Explaining the border effects: the role of policy and non-policy barriers in the Quad food trade

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Paper prepared for the IATRC Summer symposium

"Food Regulation and Trade: Institutional Framework, Concepts of Analysis and Empirical Evidence"
Bonn, Germany, May 28-30, 2006

Abstract

Starting from a 'structural' gravity-like model, this paper first provides estimates of bilateral 'border effects' in food trade among Quad countries (Canada, USA, Japan and EU) at the ISIC 4-digit level. Then, it investigates the underlying reasons of border effect, assessing the role played by policy barriers (tariffs and non-tariff barriers) with respect to barriers unrelated to trade policy, such as information related costs and cultural proximity. In contrast with several previous findings, we show that policy barriers are part of the story in explaining the strong trade reduction effect induced by national borders, and this is especially true when we control for the endogeneity of trade policy to imports, as suggested by political economy arguments. Moreover, our results show that elements linked to cultural proximity and consumer preference for home goods, matter a great deal in explaining the magnitude of border effects. The trade reduction effect induced by these policy-unrelated components are from 1.5 to 3 times larger than that induced by policy barriers. These results have implications for the economic and welfare significance of national borders.

JEL Classification: F13, F14, Q17

Keywords: border effect, food trade, market access, gravity, QUAD countries

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Alessandro Olper and Valentina Raimondi*

1 Introduction

This paper uses a gravity-like structure to measure and explain the level of 'border effect' in the food manufacturing trade among Quad countries - United States, European Union, Canada and Japan. The border effect measures how much trade within countries is above international trade, due to cross-border measures such as tariffs, non-tariff barriers and all other factors that might impede trade. Thus it captures *all* the impediments related to the existence of national borders.

The border effect literature emerges from the McCallum's (1995) findings on the large trade reduction effect induced by the Canada-US national border. This author has shown that trade between two Canadian provinces was, on average, 22 times greater than their trade with US states, after controlling for size and transport costs. This intriguing finding subsequently stimulated a lot of research.

While recent border effect estimates from theoretical-consistent gravity models have significantly reduced their magnitude (see Anderson and van Wincoop 2003; Feenstra 2004), the actual figures are still far higher than recognized trade barriers. For example, with an import substitution elasticity of 5, the *ad valorem* equivalent of border effects ranges from 70% to 120% for OECD agricultural trade (see Olper and Raimondi 2005). Thus, given the magnitude of these border costs, the most recent literature is now focusing on their explanation, trying to understand why national borders matter so much for international trade (Chen 2004).

From this perspective, the main factors highlighted in the literature that may affect the magnitude of border effect can be divided into three broad, but conceptually different, categories (see, e.g., Evans 2003): *i*) border costs related to policy barriers such as tariffs and non-tariff barriers (NTBs); *ii*) border costs unrelated to policy barriers, such as consumer 'home bias' in preference or cultural distance, and transaction costs due to communication issues; *iii*) the elasticity of substitution.

Till now, the few papers that have tried to disentangle the role played by these explanations on the size of border effect have, generally speaking, achieved mixed results. For example, Head and Mayer (2000) and Chen (2004) for intra EU trade, and Mayer and Zignago (2005) for North-South trade,

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have shown that NTBs and tariffs, respectively, do not matter so much in explaining border effects. Differently, Fontagné et al. (2005) show a sizable effect of NTBs and tariffs, on border effects between the US, EU and Japanese trade in manufactured goods. At the same time, Evans (2003) documents a nil effect of the 'home bias' in preferences on the magnitude of border effects, that instead seem to play a role in the analysis of Fontagné et al. (2005). Finally, Rauch (2001), Wagner et al. (2002) and Combes et al. (2005) suggest that business and social networks operating across borders promote trade notably through reduction in information costs and diffusion of preferences. Indeed, "informational barriers make it difficult both for consumers to obtain relevant information on the goods produced in another location and for non-local producers to learn the tastes of consumers or to be aware of the practices of local retailers" (Combes et al. 2005 p. 2).

Starting from these considerations, we add to the growing debate on the determinants of border effects, improving analyses made previously in three main directions. First, by exploring whether new proxies capturing information related issues and cultural proximity have a sizable role in explaining national border effects. Second, by using better and more comprehensive data on tariffs and non-tariff barriers. Finally by taking into account the endogeneity of policy barriers, along the line suggested by Trefler (1993) and Lee and Swagel (1997).

The reminder of the paper is organized as follows. Section 2 summarizes the theoretical and empirical framework. Section 3 describes the data sources and the variables used in the empirical model. Section 4 is devoted to the presentation of our empirical results. The final section discusses the main implications and our conclusions.

2 Theoretical and empirical framework

The estimation of border effect from gravity models, initiated by McCallum (1995) and Wei (1996), recently found a solid theoretical foundation in the work of Anderson and van Wincoop (2003) and Feenstra (2004). The underlying idea is to measure the (inverse) level of trade integration between two countries, comparing their bilateral trade with respect to the trade flow taking place within their own borders. The estimated *border effect* shows how much trade within countries is above international trade, due to cross-border measures such as tariffs, non-tariff barriers, and all other factors that might impede trade. Thus, from this perspective, the border effect represents an indirect way to measure overall market access issues.[1]

[1] For example, Mayer and Zignago (2005) recently stressed that the border effect accounts for the fact that the majority of internal demand is met by domestic producers, not foreign. Thus an ideal protection index from the point of view of foreign firms needs a benchmark based on the best possible market access situation, that is the one faced by national producers on the home market. This is exactly what the estimated border effect tells us.

2.1 The model

Our empirical framework is based on a gravity-like structure derived from a monopolistic competition model of trade introduced by Krugman (1980). Monopolistic competition is not the only available model that can be used to derive a gravity equation. However, it seems the most natural when we consider food trade among the Quad countries (see Sheldon 2005). In this paper we use the gravity like structure introduced by Head and Mayer (2000). The model establishes a relation between the relative amounts consumers spend on foreign and domestic goods, and their relative price net of transport costs.

This model combines CES utility with iceberg-type *ad valorem* equivalent transaction costs and *non strategic* price setting behavior by firms. Denoting m_{ij} the value of imports of country i from j, and m_{ii} the value of imports of country i from itself, Head and Mayer (2000) show that relative bilateral trade patterns can be expressed by the following compact characterization

$$\frac{m_{ij}}{m_{ii}} = \left(\frac{a_{ij}}{a_{ii}}\right)^{\sigma-1} \left(\frac{p_j}{p_i}\right)^{-\sigma} \left(\frac{1+\tau_{ij}}{1+\tau_{ii}}\right)^{1-\sigma} \left(\frac{v_j}{v_i}\right) \qquad (1)$$

where, v_j is the exporter's industry production value, a_{ij} represents the i consumer preferences with respect to varieties imported from j, p_j is the mill price in the exporter country, and σ is the elasticity of substitution. Finally, $(1+\tau_{ij})$ is the transaction costs that determine the delivered price of the imported product, $p_{ij} = (1+\tau_{ij})p_j$.

Before deriving an estimable equation, it is necessary to model both the transaction costs $(1+\tau_{ij})$ and the preference (a_{ij}) components of equation (1).

2.1.1 Transaction costs component

Let us consider three different elements in transaction costs: *i*) transport costs; *ii*) trade-policy; *iii*) information related costs

$$\left(1+\tau_{ij}\right) = d_{ij}^{\delta}\left(1+t_{ij}\right)\left(1+ntb_{ij}\right)I_{ij} \qquad (2)$$

In this specification, we use distance between countries as proxy for physical transport costs d_{ij}, while trade policy costs are related to international trade-policy and depend on the level of protection of the country i vs. country j. Thus, trade-policy consists of an *ad valorem* tariff t_{ij} and the *ad valorem* equivalent of non-tariff barriers ntb_{ij}. Finally, I_{ij} represents information costs.

We assume that trade-policy cost structure vary across all the partner pairs, and depends on the direction of the flow. Thus, the protection structure is specified as

$$(1+t_{ij})(1+ntb_{ij}) \equiv \exp[a_1 EU_{ij} + a_2 EUCAN_{ij} + a_3 CANEU_{ij}] \qquad (3)$$

For simplicity purposes, equation (3) considers only trade between European countries and Canada, where EU_{ij} is a dummy variable set equal to 1 when i and j belong to EU (for $i \neq j$), $EUCAN_{ij}$ is a dummy variable set equal to 1 when i ($\neq j$) belongs to EU and j is Canada, $CANEU_{ij}$ is a dummy variable set equal to 1 when i is Canada and j ($\neq i$) belongs to the EU.

The information costs depend on the ease of communication and the quality of reciprocal information and result higher between two geographically and linguistically noncontiguous regions. Moreover, we assume that also the information cost structure varies across all the partner pairs. Thus, following Combes et al. (2005), their structure can be specified as follows

$$I_{ij} = \left(1 + news_{ij}\right)^{-\mu} \exp[(b_1 EU_{ij} + b_2 EUCAN_{ij} + b_3 CANEU_{ij}) - \psi C_{ij} - \gamma L_{ij}] \quad (4)$$

where $news_{ij}$ measures the bilateral flows of newspapers and is used as a proxy for the ease of communication and the quality of reciprocal information (Disdier and Mayer 2005); C_{ij} and L_{ij} are dummy variables that take value 1 when country i and country j (for $i \neq j$) share a common border and/or speak a common language (0 otherwise).

2.1.2 Consumer preference component

The consumer preference a_{ij} is often simplified as a 'home bias' in preferences for goods produced in the home country, mostly because bilateral information on preferences is not available. However, we assume that consumers prefer goods produced in a contiguous country and that the sharing of cultural features generates greater similarity in taste and mitigates the 'home bias' (see Disdier and Mayer 2005).

Thus, we use bilateral exchange in printed books as well as contiguity and common language dummies as proxies of cultural proximity and similar preferences between two countries. Moreover, as assumed for information costs and formal protection measures, we also assume that the structure of consumer preferences (a_{ij}) varies across all the partner pairs, and depends on the flow direction of a given pair

$$a_{ij} \equiv \left(1 + books_{ij}\right)^{\rho} \exp\left[e_{ij} - \left(c_1 EU_{ij} + c_2 EUCAN_{ij} + c_3 CANEU_{ij}\right) + \psi C_{ij} + \gamma L_{ij}\right] \quad (5)$$

where $books_{ij}$ brings common cultural traits and therefore should be a proxy of similar consumer taste; e_{ij} is a random component of preferences.

2.2 The empirical model

Omitting protection, information and preference explanatory variables, the estimable gravity equation from the monopolistic competition model of trade yields the following logarithmic form

$$\begin{aligned} \ln\left(\frac{m_{ij}}{m_{ii}}\right) &= \ln\left(\frac{v_j}{v_i}\right) - (1-\sigma)\delta \ln\left(\frac{d_{ij}}{d_{ii}}\right) - \sigma \ln\left(\frac{p_j}{p_i}\right) + \psi C_{ij} + \gamma L_{ij} - (\sigma - 1)(a_1 + b_1 + c_1) EU_{ij} + \\ &- (\sigma - 1)(a_2 + b_2 + c_2) EUCAN_{ij} - (\sigma - 1)(a_3 + b_3 + c_3) CANEU_{ij} + \varepsilon_{ij} \end{aligned} \quad (6)$$

where $\varepsilon_{ij} = (\sigma - 1)(e_{ij} - e_{ii})$.

Taking the antilog of the estimated country-group dummy coefficients we have the so called *border effect*, namely how much intra-country trade is above international trade after controlling for size, transport costs and relative prices. Each of the dummy variables' coefficient $(\sigma-1)(a_n+b_n+c_n)$, thus captures both the policy component, a_n, and the non-policy components of the border, b_n and c_n (information costs and consumer preferences, respectively).

For example, the coefficient on $EUCAN_{ij}$ equal to $(\sigma-1)(a_2+b_2+c_2)$, indicates the difficulty faced by Canadian exporters when selling their products to EU markets, and includes the average level of importing country protection, the information costs and the consumer 'home bias' component. Symmetrically, the $CANEU_{ij}$ coefficient, equal to $(\sigma-1)(a_3+b_3+c_3)$, indicates the difficulty European exporters have in accessing the Canadian market.

Thus, the use of the empirical model specified in equation (6) drives our work to this first result: the estimation of bilateral *border effect* inclusive of all bilateral trade impediments.

Nevertheless, following the approach of Fontagné et al. (2005), the inclusion in the model of the assumed border effect determinants, specified in equations (2-5), allows us to reach a second result: an analysis of the border effect reduction induced by policy and non-policy barriers. Indeed, the inclusion in equation (6) of tariff and NTB should reduce the policy component of the border (a_n), just as the inclusion of the information network variables and cultural proximity variable should reduce the magnitude of information (b_n) and preference (c_n) component of the border. By doing so we can asses their relative importance in explaining national border effects.

3 Data and measures

Our gravity model includes 13 countries: United States, Canada, Japan and 10 European Union countries[2]. The database considers the imports among the Quad countries for the period 1996-2001 (see Table A3 in Appendix). The full data set presents a total of 14,061 observations and considers 33% of the world food trade and 52% of the Quad country food imports from the world. The necessary data to implement equation (6) involve the use of several sources:

- *UN Comtrade database* for bilateral trade, at the HS-96 6-digit level, reported by the importer countries, then aggregated at the ISIC 4-digit level.
- *OECD Structural Statistics for Industry and Services database*, for output data, at ISIC Rev.3 4-digit level (code from 1511 to 1600), supplemented by other national sources in the case of missing values.
- *CEPII* (Centre d'Economie Publique and Internationale)[3] for distance between and within countries, and for dummies on language and contiguity.
- *Penn World Tables v.6.1* for relative prices[4].

[2] The observations for Austria, Greece, Ireland, Luxembourg and the Netherlands are not considered due to a large zero value in the production dataset.

[3] See, http://www.cepii.fr.

[4] The industry-level mill price required by the theoretical model is not used because of endogeneity concerns and low data availability. Thus, following the example of previous authors we considered the more general price level of GDP, expressed relative to the United States.

- *MacMaps (Market Access Maps)* database for *ad valorem* tariffs at the bilateral HS 6-digit level, then aggregated using arithmetic means and converted to ISIC 4-digit. These data represent a not negligible improvement on the cruder Unctad Trains data usually used in previous studies (see, Boüet et al. 2003, for a description of the MacMap database).
- *Kee, Nicita and Olarreaga (2004)* for the *ad valorem* equivalent (AVE) of NTBs, at the HS 6-digit level[5]. These data are then aggregated and converted to ISIC 4-digit using arithmetic means. Note that due to data problems and the conceptual difficulty of measuring the *ad valorem* equivalent of NTBs, previous studies normally used a-theoretic indices based on frequency or coverge ratio to capture the trade effect of NTBs (see, e.g., Haveman and Thursby 2000; Fontagnè et al. 2005; Lee and Swagel 1997; Trefler 1993). However, the last procedure implicitly imposed a strong regularity condition, because it assumed that all changes in the coverage ratio are equally important for trade flow, ignoring the fact that different NTBs can have different trade effects (see Anderson and van Wincoop 2004). An extract of the average tariffs and AVE of NTBs is shown in table 1.

The empirical implementation of equation (5) needs intra-country trade data, but these figures were not available for our country sample. Thus, as in Wei (1996), Chen (2004) and others, we constructed such measures based on the assumption that what a country imports from itself is just the difference between its total output and its total export to the rest of the world in each sector.

Finally, as discussed in section (2), we use two variables as proxy for information related costs and cultural proximity: bilateral flow of *newspapers* and bilateral exchange in printed *books*, respectively. Both variables are calculated as bilateral imports relative to importer production value. Trade data come from UN Comtrade, while the production data are from OECD, UNIDO and National statistics.

4 Results

4.1 The level of border effects

We begin with an estimation of the magnitude of the border effect, testing some different specifications based on the gravity equation (6). The results are reported in Table 2. Regressions from 1 to 3 are based on ordinary least squares (OLS) pooled over 1996-2001, and across 18 food industries. Differently, regression 4 uses Heckman's two-stage procedure to address selection bias concern, due to the zero value of some bilateral trade flow combinations.

Column (1) involves a simple specification where we estimate only one border effect coefficient, the Quad *average* border effect. The overall fit of the regression is in line with the usual findings based on

[5] To obtain the AVE of NTBs, these authors first estimate the impact of NTBs on imports using Leamer's comparative advantage approach. Then they transform the quantity impact into price equivalent, using a careful estimate of the import demand elasticity, at HS 6-digit.

this kind of gravity specification.[6] All the estimated coefficients have the expected sign and are highly significant ($p<0.01$). The coefficient on relative production, equal to 0.8, is quite near the unitary value predicted by theory. The trade elasticity of relative distance is, as expected, negative, as is the relative price. However the last coefficient appears too small to represent the elasticity of substitution, a result that often emerges from this kind of specification (see Head and Mayer 2000). Finally, the coefficient on contiguity is significantly positive, while the effect of language is virtually nil.

This basic specification gives quite a large estimated border effect. Its magnitude implies that, on average, each country trades around 58 times more [=*exp*(4.07)] within its national borders than with another Quad country. Two countries sharing a common border have a border effect reduced from 58 to 16 [=*exp*(4.07-1.26)], everything else holds constant.

In column (2) we split the single border into 13 dummy variables, one for each of the possible bilateral combinations of the four Quad countries[7]. The border effect for intra-EU trade is quite large. This means that intra-country trade is, on average, 69 times greater [=*exp*(4.24)] than crossing a national border between EU countries. A comparable estimate for food trade does not exist, but a recent estimation for all manufactured goods by Fontagné et al. (2005) found an intra-EU border effect of only 12.8 in the late nineties. However, Head and Mayer (2000) found also that intra-EU border coefficients for most 'ingestible products' are higher than for non-food products, ranging from 49 for dairy to 600 for sugar. Thus, from this perspective, our results are within the range of the previous border effect estimation on food trade in the EU.

Contrary to expectations, the border effect for intra-EU trade is not the lowest one among the Quad countries. Indeed, quite surprisingly, Japan's market presents an easier access level for imports from all the other countries considered here, especially from the United States. Moreover, Japanese exporters suffer a constantly higher level of border effect, evident not only for the US but also for the EU and Canadian markets. This defines big asymmetries across these country-trade combinations.

The results, albeit quite surprising, are in any case similar to previous findings, showing that the Japanese market is often more open to imports from the US, than the reverse. For example, Fontagné et al. (2005) consider that this 'spectacular' result might be driven by an overestimate of the US-Japan distance, with respect to intra-EU distances. By contrast, Harrigan and Vanjani (2003) explain it by considering that the US has a proportionately larger demand for manufactured goods. However, another explanation of the low border effect for Japan food imports could be related to the strong differences in comparative advantage, not captured by the model, due to the resource based (land) nature of food production.

[6] Specifically, the relative nature of our specification gives lower explanatory power with respect to traditional or fixed effect gravity specifications. This is not surprising as in our case the variables are computed as differences with respect to internal flow used as the reference. Thus, our specification is comparable to a first-difference panel model estimation that, notoriously, increased the variance to be explained compared to the estimations in levels (see Combes et al. 2005 on this point).

To check for the last conjecture, two classical endowment measures were introduced into column 3 of Table 2: land per-capita and GDP per-capita, both expressed as a ratio between the exporter and importer values to preserve the relative nature of the model (*source*: World Development indicators). Interestingly, the two variables are highly significant, and their introduction induces a significant change in the estimated border coefficients that appears in line with the comparative advantage hypothesis. Indeed, in each bilateral combination we see a reduction (increase) in the border coefficients of the relative land abundance (scarce) countries, that is broadly proportional to the country's endowment differences in land.

With this modification of the base model, the strong border effect asymmetries shown in regression (2) are, at least partially, recomposed with common perception. For example, the figures suggest that there exists a higher border protection in the EU (vis-à-vis US producers) than in the US (vis-à-vis EU producers) or in border protection in Canada (vis-à-vis US producers) rather than the reverse. However, Japan's border effect incongruence, albeit reduced, is still present.

The last regression of Table 2 reports a specification identical to column (3) but estimated with Heckman's two stage procedure (a first-stage probit model and a second-stage OLS model). The significant coefficient on Mills ratio in the bottom half of the table indicates the need for this adjustment. As a result of this correction, the border effects in several cases are somewhat increased. However, the slight increase in border coefficient does not change the border effect patterns discussed above.

Not surprising, border effects also differ across industries. Table A2 (in appendix) gives the results of estimating industry-specific gravity equations, and orders the industries in terms of decreasing magnitude of border effect. The strongest value, equal to 483 [=*exp*(6.18)], is found for the manufacture of sugar, followed by animal feed, tobacco and soft drinks. These results are in line with the Head and Mayer (2000) findings, both for order and magnitude of border coefficients. On the contrary, the lowest border effects are estimated for the distilling industry, the manufacture of cocoa and of dairy products where the border effects range from 4 [=*exp*(1.2)] to 6 [=*exp*(1.85)] respectively. The dairy value is close to the border effect estimated by Chen (2004) for dairies and cheese trade between EU countries, equal to 5.7.

4.2 Explaining border effects: the role of policy and non-policy barriers

In the previous section we estimated bilateral levels of border effects that derive from both policy and non-policy related border costs. Now, let us try to answer a few additional key questions: how much of the national borders are due to policy barriers? Or, which kind of barriers are more 'protectionist': tariffs and NTBs or policy unrelated barriers such as information related costs or cultural proximity?

[7] In agreement with previous literature (Fontagné et al. 2005; Mayer and Zignago 2005), we dropped the regression constant so as to incorporate all the dummy variables for the estimation of each bilateral border coefficient.

Trying to answer these questions is important because, as recently argued by several authors (see, e.g., Evans 2003; Chen 2004; Anderson and van Wincoop 2002), the economic significance of the border differs greatly if policy, not preferences or information related costs, poses the main national border hindrances. In fact, in the first case the importance of the border translates directly into distortions, with significant welfare costs and a role for policy, while in the second case it does not.

Following Fontagnè et al. (2005), to understand the relative importance of the two explanations, variable proxies for the different determinants of border effects are introduced into the specifications. Then, by measuring the resulting reduction in the estimated border effects we have an estimation of the role played by the variables in explaining the trade reduction effect of national borders.

Column (1) of Table 3 shows the results of a basic regression estimated on the 2000-01 data, with a specification identical to Column 3 of Table 2. Thus, it represents our benchmark to compare the explanatory power of the determinants of border effects. The regressions are estimated by OLS as the Mills ratio is insignificant for half of the specifications, suggesting that working with only one year of data does not justify the Heckman procedure.

4.2.1 The impact of tariffs and non-tariff barriers on national borders

In regression (2) we add the first policy component of the border, tariffs. The result is that bilateral tariffs, with a negative and highly significant coefficient, explain a not negligible part of the border. Indeed, except for the EU countries that have nil bilateral tariffs, border coefficients decrease in all country combinations, with a (simple) average border effect reduction of 26%. This result confirms the findings of Fontagné et al. (2005), though the border effect reduction is, in the present case, much larger.

The changes in border effect induced by tariffs, for each bilateral country combination, are reported in Table 4. For instance, the figures indicate that when only tariffs are controlled for, the total border reduction of EU imports from Canada varies by [*exp*(5.82–6.24)–1]= –34%, where 6.24 and 5.82 are the estimates of the border coefficients, taken from Table 3 columns (1) and (2), respectively. As can be seen, tariffs explain about 47% of Japan's border effect for imports coming from the other Quad countries, but only 12% of the US' border effects for imports coming from the EU and Japan.

Column (3) adds the *ad valorem* equivalent of NTB as a policy variable. Once again, there is a general decrease in border coefficient (except for intra-EU trade) and the NTB coefficient significantly decreases bilateral trade.[8] Note that, the (simple) average border effect reduction of NTB, equal to 31%, is higher than the reduction induced by tariffs. Thus, non-tariff barriers seem more protectionist than tariffs. Moreover, the stronger border effect reduction is that involving access to the EU market (50%), followed by access to Japan (45%) and USA (26%) respectively (see Table 4, column 2).

[8] It is important to underline that using an aggregated frequency ratio of all NTBs, instead of the *ad valorem* equivalent used here, the estimated coefficient of NTBs is positive but insignificant, while considering the different types of NTBs separately, only price control NTBs seem to have an impact on trade flow (see table A2 in appendix).

Next, column (4) of Table 3 includes the two policy variables together. It can be seen that their coefficients are both significantly negative. Overall, the border effect reduction explained by policy barriers ranges from 23% for US export to Canada to 60% for the combinations involving Japan as the importing country, with an average border effect reduction of 39%. Thus, in contrast with most of the previous findings, our figures suggest that policy barriers explain a not negligible component of the border effects in the Quad food trade. Moreover, they show that the trade reduction effect induced by NTBs dominates that of tariffs. Finally and not surprisingly, the inclusion of policy variables do not affect the other trade cost components of our model, namely the coefficients of distance, language and contiguity variables (see the bottom of Table 4).

4.2.2 The impact of information related costs and cultural proximity

In the next regression of Table 3, we add to the basic specification our first non-policy related proxy, the bilateral flow of *newspapers* (column (5)). This variable should capture the ease of communication and quality of reciprocal information, thus reducing the information related component of the trade costs. As can be seen, its coefficient is positive and strongly significant and, interestingly, it induces a quite strong reduction in the estimated border effects. Specifically, information related costs induce an average variation in border effects of about −50%, with a higher value for EU imports from Canada (−83%), and a lower one for combinations involving Japan. Note that these patterns of border effect variations appear consistent with the idea that the proxy captures information related costs. Moreover, this conclusion is reinforced by the fact that, when information costs are controlled for, we detected a reduction in the language effect (47%), which is four times stronger with respect to the reduction in the contiguity effect (12%) (see the last lines of Table 4). Finally, it is also interesting to note that the inclusion of information proxy reduces the impact of transport costs by about 30%. This suggests that the traditional distance coefficient of the gravity equation captures more than the simple transport cost components of trade costs. Similar results are obtained by Combes et al. (2005), using as information related proxy the stock of migrants.

Regression (6) of Table 3, analyzes the impact of cultural similarity, proxy by bilateral exchange in *books*. The estimated coefficient is positive and strongly significant, at the same time the inclusion of this variable induces a very strong reduction in the estimated bilateral border coefficients. Cultural proximity and preferences thus appear important determinants of the border effect, inducing an average reduction of about 83%. Moreover, it is interesting to note that with the exclusion of US exports to Japan, the variation in border effects when cultural ties are controlled for, appears quite uniform between the different bilateral country combinations. Finally, while cultural proximity affects the coefficients of both language (−50%) and contiguity (−26%) dummies, the effect on distance is quite limited (−11%).

Next, in Column 7 of Table 3 we add the non-policy variables simultaneously. When controlling for the bilateral exchange of books, the impact of the information related proxy (newspapers) is significantly lower than when introduced alone. Differently, the effect of the cultural proximity variable is only slight affected. Therefore, considering the stronger border reduction induced by *books*, one can conclude that in our dataset the information related component of the border, tends to be dominated by trade costs due to cultural distance and consumer preferences. However, such a conclusion should be reached with care as the significantly lower trade creation effect - induced by information related costs, relative to the cultural and preferences component - could simply be due to the poor proxy used here. Indeed, as stressed by Disdier and Mayer (2005), newspapers, due to time constraints, could also be printed directly in the host country, especially where there is a large potential readership, as is the case in several countries of our data set.

Finally, regression (8) includes both policy and non-policy variables simultaneously. Overall, the estimated coefficients remain substantially unchanged in significance and magnitude, reinforcing our previous conclusions. In this specification, the border effects explained by policy variables, information costs and cultural proximity are very high, ranging from 73% for US export to Japan, to 96% for Canada's export to the EU. Therefore, these explanations of border effects appear very important in the food sectors. However, note that the border coefficients, although strongly reduced with respect to our benchmark, are still significant. Thus, these explanations of the border effects are important, but do not explain the whole story of the strong trade reduction effect of the border.

4.2.3 Endogeneity issues

There are potential sources of endogeneity for both policy and non-policy determinants of border effect. First of all, in the above regressions we treat the level of protection as given. However, the level of protection is not exogenous. A large political economy literature of trade policy suggests that not only does trade policy affect imports, but also that the levels and growth of imports affect protection as well. Indeed, the endogenous theory of protection predicts that, in response to increased import competition, domestic interest groups will intensify their lobbying activity. Thus, higher levels of import will lead to greater protection. In this case, if import and protection are not modeled as being simultaneously determined, the estimated impact of protection on imports will be biased downward (see Trefler 1993). Interesting, the recognition of the endogeneity of protection to import may partially explain why tariffs and NTBs often represent only a small fraction of the estimated border effect in the gravity literature.

In order to check for this simultaneity bias, two stage last square regressions (2SLS) are used, where tariffs and non-tariff barriers are treated as endogenous, and instrumented by means of traditional political economy determinants.[9] Specifically, following Lee and Swagel (1997) we use industry

[9] Typically, the literature on endogenous protection treats tariffs as predetermined regressors in import equations (see, e.g., Ray 1981; Lee and Swagel 1997). The argument is that applied tariff rates do not diverge much from the World Trade Organsation (WTO) binding rates, set during the previous round. However, while this assumption is probably not too bad when applied to manufacturer industries, it appears quite strong in our case, because it is only very recently - since the

conditions such as labor productivity, the wage per worker, the share of value added, and the amount of employment (and its square) plus industry fixed effects, to instrument for tariffs and NTBs.

Table 5 displays the 2SLS estimate of tariffs and NTBs coefficients. Interestingly, on comparing the coefficients of policy variables, the striking feature is that the 2SLS estimate for both tariffs and NTBs is more than twice that of the OLS counterpart (see the bottom of Table 5).[10] In addition, after the inclusion of policy variables, the *t*-statistic in the 2SLS equations for policy variables is greater, while the reduction induced in the border effect coefficients is about 30% stronger than in the OLS regressions; all these are elements indicative of simultaneity bias. The bottom of Table 5 provides the Hausman (1978) specification test of the null hypothesis of no simultaneity bias.[11] As can be seen, we cannot reject this null at the 1% significance level for either of our policy variables. Thus our results confirm the importance of treating trade barriers as endogenous when assessing the effect of protection on trade in gravity-like models.

Another potential source of endogeneity is linked to the non-policy determinants of border effects, *newspapers* and *books*. Indeed, one can suppose that potentially omitted variables may affect both food import and the flow of newspapers and books. Think, for example, of the migrant stock: an increase in the number of migrants in a region may raise the import levels of food and newspapers simultaneously. If this is the case, the coefficients of non-policy variables will be biased due to omitted variables problem. Addressing this simultaneity bias, however, is difficult because of the lack of good instruments for newspapers and books. In any case, in order to at least understand the direction of the bias we perform some regressions where the 2001 newspaper and book variables are instrumented with their 1995 values (see Table 5 columns 4, 5, 6). The results appear to confirm our concern for simultaneity bias. Indeed the *F*-Hausman of no-simultaneity cannot be rejected at 1% significance level for either proxy. However, if anything, endogeneity appears to introduce a downward bias. Virtually all the coefficients for non-policy variables are now larger than in OLS regressions, and this is especially true for newspapers. Thus, while simultaneity bias may represent a problem, our results and conclusions do not appear driven by endogeneity issues.

Uruguay Round agreement – that tariffs in the food industry are strictly regulated under WTO rules. The results below strongly support this argument.

[10] The OLS coefficients of policy (and non-policy) variables, reported at the bottom of Table 5, are close, but not identical, to those reported in Table 3, because not every country had data available on the industry characteristics used as instruments. Thus, the sample is somewhat smaller than in previous regressions.

[11] Specifically, the bottom Table 5 shows the *F*-Hausman statistic (and its significance level) based on Hausman (1978) and Smith and Blundell (1986). Those papers showed that, in a linear model, an easy way of implementing the Hausman test for exogeneity, is to first run reduced form regressions of each of the variables suspected to be endogenous, on all the exogenous variables from our main regression and other exogenous variables which theory suggests might affect any of the endogenous variables. The second step involves computing the residuals from these auxilliary regressions and inserting them as additional right-hand side variables in our main estimating equations. If these residual are significant (insignificant), than the OLS estimation produces are inconsistent (consistent) estimates. Thus, the *F*-Hausman gives the *F*-statistic for the significance of these residuals in the auxiliary regressions (not shown).

5 Summary and conclusions

Using a structural gravity-like equation this paper has investigated the difficulties in market access faced by exporting countries when selling their food products to other countries. The approach uses a trade model under monopolistic competition, developed by Head and Mayer (2000), to measure and explain the so-called border effects – namely how much within country trade is above international trade after controlling for size, transport costs and price differences. Thus, the model extracts information on trade costs by comparing international and intra-national bilateral trade flows, along the lines initiated by McCallum (1995) and recently surveyed by Anderson and van Wincoop (2004). Using this method we first investigated bilateral levels in border cost asymmetry between Canada, the EU, Japan and US food trade. Then, we tried to disentangle the role played by policy variables, compared with variables related to information and cultural proximity, in explaining the magnitude of border costs.

The analysis strongly confirms the existence of important asymmetries in the levels of market access for food trade across both countries and industries. For example, US exports to the EU appear much more affected by the border than the exports of the EU to the US; the same can be said for the US exports to Canada. However, quite surprisingly, Japan seems to be more open to manufactured food imports from Quad countries, than Quad countries are to Japanese foods. Given the long term recognition of high food protection in Japan, this “openness” appears puzzling, and tends to persist even after controlling for differences in comparative advantage.

The results show, overall, that the border effect, explained by policy variables, information costs and cultural proximity, is very high, ranging from 73% for US export to Japan to 96% for Canada’s exports to the EU. Therefore, such explanations for border effects in the food sectors appear very important. It is interesting to note that tariffs and NTBs together explain about 39% of the trade reduction effect of national borders, and this role appears significantly stronger if we recognize the endogeneity of protection due to political economy arguments. All this would point to potential gain being achieved from policy reform. Nevertheless, because the effect of policy barriers seem dominated by consumer preferences and information related costs, the distortions and welfare consequences of the border appear, at least partially, mitigated.

Further work is needed to better quantify the impact of policy and non-policy barriers on national borders. For example, with regard to policy, we actually have good data for just one cross section, and this reduces our ability to look at the effects of *change* in protection over time, and thus limits the possibility of a better identification of the effect of tariffs and NTBs. On the non-policy side, a challenge for the future is to identify, and separate, the effect of consumer preferences from that of information related costs. This is an important point as the policy implications of these two trade costs are, evidently, quite different.

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Table 1. Tariffs (2001) and AVE of NTBs (1999-2000) in QUAD countries.

	Tariff				NTB ave			
	CAN	EU	USA	JPN	CAN	EU	USA	JPN
Production, processing and preserving of meat	16.0	21.1	1.7	49.1	25.1	41.7	35.6	41.3
Processing and preserving of fish	1.2	11.2	1.4	6.6	13.5	26.0	20.1	23.3
Processing and preserving of fruit	5.1	15.7	6.5	13.4	15.7	47.3	33.4	43.4
Manufacture of vegetable and animal oils	4.3	11.6	4.4	6.2	4.5	32.8	3.7	19.5
Manufacture of dairy products	101.0	44.6	17.7	111.4	52.8	79.9	67.9	73.6
Manufacture of grain mill products	6.2	42.9	3.6	182.9	23.4	34.9	6.8	30.5
Manufacture of starches and starch products	6.3	45.2	3.4	36.6	27.5	61.0	0.0	49.3
Manufacture of prepared animal feed	12.3	16.5	3.8	6.5	0.0	47.6	0.0	19.4
Manufacture of bakery products	3.5	12.6	0.4	14.6	0.0	53.8	30.0	51.8
Manufacture of sugar	4.0	61.9	19.1	150.1	0.0	59.9	0.0	45.5
Manufacture of cocoa, chocolate and sugar confectionery	17.8	12.8	6.3	21.1	0.0	68.5	4.6	39.3
Manufacture of macaroni, noodles, couscous and similar	6.2	24.5	4.7	24.6	0.0	66.6	53.4	44.0
Manufacture of other food products n.e.c.	12.9	10.4	5.3	21.5	14.1	63.7	47.0	42.7
Distilling, rectifying and blending of spirits	1.5	7.1	0.4	22.2	0.0	0.0	23.7	34.0
Manufacture of wines	23.2	12.2	5.9	30.6	0.0	0.0	9.9	9.7
Manufacture of malt liquors and malt	1.2	31.7	0.7	40.4	55.4	73.5	0.0	61.6
Manufacture of soft drinks; production of mineral water	12.9	7.0	3.1	6.5	0.0	53.4	10.4	41.7
Manufacture of tobacco products	7.5	39.7	4.4	7.9	0.0	30.5	0.0	0.0

Source: our computation from MacMaps database and Kee, Nicita and Olarreaga (2004)

Table 2. Border effects in the QUAD countries food trade

Dependent variable	Ln (Imports / Intra-country trade)			
Time period	1996-01	1996-01	1996-01	1996-01
Regression	(1)	(2)	(3)	(4)
Ln Yj/Yi	0.78	0.82	0.85	0.82
	(0.01)	(0.01)	(0.01)	(0.01)
Ln Distance ij/Distance ii	-1.40	-1.08	-1.22	-1.08
	(0.03)	(0.04)	(0.04)	(0.04)
Common Language	0.02	0.94	0.92	0.80
	(0.07)	(0.08)	(0.08)	(0.08)
Contiguity	1.26	1.13	1.01	1.06
	(0.05)	(0.05)	(0.05)	(0.05)
Ln prices	-1.99	0.10	-0.97	-1.00
	(0.09)	(0.10)	(0.18)	(0.18)
Ln gdp-pc			0.71	0.73
			(0.09)	(0.09)
Ln land			0.43	0.37
			(0.03)	(0.03)
Border ave.	-4.07			
	(0.06)			
Mills Ratio				-1.84
				(0.30)
Bilateral Border coefficients				
EU→ EU		-4.24	-3.99	-4.14
		(0.07)	(0.07)	(0.07)
CAN→ EU		-5.54	-6.05	-6.03
		(0.15)	(0.16)	(0.16)
EU→ CAN		-6.55	-5.37	-5.57
		(0.10)	(0.14)	(0.14)
CAN→ USA		-4.62	-4.54	-4.56
		(0.15)	(0.15)	(0.15)
USA→ CAN		-6.48	-6.22	-6.12
		(0.14)	(0.14)	(0.14)
CAN→ JPN		-2.19	-3.44	-3.67
		(0.25)	(0.26)	(0.26)
JPN→ CAN		-8.04	-6.07	-6.47
		(0.24)	(0.28)	(0.28)
EU →JPN		-3.56	-3.85	-4.04
		(0.14)	(0.14)	(0.14)
JPN→ EU		-7.79	-6.55	-6.71
		(0.16)	(0.20)	(0.20)
USA→ EU		-5.40	-5.81	-6.07
		(0.14)	(0.15)	(0.15)
EU →USA		-5.03	-3.94	-4.19
		(0.10)	(0.13)	(0.13)
USA→ JPN		-1.71	-2.88	-3.10
		(0.19)	(0.21)	(0.21)
JPN→ USA		-5.98	-4.11	-4.55
		(0.22)	(0.26)	(0.26)
Adj R-square	0.419	0.511	0.517	0.519
# obs.	14,061	14,061	14,061	14,061

Notes: Heteroskedasticity-consistent standard errors are in parentheses. OLS regression in columns from (1) to (3); Heckman's regression in column (4). See text.

Table 3. Policy and non-policy determinants of national border effects

Dependent variable	Ln (Imports / Intra-country trade)							
Regression	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln Yj/Yi	0.91	0.91	0.91	0.91	0.83	0.80	0.79	0.79
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Common Language	0.96	0.95	0.95	0.94	0.50	0.33	0.29	0.28
	(0.19)	(0.19)	(0.18)	(0.18)	(0.19)	(0.18)	(0.18)	(0.18)
Contiguity	0.95	0.95	0.97	0.96	0.86	0.68	0.70	0.71
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Ln Distance ij/Distance ii	-1.24	-1.24	-1.22	-1.23	-0.99	-1.14	-1.06	-1.05
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	(0.10)
Ln prices	-2.11	-2.10	-2.05	-2.06	-3.03	-3.02	-3.19	-3.15
	(0.42)	(0.42)	(0.42)	(0.42)	(0.42)	(0.41)	(0.41)	(0.41)
Ln gdp-pc	1.22	1.22	1.19	1.20	1.53	1.56	1.61	1.60
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.19)	(0.19)	(0.19)
Ln land	0.53	0.53	0.52	0.53	0.42	0.48	0.45	0.45
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.08)	(0.08)
Ln (1+Tariff)		-2.19		-1.78				-1.82
		(0.45)		(0.47)				(0.46)
Ln (1+NTBave)			-1.94	-1.39				-1.33
			(0.48)	(0.50)				(0.48)
Ln Newspapers					0.13		0.06	0.06
					(0.02)		(0.02)	(0.02)
Ln Books						0.28	0.22	0.22
						(0.03)	(0.04)	(0.04)
Bilateral Border coefficients								
EU → EU	-3.87	-3.87	-3.90	-3.89	-3.16	-2.31	-2.37	-2.40
	(0.17)	(0.17)	(0.17)	(0.17)	(0.20)	(0.22)	(0.22)	(0.22)
CAN → EU	-6.24	-5.82	-5.55	-5.40	-4.97	-4.25	-4.18	-3.36
	(0.37)	(0.38)	(0.41)	(0.41)	(0.39)	(0.40)	(0.40)	(0.44)
EU → CAN	-5.02	-4.74	-4.82	-4.64	-4.51	-2.87	-3.17	-2.80
	(0.34)	(0.34)	(0.34)	(0.34)	(0.35)	(0.39)	(0.40)	(0.41)
CAN → USA	-4.40	-4.34	-4.09	-4.13	-3.67	-2.25	-2.45	-2.19
	(0.35)	(0.35)	(0.37)	(0.36)	(0.35)	(0.38)	(0.39)	(0.40)
USA → CAN	-6.08	-5.93	-5.88	-5.81	-5.46	-4.22	-4.39	-4.14
	(0.34)	(0.33)	(0.33)	(0.33)	(0.34)	(0.37)	(0.37)	(0.36)
CAN → JPN	-3.86	-3.18	-3.27	-2.88	-3.26	-2.31	-2.42	-1.46
	(0.54)	(0.57)	(0.56)	(0.58)	(0.55)	(0.56)	(0.56)	(0.60)
JPN → CAN	-5.29	-5.04	-5.13	-4.97	-4.84	-3.14	-3.45	-3.13
	(0.71)	(0.69)	(0.71)	(0.70)	(0.71)	(0.74)	(0.74)	(0.73)
EU → JPN	-4.35	-3.72	-3.78	-3.43	-3.99	-2.94	-3.12	-2.22
	(0.36)	(0.38)	(0.39)	(0.40)	(0.36)	(0.38)	(0.38)	(0.42)
JPN → EU	-5.91	-5.49	-5.26	-5.10	-5.10	-3.94	-4.07	-3.27
	(0.50)	(0.50)	(0.53)	(0.53)	(0.51)	(0.52)	(0.52)	(0.54)
USA → EU	-6.11	-5.67	-5.43	-5.26	-5.59	-4.65	-4.77	-3.94
	(0.37)	(0.37)	(0.40)	(0.40)	(0.37)	(0.38)	(0.38)	(0.41)
EU → USA	-3.49	-3.36	-3.18	-3.16	-3.02	-1.63	-1.87	-1.56
	(0.31)	(0.31)	(0.32)	(0.32)	(0.31)	(0.35)	(0.36)	(0.37)
USA → JPN	-3.55	-2.91	-3.00	-2.63	-3.64	-3.00	-3.17	-2.25
	(0.51)	(0.51)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
JPN → USA	-3.27	-3.13	-3.00	-2.96	-2.99	-1.40	-1.72	-1.43
	(0.62)	(0.61)	(0.62)	(0.61)	(0.62)	(0.64)	(0.65)	(0.64)
Adj R-square	0.532	0.537	0.535	0.555	0.548	0.554	0.555	0.562
# obs.	2,355	2,355	2,355	2,355	2,355	2,355	2,355	2,355

Notes: Heteroskedasticity-consistent standard errors are in parentheses (see text). OLS regressions.

Table 4. Effect of policy and non-policy barriers on border, language, contiguity and distance

	Policy barriers			Non policy barriers			All
	Tariff	NTB	Both	Newspapers	Books	Both	
Borders							
CAN to EU	-34%	-50%	-57%	-83%	-89%	-90%	-96%
CAN to JPN	-49%	-45%	-62%	-57%	-82%	-79%	-92%
CAN to USA	-6%	-26%	-24%	-64%	-91%	-88%	-91%
EU to CAN	-24%	-18%	-31%	-51%	-91%	-86%	-91%
EU to EU	0%	3%	2%	-63%	-83%	-81%	-81%
EU to JPN	-46%	-43%	-60%	-39%	-79%	-73%	-89%
EU to USA	-12%	-26%	-28%	-48%	-88%	-82%	-87%
JPN to CAN	-23%	-15%	-28%	-47%	-91%	-86%	-90%
JPN to EU	-34%	-48%	-56%	-68%	-89%	-87%	-94%
JPN to USA	-12%	-24%	-26%	-32%	-88%	-80%	-86%
USA to CAN	-14%	-18%	-23%	-58%	-88%	-84%	-88%
USA to EU	-36%	-50%	-57%	-52%	-81%	-77%	-90%
USA to JPN	-48%	-43%	-60%	14%	-47%	-32%	-73%
Language	0%	-1%	-1%	-47%	-50%	-54%	-54%
Contiguity	0%	2%	1%	-12%	-26%	-24%	-23%
Distance	0%	-2%	-1%	-29%	-11%	-20%	-21%

Notes: The figures reported are variation in *border effects* computed by comparing the border coefficients of Table 3, column from (2) to (8), with the coefficients of baseline regression of column (1). See text.

Table 5. Robustness checks: 2SLS regressions

Regression	(1)	(2)	(3)		(4)	(5)	(6)	
Independent Variables	Tariff	NTB	Tariff+NTB		Books	Newspapers	Books+Newspapers	
Coeff. Variable	-4.90	-4.24	-3.91	-2.34	0.32	0.19	0.21	0.10
	(0.88)	(0.89)	(1.02)	(1.04)	(0.03)	(0.02)	(0.04)	(0.03)
Bilateral Border coefficients								
EU → EU	-3.89	-3.97	-3.93		-2.11	-2.93	-2.21	
	(0.18)	(0.18)	(0.18)		(0.24)	(0.20)	(0.24)	
CAN → EU	-5.31	-4.71	-4.65		-3.99	-4.50	-3.83	
	(0.42)	(0.51)	(0.51)		(0.42)	(0.41)	(0.43)	
EU → CAN	-4.42	-4.61	-4.31		-2.61	-4.37	-3.11	
	(0.35)	(0.36)	(0.36)		(0.41)	(0.35)	(0.42)	
CAN → USA	-4.21	-3.64	-3.85		-1.91	-3.36	-2.24	
	(0.36)	(0.40)	(0.40)		(0.41)	(0.37)	(0.42)	
USA → CAN	-5.83	-5.69	-5.64		-3.97	-5.27	-4.26	
	(0.33)	(0.35)	(0.34)		(0.39)	(0.35)	(0.39)	
CAN → JPN	-2.25	-2.46	-1.85		-2.03	-2.97	-2.21	
	(0.63)	(0.60)	(0.63)		(0.57)	(0.55)	(0.57)	
JPN → CAN	-4.88	-5.10	-4.80		-2.97	-4.83	-3.51	
	(0.69)	(0.73)	(0.70)		(0.75)	(0.72)	(0.76)	
EU → JPN	-2.88	-3.03	-2.48		-2.72	-3.82	-3.03	
	(0.44)	(0.45)	(0.47)		(0.39)	(0.37)	(0.40)	
JPN → EU	-5.07	-4.56	-4.45		-3.78	-4.94	-3.98	
	(0.54)	(0.61)	(0.61)		(0.54)	(0.52)	(0.54)	
USA → EU	-5.24	-4.68	-4.58		-4.51	-5.51	-4.72	
	(0.41)	(0.49)	(0.49)		(0.39)	(0.37)	(0.40)	
EU → USA	-3.05	-2.64	-2.73		-1.27	-2.73	-1.68	
	(0.32)	(0.36)	(0.36)		(0.36)	(0.32)	(0.37)	
USA → JPN	-2.08	-2.30	-1.70		-2.88	-3.65	-3.18	
	(0.57)	(0.54)	(0.57)		(0.50)	(0.50)	(0.51)	
JPN → USA	-2.98	-2.68	-2.71		-1.18	-2.93	-1.73	
	(0.61)	(0.65)	(0.63)		(0.67)	(0.65)	(0.68)	
# obs.	2,207	2,207	2,207		2,207	2,207	2,207	
Adj R-square	0.537	0.533	0.537		0.551	0.549	0.554	
OLS Coeff. Variable	-2.05	-2.05	-1.63	-1.53	0.28	0.13	0.22	0.05
	(0.45)	(0.49)	(0.47)	(0.51)	(0.03)	(0.02)	(0.04)	(0.02)
F-Hausman	31.01	22.53	18.95		105.57	80.15	56.15	
(significance level)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)	
Degree of freedom	2185	2185	2183		2185	2185	2183	

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Each regression have a specification identical to regressions of Table 3, but use 2SLS procedure. The instruments for tariffs are: numbers of employment (and its square), labor productivity, wage per worker, share of value added and the industry fixed effects; the instruments for NTBs are: labor productivity, wage per worker, share of value added and industry fixed effects. Differently, *newspapers* and *books* are instrumented by their 1995 values. See text.

Appendix

Table A1. Industry-specific border effects

		Border ave.	Border effects	adj-R2	obs
Manufacture of sugar	1542	-6.18	483	0.54	449
Manufacture of prepared animal feed	1533	-4.87	131	0.59	853
Manufacture of tobacco products	1600	-4.54	93	0.44	617
Manufacture of soft drinks; production of mineral water	1554	-4.44	86	0.54	856
Manufacture of malt liquors and malt	1553	-3.96	53	0.43	716
Manufacture of vegetable and animal oils	1514	-3.61	37	0.48	887
Manufacture of macaroni, noodles, couscous and similar	1544	-3.42	57	0.60	770
Manufacture of bakery products	1541	-3.23	25	0.59	899
Manufacture of other food products n.e.c.	1549	-3.19	24	0.59	923
Production, processing and preserving of meat	1511	-2.87	18	0.59	835
Processing and preserving of fruit	1513	-2.65	14	0.68	929
Manufacture of wines	1552	-2.53	13	0.75	507
Manufacture of starches and starch products	1532	-2.32	10	0.55	875
Manufacture of grain mill products	1531	-2.30	10	0.63	870
Processing and preserving of fish	1512	-2.10	8	0.58	780
Manufacture of dairy products	1520	-1.85	6	0.55	876
Manufacture of cocoa, chocolate and sugar confectionery	1543	-1.62	5	0.67	881
Distilling, rectifying and blending of spirits	1551	-1.20	4	0.66	534

Notes: Border effects are given by the antilog of border coefficients. Coefficients (not reported) on relative production, distance, land per-capita, contiguity and language are systematically significant and display the correct sign, otherwise prices and GDP per-capita in few regressions are insignificant and/or with wrong sign.

Table A2. Ad Valorem Equivalent vs. Frequency Index of NTB

Dependent variable	Ln (Imports / Intra-country trade)					
Regression	(1)	(2)	(3)	(4)	(5)	(6)
Ln Yj/Yi	0.91	0.91	0.92	0.91	0.91	0.91
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Common Language	0.94	0.95	0.95	0.95	0.96	0.95
	(0.18)	(0.19)	(0.19)	(0.18)	(0.19)	(0.19)
Contiguity	0.96	0.95	0.95	0.97	0.95	0.95
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Ln Distance ij/Distance ii	-1.23	-1.24	-1.24	-1.22	-1.24	-1.24
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Ln prices	-2.06	-2.11	-2.14	-2.05	-2.11	-2.13
	(0.42)	(0.42)	(0.42)	(0.42)	(0.42)	(0.42)
Ln gdp-pc	1.20	1.22	1.24	1.19	1.22	1.23
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Ln land	0.53	0.53	0.53	0.52	0.53	0.53
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Ln (1+Tariff)	-1.78	-2.41	-2.26			
	(0.47)	(0.46)	(0.47)			
Ln (1+NTBave)	-1.39			-1.94		
	(0.50)			(0.48)		
Frequency Index (FI) of all NTB		0.51			0.02	
		(0.34)			(0.33)	
FI of Price control NTB			-3.19			-3.92
			(1.59)			(1.64)
FI of Automatic licensing NTB			0.63			-0.12
			(0.59)			(0.59)
FI of Quantity control NTB			0.72			0.73
			(0.49)			(0.49)
FI of Technical NTB			-0.09			-0.64
			(0.49)			(0.48)
Bilateral Border coefficients						
EU → EU	-3.89	-3.86	-3.86	-3.90	-3.87	-3.86
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
CAN → EU	-5.40	-5.95	-5.96	-5.55	-6.24	-6.18
	(0.41)	(0.39)	(0.41)	(0.41)	(0.39)	(0.41)
EU → CAN	-4.64	-4.87	-4.87	-4.82	-5.02	-5.17
	(0.34)	(0.36)	(0.36)	(0.34)	(0.36)	(0.36)
CAN → USA	-4.13	-4.55	-4.19	-4.09	-4.41	-4.02
	(0.36)	(0.38)	(0.42)	(0.37)	(0.39)	(0.43)
USA → CAN	-5.81	-6.07	-6.08	-5.88	-6.08	-6.23
	(0.33)	(0.34)	(0.35)	(0.33)	(0.35)	(0.35)
CAN → JPN	-2.88	-3.21	-3.21	-3.27	-3.86	-3.86
	(0.58)	(0.57)	(0.57)	(0.56)	(0.55)	(0.53)
JPN → CAN	-4.97	-5.16	-5.16	-5.13	-5.30	-5.43
	(0.70)	(0.70)	(0.70)	(0.71)	(0.72)	(0.71)
EU → JPN	-3.43	-3.75	-3.74	-3.78	-4.35	-4.34
	(0.40)	(0.38)	(0.38)	(0.39)	(0.37)	(0.37)
JPN → EU	-5.10	-5.62	-5.60	-5.26	-5.92	-5.83
	(0.53)	(0.51)	(0.52)	(0.53)	(0.52)	(0.52)
USA → EU	-5.26	-5.80	-5.82	-5.43	-6.12	-6.06
	(0.40)	(0.38)	(0.39)	(0.40)	(0.38)	(0.39)
EU → USA	-3.16	-3.56	-3.22	-3.18	-3.49	-3.14
	(0.32)	(0.34)	(0.36)	(0.32)	(0.34)	(0.36)
USA → JPN	-2.63	-2.93	-2.94	-3.00	-3.56	-3.56
	(0.50)	(0.50)	(0.51)	(0.50)	(0.51)	(0.50)
JPN → USA	-2.96	-3.33	-2.96	-3.00	-3.27	-2.88
	(0.61)	(0.63)	(0.60)	(0.62)	(0.63)	(0.61)
Adj R-square	0.539	0.537	0.538	0.536	0.531	0.533
# obs.	2,355	2,355	2,355	2,355	2,355	2,355

Notes: Heteroskedasticity-consistent standard errors are in parentheses. Frequency index based on Trains database (UNCTAD).

Table A3. Bilateral trade among QUAD countries (million US$)

	Year					
	1996-1997		1998-1999		2000-2001	
CAN-EU	1,535	1.6%	1,671	1.7%	1,706	1.8%
EU to CAN	*980*	*64%*	*1,105*	*66%*	*1,148*	*67%*
CAN to EU	*554*	*36%*	*566*	*34%*	*558*	*33%*
CAN-JPN	1,359	1.4%	1,255	1.3%	1,448	1.5%
CAN to JPN	*1,329*	*98%*	*1,224*	*98%*	*1,417*	*98%*
JPN to CAN	*30*	*2%*	*31*	*2%*	*32*	*2%*
CAN-USA	9,575	10.0%	11,388	11.7%	12,265	12.8%
CAN to USA	*5,459*	*57%*	*6,771*	*59%*	*7,500*	*61%*
USA to CAN	*4,116*	*43%*	*4,617*	*41%*	*4,765*	*39%*
EU-JPN	3,837	4.0%	3,851	4.0%	4,004	4.2%
EU to JPN	*3,760*	*98%*	*3,779*	*98%*	*3,933*	*98%*
JPN to EU	*77*	*2%*	*72*	*2%*	*72*	*2%*
EU-USA	8,964	9.3%	9,882	10.2%	9,897	10.4%
EU to USA	*6,154*	*69%*	*6,951*	*70%*	*7,367*	*74%*
USA to EU	*2,810*	*31%*	*2,931*	*30%*	*2,530*	*26%*
USA-JPN	9,856	10.2%	8,997	9.3%	9,702	10.2%
USA to JPN	*9,479*	*96%*	*8,566*	*95%*	*9,248*	*95%*
JPN to USA	*377*	*4%*	*431*	*5%*	*454*	*5%*
EU-EU	61,052	63.5%	60,169	61.9%	56,491	59.1%
Total Trade	96,177	100.0%	97,212	100.0%	95,514	100.0%

Notes: EU countries are: Belgium-Luxembourg, Germany, Denmark, Spain, Finland, France, United Kingdom, Italy, Portugal, Sweden
Source: Comtrade database