}}$$

So, I have that:

$$x_{cc'}^g = (\frac{p_{cc'}^g}{G_c^g \beta_{c'}^g})^{-\sigma_g} X_c^g$$

substituting into total expenditure on manufactures, I find that this total expenditure is $G_g^c X_g^c$. Solving the upper-level utility maximization problem, I find:

$$x_{cc'}^g = \frac{\mu^g Y^c (\beta_{c'}^g)^{\sigma_g}}{(p_{cc'}^g)^{\sigma_g} (G_c^g)^{1-\sigma_g}}$$

Trade is characterized by both transport costs and other barriers to trade:

$$p_{cc'}^g = p_{c'c'}^g D_{cc'}^g T_{cc'}^g$$

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where $p^g_{cc'}$ is the price of good g produced in c' and imported by c, $p^g_{c'c'}$ represents the price of good g at the factory in the country of production, and $D^g_{cc'}$ and $T^g_{cc'}$ represent, respectively, transportation costs (either domestic or international) and other costs of international trade. I assume that $T^g_{cc'} = 1$ for trade within a country, i.e. if $c' = c$. I now have:

$$G^g_c = [\sum_{c'} (\beta^g_{c'})^{\sigma_g} (p^g_{c'c'} D^g_{cc'} T^g_{cc'})^{1-\sigma_g}]^{\frac{1}{1-\sigma_g}}$$

Thus, consumption in location c of a variety produced in c' is:

$$x^g_{cc'} = \frac{\mu^g Y^c (\beta^g_{c'})^{\sigma_g}}{(G^g_c)^{1-\sigma_g} (p^g_{c'c'} D^g_{cc'} T^g_{cc'})^{\sigma_g}}$$

Since total shipments must account for transport costs and ad valorem barriers, I find that total shipments from a location c' to a location c in industry g are:

$$EX^g_{cc'} = \frac{\mu^g Y_c (\beta^g_{c'})^{\sigma_g}}{(G^g_c)^{1-\sigma_g} (p^g_{c'c'})^{\sigma_g} (D^g_{cc'} T^g_{cc'})^{\sigma_g-1}}$$

Thus, I may define the portion of national income for country c' obtained from sales of good g produced in c', as:

$$Y^g_{c'} = p^g_{c'c'} * (\mu^g (\beta^g_{c'})^{\sigma_g} (\sum_c \frac{Y^c}{(G^g_c)^{1-\sigma_g} (p^g_{c'c'})^{\sigma_g} (D^g_{cc'} T^g_{cc'})^{\sigma_g-1}}))$$

Solving for $\beta^g_{cc'}$, substituting in the expression for consumption of an individual variety shipped to country c from country c', I find:

$$SHIP^g_{cc'} = \frac{Y_c Y^g_{c'}}{(G^g_c)^{1-\sigma_g} (p^g_{c'c'} D^g_{cc'} T^g_{cc'})^{\sigma_g} \sum_c \frac{Y_c}{(p^g_{c'c'} D^g_{cc'} T^g_{cc'})^{\sigma_g-1} (G^g_c)^{1-\sigma_g}}}$$

where $SHIP^g_{cc'}$ is total purchases of the g good by country c from a producer located in country c', Y_c is the income of the importer, $Y^g_{c'}$ is the income of the producer derived from sales of good g, and G^c_g is a price index, as noted above.

Define $R^g_{c'}$ and R^g_c as measures of a country's remoteness, which measure the GDP-weighted distance of a given country from alternative trading partners, where:

$$R^g_{c'} = [\sum_c (p^g_{c'c'} T^g_{cc'} D^g_{cc'})^{(1-\sigma_g)} Y_c G^{(\sigma_g-1)}_c]^{-1}$$

$$R^g_c = G^{\sigma_g-1}_c$$

Assuming that a good g has a price of 1 in its country of origin, I thus have:

$$\log SHIP^g_{cc'} = \log Y_c + \log Y^g_{c'} + \log R^g_{c'} + \log R^g_c$$
$$-\sigma_g \log D^g_{cc'} - \sigma_g \log T^g_{cc'}$$

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which is the same as equation 1 in the text.

Indirect utility in this model is given by::

$$U_c = Y_c \Pi_g \left(\frac{\mu^g}{G_c^g}\right)^{\mu_g}$$

The calculations in the text use a percentage change in indirect utility between two alternative scenarios.

Figure 1

P

Inelastic

$P_B{}^i$

τ^i

τ^e

$P_B{}^e$

$P_{FT}{}^i = P_{FT}{}^e$

Elastic

TV_B TV_{FT}

Q

Figure 2

P

Inelastic

$P_B{}^i$

ΔCS^i

ΔCS^e

$P_B{}^e$

$P_{FT}{}^i = P_{FT}{}^e$

Elastic

TV_B TV_{FT}

Q
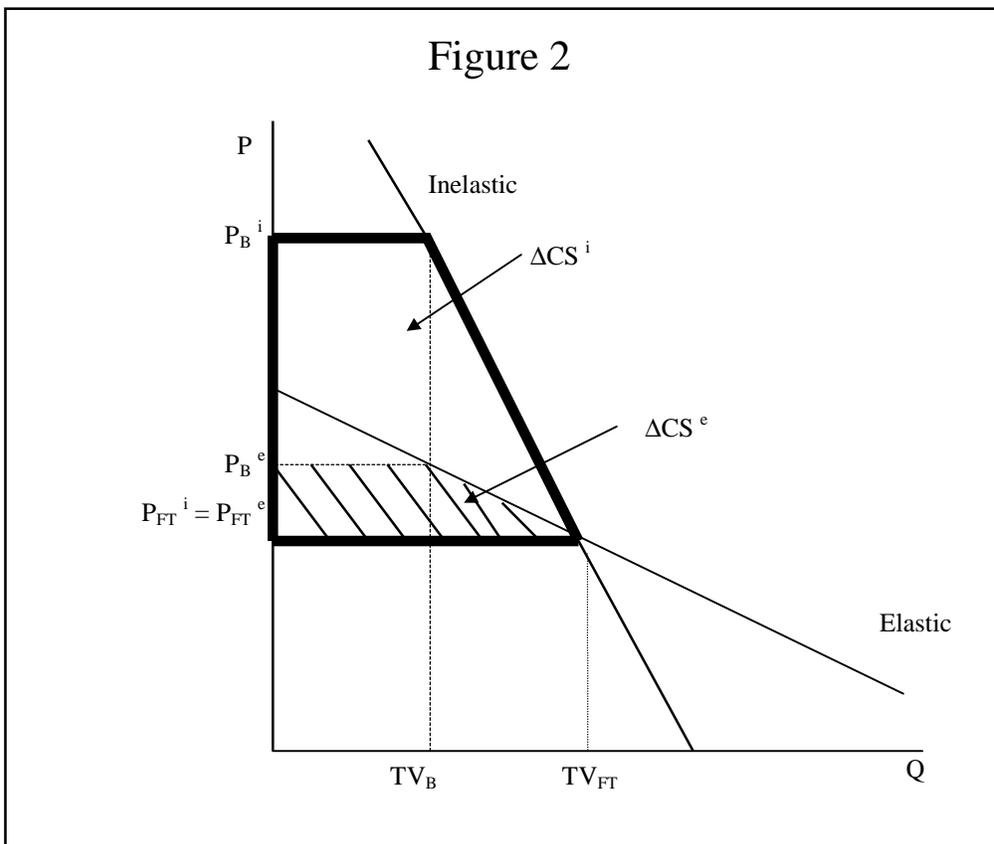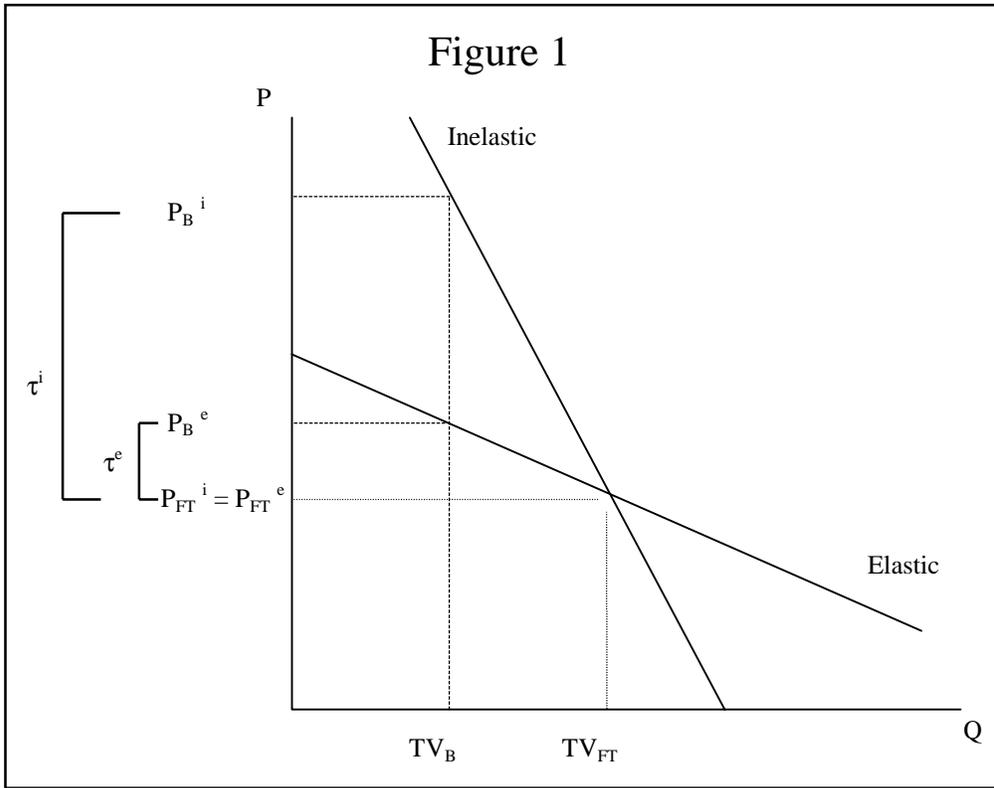
Table 1

Section	Countries	Years	Industries	Sources of Production
3.1 3.2	8 OECD countries	1990	11 manufacturing industries, non-manufactured products	• Domestic • All bilateral-pair imports
4.1	8 OECD countries	1990	5 manufacturing industries*	• Domestic • All bilateral-pair imports
4.2	9 OECD countries	1989 to 1994	7 manufacturing industries	• Domestic • Imports from U.S. • U.S. foreign affiliates

* Only five manufacturing industries are used due to data availability.

Table 2
Border Effects, Price Wedges (PWs), and Elasticities

	(1) Unobservable Elasticity-Price Wedge Relation	(2) Observable Elasticity-Border Effect Relation	Implications for Economic Significance of Aggregate Border Effects	
			PWs	Welfare
Case 1	• Low elasticity goods have high PWs • High elasticity goods have low PWs	• Low elasticity goods have high border effects • High elasticity goods have low border effects	High aggregate border effects imply very high PWs on low elasticity products	High aggregate border effects probably imply large adverse welfare consequences, depending on the origins of PWs
Case 2	• No relationship	• Low elasticity goods have low border effects • High elasticity goods have high border effects *Or* • No Relationship	Likely that high aggregate border effects imply low PWs on high elasticity goods	High aggregate border effects probably imply smaller adverse welfare consequences, depending on origins of PWs
Case 3	• Low elasticity goods have low PWs • High elasticity goods have high PWs	• Low elasticity goods have low border effects • High elasticity goods have high border effects	High aggregate border effects imply low PWs on high elasticity goods	High aggregate border effects imply only small adverse welfare consequences

(1) Relation between (a) elasticity of substitution between imports and domestic goods, and (b) import-domestic good perceived price wedges (unobservable)
(2) Relation between (a) elasticity of substitution between imports and domestic goods, and (b) border effects (observable)

Table 3
Product Differentiation/ Elasticity Effects

Equation	(i)	(ii)	(iii)	(iv)
Dependent Variable: $\ln(\text{SHIP}^g_{cc'})$				
ln(Production Exporter)	0.79 *	0.79 *	0.79 *	0.79 *
	(0.04)	(0.04)	(0.04)	(0.04)
ln(GDP Importer)	0.85 *	0.85 *	0.85 *	0.85 *
	(0.04)	(0.04)	(0.04)	(0.04)
ln(Distance)	-0.80 *	-0.75 *	-0.79 *	-0.77 *
	(0.08)	(0.08)	(0.08)	(0.08)
ln(Remoteness Exporter)	0.37 *	0.37 *	0.37 *	0.37 *
	(0.16)	(0.16)	(0.16)	(0.16)
ln(Remoteness Importer)	1.39 *	1.39 *	1.39 *	1.39 *
	(0.15)	(0.15)	(0.15)	(0.15)
LOCAL	3.27 *	2.27 *	1.69 *	1.72 *
	(0.70)	(0.33)	(0.24)	(0.23)
Intra-Industry Trade/Total Trade LOCAL*IIT	-2.86 *			
	(1.01)			
Rauch Index LOCAL*Rauch		-1.52 *		
		(0.52)		
Industry R&D/Sales LOCAL*RDS			-17.45 *	
			(6.71)	
Industry Advertising/Sales LOCAL*ADS				-16.21
				(8.77)
No. Obs.	768	768	768	768
R^2	0.85	0.85	0.85	0.85
SER	1.16	1.16	1.16	1.16

Note: Non-manufactured goods is the excluded industry. Industry-specific intercepts are included in all equations, but are not reported here. Industry-specific distance interaction terms are also included, but are not included here.
IV with heteroscedasticity consistent standard errors.
* Significant at the 5% level.

Table 4

Border Effects, Tariffs (%), and Price Wedges (%)

OECD Industry	Border Effect (non-intra-EU, non-adjacent trade)	Average Tariff (%)	Elasticity=2			Range (2 to 5)			Elasticity=5		
			Assumed Elasticity	Implied Price Wedge	Un-explained Price Wedge	Assumed Elasticity*	Implied Price Wedge	Un-explained Price Wedge	Assumed Elasticity	Implied Price Wedge	Un-explained Price Wedge
Non-manufactured Products	20.21		2.00	349.50		4.22	103.93		5.00	82.43	
Food, Beverages, Tobacco	25.44	8.59	2.00	404.42	395.83	4.63	101.14	92.55	5.00	91.04	82.45
Textiles, Apparel, Leather	12.65	12.20	2.00	255.60	243.41	2.76	150.53	138.33	5.00	66.11	53.91
Wood Products, Furniture	17.06	4.65	2.00	313.06	308.40	2.70	185.42	180.77	5.00	76.36	71.71
Paper Products and Printing	19.96	4.90	2.00	346.73	341.84	3.89	115.85	110.96	5.00	81.98	77.08
Chemicals and Drugs	10.51	6.90	2.00	224.23	217.33	4.04	79.06	72.16	5.00	60.08	53.19
Petroleum Refineries and Products	42.77	5.09	2.00	553.99	548.89	5.00	111.94	106.85	5.00	111.95	106.86
Rubber and Plastic Products	10.71	8.68	2.00	227.33	218.65	3.28	106.24	97.56	5.00	60.69	52.01
Non-metallic Mineral Products	24.76	6.55	2.00	397.62	391.07	2.70	227.67	221.12	5.00	90.00	83.46
Basic Metal Industries	4.89	4.89	2.00	121.10	116.21	3.09	67.22	62.33	5.00	37.35	32.46
Fabricated Metal Pdcts., Mach. and Equip.	8.26	4.93	2.00	187.37	182.44	2.05	180.73	175.81	5.00	52.54	47.61
Other Manufacturing	3.87	5.88	2.00	96.66	90.79	2.00	96.66	90.78	5.00	31.07	25.19

*Note: Elasticities calculated based on Rauch index, which varies between 0 and 1. Higher values indicate more differentiated products.

Rauch Index:	Max	Min
	1.00	0.03

30

Table 5
Border Effects, Tariffs, and Implied Elasticities

What elasticities are implied by measured border effects and average tariffs?

OECD Industry	*Border Effect (non-intra-EU, non-adjacent trade)*	*Average Tariff (%)*	*Implied Elasticity*
Non-manufactured Products	20.21	--	--
Food, Beverages, Tobacco	25.44	8.59	39.29
Textiles, Apparel, Leather	12.65	12.20	22.05
Wood Products, Furniture	17.06	4.65	62.36
Paper Products and Printing	19.96	4.90	62.64
Chemicals and Drugs	10.51	6.90	35.28
Petroleum Refineries and Products	42.77	5.09	75.62
Rubber and Plastic Products	10.71	8.68	28.49
Non-metallic Mineral Products	24.76	6.55	50.61
Basic Metal Industries	4.89	4.89	33.23
Fabricated Metal Pdcts., Mach. and Equip.	8.26	4.93	43.91
Other Manufacturing	3.87	5.88	23.69

Table 6
The Costs of Information

Equation	(i)	(ii)	(iii)	(iv)	(v)
Dependent Variable: $\ln(\text{SHIP}^g_{cc'})$					
$\ln$(Production Exporter)	0.72 *	0.72 *	0.72 *	0.72 *	0.72 *
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$\ln$(GDP Importer)	0.86 *	0.86 *	0.86 *	0.86 *	0.86 *
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
$\ln$(Distance)	-1.17 *	-1.12 *	-1.10 *	-1.09 *	-1.17 *
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
$\ln$(Remoteness Exporter)	0.26	0.26	0.26	0.26	0.26
	(0.20)	(0.19)	(0.19)	(0.19)	(0.20)
$\ln$(Remoteness Importer)	1.50 *	1.50 *	1.50 *	1.50 *	1.50 *
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
LOCAL	1.23 *	1.61 *	3.55 *	1.86 *	1.22 *
	(0.24)	(0.27)	(1.03)	(0.34)	(0.31)
Industry Variables:					
Products made to order		-0.01 *			
LOCAL*ORDER		(0.01)			
Frequent Sales/Technical Service			-0.06 *		
LOCAL*SERVICE			0.03		
Major purchase				-0.01 *	
LOCAL*MAJOR				0.01	
Infrequent purchase					0.00
LOCAL*INFREQUENT					(0.01)
No. Obs.	320	320	320	320	320
R^2	0.88	0.88	0.89	0.89	0.88
SER	0.92	0.92	0.91	0.91	0.92

Industry fixed effects and distance-industry interaction terms included.

IV with heteroscedasticity consistent standard errors.

* Significant at the 5% level.

Table 7
Location and Nationality

Dependent Variable: $\ln(SHIP^g_{cc'})$

	(i)		Border Effect			(ii)		Border Effect		
	Domestic Sales	Foreign Affiliate Sales	Domestic Sales	Foreign Affiliates	P-Value[1]	Domestic Sales	Foreign Affiliate Sales	Domestic Sales	Foreign Affiliates	P-Value[1]
ln(Production)	0.99 *	0.98 *				0.98 *	0.97 *			
	(0.02)	(0.02)				(0.02)	(0.02)			
ln(GDP Consumer)	0.39 *	0.36 *				0.39 *	0.35 *			
	(0.03)	(0.03)				(0.03)	(0.03)			
ln(Distance)	-0.83 *	-0.80 *				-0.65 *	-0.60 *			
	(0.05)	(0.05)				(0.09)	(0.09)			
ln(Remoteness Producer)	0.75 *	0.73 *				0.73 *	0.70 *			
	(0.16)	(0.16)				(0.15)	(0.16)			
ln(Remoteness Consumer)	0.97 *	0.96 *				0.97 *	0.96 *			
	(0.10)	(0.10)				(0.09)	(0.10)			
Location Effects:										
Local	2.38 *	2.35 *	10.77	10.52	0.81					
(1 for dom. or foreign-affil. sales, 0 otherwise)	(0.16)	(0.17)								
CHEM*Local						3.12 *	2.67 *	22.59	14.45	0.00
						(0.35)	(0.37)			
ELEC*Local						1.69 *	1.63 *	5.41	5.12	0.72
						(0.35)	(0.36)			
FOOD*Local						3.88 *	4.02 *	48.44	55.73	0.37
						(0.35)	(0.37)			
MACH*Local						1.47 *	1.56 *	4.34	4.74	0.60
						(0.37)	(0.38)			
OTHER*Local						3.15 *	3.17 *	23.41	23.86	0.91
						(0.36)	(0.38)			
PFMET*Local						2.25 *	2.11 *	9.53	8.25	0.37
						(0.35)	(0.37)			
TRANS*Local						0.85 *	0.98 *	2.35	2.67	0.41
						(0.36)	(0.37)			
Number of Observations	692	692				692	692			
Estimation	3SLS					3SLS				
Industry Fixed Effects	Yes					Yes				
Distance-Industry Interaction	Yes					Yes				
Time Period	1989-1994					1989-1994				
Year Fixed Effects	Yes					Yes				

1. P-value is the probability associated with the hypothesis that domestic sales and foreign affiliate sales effects are equal.

A low value indicates that we are able to reject that hypothesis, I.e. that the two differ from each other significantly.

* Significant at the 5% level.

Table 7 (Cont.)
Location and Nationality

	(iii)					(iv)				
	Border Effect					*Border Effect*				
	Domestic Sales	Foreign Affiliate Sales	Domestic Sales	Foreign Affiliates	P-Value[1]	Domestic Sales	Foreign Affiliate Sales	Domestic Sales	Foreign Affiliates	P-Value[1]
ln(Production)	0.98 *	0.97 *				0.97 *	0.97 *			
	(0.02)	(0.02)				(0.02)	(0.02)			
ln(GDP Consumer)	0.40 *	0.37 *				0.41 *	0.38 *			
	(0.03)	(0.03)				(0.03)	(0.03)			
ln(Distance)	-0.89 *	-0.87 *				-0.89 *	-0.86 *			
	(0.05)	(0.05)				(0.05)	(0.05)			
ln(Remoteness Producer)	0.81 *	0.75 *				0.80 *	0.75 *			
	(0.18)	(0.18)				(0.18)	(0.18)			
ln(Remoteness Consumer)	1.00 *	0.99 *				1.01 *	1.00 *			
	(0.10)	(0.10)				(0.10)	(0.10)			
R&D/Sales, U.S. as ex., Direct		-2.00								
		(1.26)								
R&D/Sales, Interaction							-5.80 *			
							(1.69)			
Location Effects:										
Local	2.16 *	2.06 *	8.66	7.84	0.32	2.13 *	2.13 *	8.44	8.44	1.00
(1 for dom. or foreign-affil. sales, 0 otherwise)	(0.17)	(0.18)				(0.17)	(0.18)			
Number of Observations	627	627				627	627			
Estimation	3SLS					3SLS				
Industry Fixed Effects	Yes					Yes				
Distance-Industry Interaction	Yes					Yes				
Time Period	1989-1994					1989-1994				
Year Fixed Effects	Yes					Yes				

1. P-value is the probability associated with the hypothesis that domestic sales and foreign affiliate sales effects are equal.

A low value indicates that we are able to reject that hypothesis, I.e. that the two differ from each other significantly.

* Significant at the 5% level.

Table 8
Welfare Effects of Elimination of Border Effects
(% Change in Indirect Utility)

Suppose barriers to imports drop to 0.

Importing Country	$Sigma^1 = 2$ % Change in IU	$Sigma^1 = 5$ % Change in IU	$Sigma^1 = 10$ % Change in IU
Australia	61.16	15.74	6.01
Canada	61.26	16.45	6.68
Denmark	70.41	17.55	7.05
France	37.57	11.64	4.97
Germany	37.61	11.66	4.97
Japan	36.17	11.65	4.97
UK	40.01	12.22	5.22
US	25.08	8.46	3.74

Suppose barriers to imports drop to actual tariff levels.

Importing Country	$Sigma^1 = 2$ % Change in IU	$Sigma^1 = 5$ % Change in IU	$Sigma^1 = 10$ % Change in IU
Australia	--	--	--
Canada	57.51	13.84	4.48
Denmark	68.10	16.17	6.08
France	35.63	10.29	4.02
Germany	35.25	10.03	3.83
Japan	32.66	8.90	2.64
UK	38.24	10.99	4.36
US	22.21	6.07	1.65

1. Sigma is the elasticity of substitution between domestic goods and imports.

Table A.1
Border Effects Across Industries

Dependent Variable: ln(SHIP$^g_{cc'}$)		Implied Border Effects	
		Non Intra-EU, Non-Adjacent trade	EU-EU, Non-Adjacent trade
ln(Production Exporter)	0.81 *		
	(0.04)		
ln(GDP Importer)	0.87 *		
	(0.04)		
ln(Distance)	-0.46 *		
	(0.11)		
ln(Remoteness Exporter)	0.23		
	(0.17)		
ln(Remoteness Importer)	1.25 *		
	(0.16)		
Adjacency	0.62 *		
	(0.12)		
EU members	0.55 *		
	(0.21)		
Non-manufactured products	3.01 *	20.21	11.65
	(0.57)		
Food, Beverages, Tobacco	3.24 *	25.44	14.67
	(0.54)		
Textiles, Apparel, Leather	2.54 *	12.65	7.29
	(0.50)		
Wood Products, Furniture	2.84 *	17.06	9.84
	(0.60)		
Paper Products and Printing	2.99 *	19.96	11.50
	(0.54)		
Chemicals and Drugs	2.35 *	10.51	6.06
	(0.44)		
Petroleum Refineries and Products	3.76 *	42.77	24.65
	(0.80)		
Rubber and Plastic Products	2.37 *	10.71	6.18
	(0.49)		
Non-metallic Mineral Products	3.21 *	24.76	14.27
	(0.59)		
Basic Metal Industries	1.59 *	4.89	2.82
	(0.55)		
Fabricated Metal Products, Machinery, and Equip.	2.11 *	8.26	4.76
	(0.47)		
Other Manufacturing	1.35	3.87	2.23
	(0.75)		
No. Obs.	768		
R^2	0.85		
SER	1.16		

Note: Non-manufactured goods is the excluded industry. Industry-specific intercepts are included in all equations, but are not reported here. Industry-specific distance interaction terms are also included, but are not included here.
IV with heteroscedasticity consistent standard errors.
* Significant at the 5% level.