Border Effect Estimates for France and Germany Combining International Trade and Intranational Transport Flows

Matthias Helble

Abstract: Since the seminal contribution of McCallum (1995) economists have tried to estimate the border effect for other countries than the United States and Canada, but have been confronted with a key data problem: data on regional trade flows are extremely rare. The different approaches put forward to overcome this lack of information have been shown to hinge crucially on certain distance measures. The main purpose of this paper is to develop a method that allows us determining border effects with a high degree of accuracy in the absence of intranational trade data. We show how to improve the estimation of border effects with the example of France and Germany using data on regional transportation flows. Our results indicate that France trades about eight times more and Germany about three times more with itself than with other EU countries, respectively, compared to the predictions of the gravity equation. JEL no. F15

Keywords: Border effect; gravity equation; transport infrastructure; eurozone trade effects

1 Introduction

In his seminal contribution McCallum (1995) studied trade flows between Canadian provinces and US states and found that the Canadian trade was heavily biased toward trade within its national borders. This so-called "border effect" between Canada and the United States was confirmed in several other studies (Helliwell 1996; Hillberry 1998; Anderson and Smith 1999). Since then researchers have been interested to know whether similar border effects exist for trade between other country pairs. However, they have

been confronted with a key data problem: data on regional trade flows is extremely rare.

Wei (1996) introduces an ingenious way to estimate border effects in the absence of detailed data on intranational trade flows. He uses the difference between the industrial production of a country and its exports to estimate trade flows within a country. His methodology allows to determine border effects for countries that do not record regional trade flows. However, Head and Mayer (2002) show that the estimation of the border effect with the methodology of Wei (1996) depends crucially on certain distance measures, called internal distance. Estimating internal distance differently changes the magnitude of the border effect substantially. As a consequence, for countries with the before-mentioned data limitation the precise influence of national borders on trade is still unknown.

The main purpose of this paper is to develop a methodology that allows us to gauge border effects for EU countries with higher precision. We show how to improve the estimation of border effects at the example of France and Germany. For both countries extensive data is available on trade flows between each region (Région or Bundesland) and the 14 member States of the European Union prior the enlargement (EU-14). In addition, transportation flows (by road, rail, inland navigation, and pipeline) between the regions within France and Germany are documented. Even though these transportation flows are not recorded in monetary units, but in weight, we demonstrate that this data can serve as an appropriate approximation for intranational trade flows. Combined with the first data source, namely the trade flows between regions and the 14 EU countries, we possess the necessary data to estimate the border effects for both countries.

The paper is organized as follows. In Section 2, we review the relevant trade literature on the border effect and point out the main drawbacks. Section 3 explains the methodology used and describes the different data sources that we have exploited for our research. Section 4 presents the estimation of the border effect in the case of France and Germany. Before concluding, Section 5 studies the evolution of the border effect in the case of Germany during the years 1997–2004.

2 The Border Effect Literature

Although the importance of national borders was known long before, it was only with the contribution of McCallum (1995) that the size of the border

as trade barrier was estimated empirically. McCallum (1995) analyzes trade flows between Canadian provinces as well as between Canadian provinces and US states. His study is based on the Statistic Canada data set that reports interprovincial trade flows as well as trade flows between each Canadian province and each state of the United States. He uses a simple gravity equation and includes a dummy variable that controls for intranational trade. For the year 1988 he estimates that a Canadian province traded on average about 20 times more with another Canadian province than with a US state which had the same economic weight and which was located at the same distance as the corresponding Canadian province.

In order to estimate empirically the border effect one needs to know the trade flows within a country, since the latter are compared to the trade flows leaving the country. The availability of data on intranational trade flows is, however, very limited. For example, intranational trade flows are not recorded in EU countries. This data limitation is disappointing for trade economists since research on border effects for other countries could yield important insights. The only possibility to overcome the data problem is to estimate intranational trade flows, but how?

It is Wei (1996) who provides an appealing answer to this question. His idea is the following: What is traded within a country must be equal to the difference between its total production and its total exports to foreign countries. In order to obtain an estimate of the total production, Wei (1996) takes the GDP and subtracts the services and the transport sector, which do not come under bilateral trade data. This methodology allows Wei (1996) to approximate the volume of intranational trade flows. In order to approximate the distance over which these goods are shipped, the author assumes that within a country the average distance is half of the distance from the economic center to the border. When a country has a land border with a neighbor, the author uses a quarter of the distance to the center of the nearest neighboring country. Finally, to calculate the distance between the economic centers of a country pair, the great-circle formula is used.

Using this approach to study the magnitude of the border effect for OECD countries during the years 1982–1994, Wei (1996) finds that OECD countries traded about 10 times more with themselves than with foreign countries as predicted by the gravity model. When using a dummy variable for common language the border effect drops to 2.6 times. The magnitude of the border effect estimated by Wei (1996) is therefore considerably smaller than the one calculated by McCallum (1995) and Helliwell (1996) for the Canada-US border. What is the reason for this large difference?

Helliwell (1997) uses the same data as Wei (1996), but separates in a more complete way the border effect and the common language effect. His result for the year 1990 indicates a border effect of 12.7 (exp (2.54)). Although this result was closer to the one found by McCallum (1995), economists realized that the methodology proposed by Wei (1996) hinged crucially on the measurement of internal distance. For example, an overestimation of internal distance with respect to international distance inflates the border effect.

It also became apparent that the methodology of Wei (1996) could be highly inconsistent for other reasons. Nitsch (2000) takes the example of Denmark and Germany to illustrate the problem of Wei's (1996) approach. Since Denmark has only a land border with Germany, the internal distance of Denmark is calculated taking 0.25 of the distance between Copenhagen and Bonn, which certainly overestimates the internal distance of Denmark. Another problem arises when the economic centers of two countries, which are very different in size, are close to each other. According to Wei's (1996) approach both countries have the same internal distance. This implies that for example France and Belgium have the identical internal distance.

In order to tackle these problems researchers have developed two new ways to measure internal distance. The first approach consists in taking measures of internal distance that are based on the geographic area of the country. The purpose of this approach is to approximate the distance between firms and consumers within the country's territory. It is Leamer (1997) in his survey on growth perspectives of Central and Eastern European Countries (CEEC) who introduced the first area-based measure.[1] Using this area-based measure of internal distance, Nitsch (2000) estimates that from the year 1979 to 1990 intranational trade in EU countries was about eleven times higher than international trade controlling for distance, economic size, common language, and adjacency. He also observes a gradual reduction in the border effect over the years. Head and Mayer (2000) also use an area-based measure for their estimation of market fragmentation in the European

---

[1] Leamer (1997) asks the question whether there is a relationship between per capita GDP and the distance of the country to the world's markets. In order to calculate the distances between countries, it is necessary to estimate how close a country is to itself. Leamer (1997) therefore assumes that countries are circular and that the average distance between two randomly chosen points within one country follows a simple formula. Having determined the internal distances of countries allows the author to estimate the relationship between per capita GDP and the closeness to world's markets. He find a strong relationship between the two dimensions and therefore predicts high growth rates for CEEC due to their closeness to markets in the European Union.

Union. Following Nitsch (2000) by approximating the geographic shape of a country by the shape of a disk, the authors assume that all production is concentrated in the center of the disk and that consumers are randomly distributed over the disk. Studying the trade flows in the European Union during the years 1984–1986 the authors report a border coefficient of 2.84, which corresponds to an approximately 17 times higher intranational trade compared to international trade.

The second approach to measure internal distance is based on actual data on the geographic distribution of economic activity within countries. Wolf (1997) asks the question whether a "border effect" can also be observed at the borders of one US state with other US states. To improve the approximation of distance between US states he uses the road distance between the largest cities. Using a similar econometric specification as McCallum (1995) he finds, most surprisingly, a "border effect", of 1.34, which means that a US state trades nearly four times more within itself than with other US states.[2]

Head and Mayer (2000) study the fragmentation of the internal market of the European Union for the years 1976–1995. In order to obtain an appropriate measure of international and internal distance the authors use the distance between regions and weigh it by the economic size of the regions (Head and Mayer 2000). Following this approach the scholars hope that the fact that economic activity is geographically dispersed is captured in a more accurate way. For the entire time period 1976–1995 the border effect seems to decrease slowly and halves from about 25 in 1976 to around 12 in 1995.

Starting with a simple gravity model, Head and Mayer (2002) deduce another measure of internal distance based on the economic geography of a country. They show analytically that compared to their approach the methodology chosen by Wei (1996) systematically overestimates internal distance and therefore translates into an inflated border effect. Re-estimating the "border effect" between US states the authors find a fall of about one third compared to the results of Wolf (1997). Doing the same exercise for the European Union they get a border effect of only 1.44 for the years 1993, 1994, and 1995. However, Head and Mayer (2002) still consider the reduced border effect as significant.

Finally, Chen (2004), investigating to what extent national borders matter in the European Union in the year 1996, takes a similar approach. She

---

[2] Given that US states have been constitutionally prevented from erecting trade barriers, this border effect is difficult to explain. The study by Wolf (2000) uses an alternative distance measure, but finds very similar results.

follows the EUROSTAT's (2004) division of the EU-15 into 206 regions. In order to estimate international distances, she calculates all bilateral distances between the main cities of both countries using the great circle formula. Then she weighs all distances by the GDP share of both regions in total. For internal distances she follows a similar approach. She calculates the great circle distances between the main cities for each pair of region and weighs the distance by the GDP share of both regions, giving more weight to economically relevant regions in the country. Finally, she constructs the average of these distances. Using this approach, she reports a border effect coefficient of 1.80 for seven EU countries (Finland, France, Germany, Italy, Portugal, Spain, and the United Kingdom) for the year 1996. For France and Germany individually, she finds a border effect of 1.96 and 0.94, respectively.

The different methods to approximate internal distance show that until today there has been little consensus among trade economists on how to measure correctly internal distance. This dissent is very troublesome, since the estimated magnitude of the border effect is very sensitive to the value of the assumed internal distance. Table 1 provides an overview of the border effects estimated for EU countries in the literature so far.

The countries covered by the empirical investigations span from nine (Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, and the United Kingdom) in Head and Mayer (2000) over ten (including Greece) in Wei (1996) and Nitsch (2000) to twelve (adding Spain and Portugal) in Head and Mayer (2002). Chen (2004) examines the trade flows between Finland, France, Germany, Italy, Portugal, Spain, and

Table 1: *Overview of Literature on Border Effects in the European Union*

Author(s)	Countries	Time period	Method used	Border effect	Sectoral analysis	Variables included
Wei (1996: 31)	EU-10	1982–1994	trad.	0.97–0.45	no	*adjac, lang, rem*
Nitsch (2000: 1101)	EU-10	1979–1990	trad.	2.51–1.99	no	*adjac, lang, rem*
Head and Mayer (2000: 26)	EU-9	1976–1995	new	3.04–2.41	yes	*lang*
Head and Mayer (2002: 21)	EU-12	1993–1995	new	1.44*	yes	*adjac, lang*
Chen (2004: 98)	EU-7	1996	new	1.80	yes	*adjac*

* Pooled Regression.

the United Kingdom. The last column shows the variables used in addition to the corresponding gravity equation (*adjac* stand for adjacency, *lang* for language, and *rem* for remoteness). Even though the studies cover different numbers of countries and different time periods, it is striking how much the estimated border effects are diverging. The main reason for this divergence resides in the fact that the estimation results depend crucially on the measurements used for internal distance. One might therefore conclude that a reliable method to estimate the border effect in absence of intranational trade data is still missing.

Not having any benchmark to assess the validity of the estimation results of border effects is very worrisome. Even though the measure of internal distance seems to be more and more sophisticated, we are unable to gauge how close or far the estimation results are from the value that would be obtained if intranational trade flow were available.

The contribution of Hillberry and Hummels (2003) illustrates how misleading the estimation of the border effect based on internal distance measures can be compared to the results using actual intranational trade flows. Using data for inner state shipments from the Commodity Flow Survey, the authors are able to verify the results of Wolf (2000). Since this survey reports detailed trade flows including the zip codes or origin and the zip code of destination, the authors do not need to estimate internal distances and are able to calculate distances more accurately. They find that Wolf's distances overstate actual distances. Controlling for wholesale shipment, they estimate a home bias with a magnitude of around one-third of Wolf's result.

Using internal distance measures to determine the magnitude of the border effect can be compared to a black box approach. It is known that different forces interact inside the box, but neither their strength nor direction can be measured directly. Intranational transport flows hold precisely this information. They provide valuable data on the intensity and geography of economic exchanges inside a country. Hereby, the black box is opened and the dynamics can be observed. As a consequence, all problems related to the estimation of internal distance can be avoided and we are able to come up with an accurate estimation of the border effect. It has to be noted that approximating regional trade flows with data on regional transportation flows is not only helpful to improve the estimations of the border effect; it also provides new opportunities for empirical investigations in the field of trade and new economic geography. The methodology presented in this paper might therefore find many useful applications.

If we find a considerable border effect for the two countries studied, how can it be explained? The empirical studies undertaken so far have had little success in finding causes for the border effect in the European Union. Border effects may be related to border related trade costs, such as tariffs, contracting and enforcement costs, different currencies, non-tariff barriers (NTB) to trade, different consumer preferences and languages. However, in the case of the European Union all formal trade barriers, such as tariffs and quotas were already removed in 1968. With the increasing common legislation contracting and enforcement costs should have lost their trade-impeding role. The introduction of a common currency in eleven out of fifteen member States in 1999 should make the use of different currencies in the European Union irrelevant for trade as well.[3]

Trade within the European Union should not suffer from NTB either. In 1986 the European Union initiated the Single Market Programme (SMP) in order to reduce all NTB. Since the end of the program in 1992 there have been two empirical studies on the impact of the SMP on intra-European trade. Fontagné et al. (1998) investigate whether the removal of NTB increased the inter- and intraindustry trade in the European Union. They observe that the trade volume did not increase substantially with the SMP, but that the composition of trade changed considerably. While the volume of intraindustry trade was reduced, the share of interindustry trade increased. Head and Mayer (2000) study the evolution of the border effect over the time period from 1976 to 1995 and find a significant reduction of the border effect. However, their findings indicate that the SMP had no influence on the decline.

Chen (2004) focuses on technical barriers to trade, one element of NTB, in order to explain border effects in the European Union. She finds that technical barriers to trade, indeed, increase border effects. However, for our estimations we do not possess the necessary data to construct a measure of NTB. Finally, there has been some empirical evidence that consumer preferences are biased toward domestic products (Head and Mayer 2000) in the European Union. Head and Mayer (2000) find a higher border effect for goods of final consumption than for other commodities. When we present our results in Section 4, we explore further, possible reasons for the border effect in France and Germany.

---

[3] However, for our estimation we will only test whether for the year 2002 the euro was already trade promoting or not.

3 Methodology and Data Sources

3.1 The Traditional Gravity Approach

McCallum (1995) used a traditional gravity equation, including country-specific variables (like GDP) as well as bilateral variables (like adjacency), plus a dummy variable for intra-Canadian trade to estimate the border effect. However, as Anderson and van Wincoop (2003) point out this traditional specification of the gravity equation neglects the different price indices between countries. The authors show that since the difference in price indices can be related to trade barriers, the estimation results are biased in equilibrium. In order to incorporate their critique, we follow their suggestion and estimate our gravity equation using fixed effects for each exporting and importing unit. This specification controls for all differences that are specific to the trading unit. All country-specific differences are therefore omitted and only bilateral variables are included.[4]

The first gravity equation we estimate has the following form:

$$\ln t_{ij} = \alpha_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \gamma_i ex_i + \delta_j im_j + \mu_{ij}. \qquad (1)$$

In this equation t_{ij} denotes the exports from country/region i to country/region j. The variable $dist_{ij}$ measures the distance between the two units. The dummy variable $border_{ij}$ is unity if the trade flow takes place between two regions of the same country and zero if not. The fixed effects for exporting and importing countries/regions are denoted ex_i and im_j, respectively. Finally, μ_{ij} denotes a Gaussian white noise error term.

In order to know in which way trade barriers contribute to the border effect, we try to control for the trade costs that are not related to distance but may arise when crossing the border. For this purpose we use an augmented gravity equation of the following form:

$$\ln t_{ij} = \alpha_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \beta_3 adjac_{ij} + \beta_4 cur_{ij}$$
$$+ \beta_5 day_{ij} + \gamma_i ex_i + \delta_j im_j + \mu_{ij}. \qquad (2)$$

The variables β_3 to β_5 control for the following bilateral relationships:

- Common border: The dummy variable *adjac* becomes unity if i and j share a land border.

---

[4] This fixed-effects specification also controls for the remoteness of countries. Deardorff (1998) discovered that not only the absolute distance between the two countries matters for bilateral trade, but also their geographic positions relative to all other countries.

- Common currency: The dummy variable *cur* is unity if i and j are members of the European Monetary Union (EMU).

The empirical studies on the border effect in EU countries (see above) have included one or both of the two additional variables and found that the border effect remains remarkably stable.[5]

   We introduce a new variable that potentially helps to explain the border effect. This variable, called *day*, tries to capture the quality of the business infrastructure between regions or regions and other EU countries. With business infrastructure we mean the opportunities for business people to travel to other destinations. A high-quality infrastructure between regions or countries facilitates traveling and as a consequence, firms' representatives might meet more easily and frequently, which at the end might stimulate trade.

   In order to measure the quality of infrastructure, we study which destinations in other regions or countries can be reached in a one-day round trip. In other words, is it possible to travel to the other country or region in the morning and come back the same day? To construct this dummy variable we check whether it is possible to travel from one center by road, rail or airplane to the corresponding center and return the same day. It is obvious that this measure is somewhat arbitrary and reflects what we thought to be reasonable, as no data is available on the preferences of business people concerning the time spent on business trips. As a rule of thumb it is assumed that a one-way trip by car or train should not take more than four hours and that the flight time should not exceed two hours. Finally, it has to be noted that in order to take care of the possibility of heteroskedasticity, the White's covariance estimator is applied for all estimations. We test the robustness of our results using different specifications of the trade variable, as explained below.

3.2 Bringing Together International Trade and Intranational Transportation Flows

One of the main contributions of this study is to introduce several methodologies how to combine international trade flows with intranational transportation flows. The absence of data on intranational trade flows prevents

---

[5] We have tested other bilateral variables like language or cultural linkages. However, they were all strongly correlated to the dummy variable "region" and therefore without additional explanatory power.

the empirical analysis of important questions in the field of trade or economic geography. This paper shows how we can overcome the data problem with the example of the border effect.

The purpose of our study is to measure the border effects in the case of France and Germany with respect to other EU countries. The first set of data needed is the trade flows of French "Régions" and German "Bundesländer" with the other EU-14 countries. In France as well as in Germany data on international trade flows are recorded on the regional level. This means each of the 22 "Régions" and each of the 16 "Bundesländer" documents all ex- and import flows from and toward all EU countries. For example, we know what Alsace trades with Italy, or Bavaria with Sweden. The data include the FOB value in currency units (in thousand euros) and in weight (in tons). The data exists at the aggregate, but also at sectoral level (various digit levels) allowing for a detailed analysis. In the case of France it is the "Direction générale des douanes et des droits indirects" that collects the data. In Germany the statistical office of each "Bundesland" records the data and the National Statistical Office of Germany, called "Statistisches Bundesamt", gathers the data. In both cases the data is not freely available.

As stated above, data on intranational trade flow do not exist in the case of the EU countries. However, for France and Germany detailed data (including the mode of transportation) is recorded on intranational commodity flows. In both countries interregional commodity flows, including the origin and destination of the flows, are estimated by drawing from stratified random samples of actual shipment. In the case of France these commodity flows are documented by the "Ministère de l'Equipement, des Transports, du Logement, du Tourisme et de la Mer, Direction des Affaires économiques et internationales".[6] The data is recorded according to the "Nomenclature Statistique des Transports" (NST) and available at the 2-digit level for 10 sectors. In the case of Germany, the commodity flow statistic is recorded by two national offices. The "Kraftfahrt-Bundesamt" in Flensburg reports commodity flows which are transported by road. The "Statistisches Bundesamt" in Wiesbaden collects the data on commodity transport by rail, waterway, pipeline and aviation. In contrast to France, in Germany no reliable sectoral data on transportation are available according to the information of the "Kraftfahrt-Bundesamt".

---

[6] Combes et al. (2005) use this rich data to measure the effect of business and social networks on trade within France.

Both data sets provide valuable information about the economic exchange between regions and countries. However, the data sets cannot be combined directly for two main reasons. First, whereas customs data reports the final destination of the shipment, national transport data does report a destination, but which is not necessarily the final one. Second, data on interregional commodity flows are only recorded in weight units and not in currency units. How can we tackle both problems?

The first problem is not easy to solve. The fact the national transport data does not report the final destination can have severe implications. To illustrate the possible effects, let us assume that a good is produced in Stuttgart (Germany, Baden-Württemberg) and then transported to the harbor of Bremerhaven (Germany, Bremen) in order to shipped to Ireland. Whereas customs will record the value and weight of the shipment from Baden-Württemberg to Ireland, the national transport authorities will report simultaneously a transport intranational transport flow from Baden-Württemberg to Bremen.

In order to know what stays in Bremen and what leaves the country, detailed data on production and trade is required. However, we do not possess this type of data on the level of regions, neither on the country level. The only way to control for this possible source of error is to omit the intranational trade flows that could be affected by this error. Therefore we test the robustness of the border effect using only those intranational trade flows that are most probably free of this potential error. All intranational trade flows that are directed towards a region within France or Germany without a border to another country or major harbor most probably stay in that region. For example, there is no obvious reason to assume that a considerable fraction of commodities transported to the region Auvergne (landlocked and in the center of France) should leave the region again to be exported to European countries.

An obvious solution for the second problem would be to use all trade flows in tons instead of euros. However, this method seems to be a clumsy way to remedy the lack of information we face. Due to the different economic structures of the regional units in France and in Germany, the average value of one ton exported to EU member countries can differ substantially between regions. This certainly comes at no surprise when we compare, e.g., the exports of the highly industrialized Ile-de-France (Paris region) with the exports of the agriculture prone Languedoc-Roussilon.

In addition to this drawback, using weight units also means that we ignore the information we have on the monetary value of trade between

regions and EU countries. Exploiting this information, we might obtain a more appropriate approximation of the monetary value of the intranational trade flows.

The first possibility to approximate the value of intranational trade flows is highly simple. We assume that the average unit value of an export flow from one subnational unit toward the 14 EU member countries corresponds to the unit value of an export flow from this unit to another subnational unit. For example, the average unit value of exports from the region Normandy to the rest of the European Union is about 1,700 euros. By assuming that this unit value corresponds to the unit value of goods traded within France, we can estimate the value of intranational trade flows. One might argue that this is a strong assumption; however, we think that it performs better than models that are based on the measurement of internal distance.[7]

Assuming identical unit values of EU and intranational trade flows would mean that the content of trade between regions within in a country is the same as the content of trade between regions and EU countries. From a theoretical point of view, this assumption might be well justified; for example, if we assumed identical factor endowments for all countries or regions within the EU-14 and only intraindustry trade.

However, studying closely the data on trade flows between subnational units and EU-14 countries, we make an interesting observation that contradicts this possibility: the unit value increases considerably the farther the trading partner is located. For example, a ton exported from Baden-Württemberg to France is worth only a third compared to a ton exported to Ireland or Greece. A quick glance at the data further reveals that the economic weight of the importing country apparently does not matter, only distance does. This observation translates into the hypothesis that the unit value of trade is determined by the distance between trading partners. Or expressed differently, the farther away the trading partner is located, the more valuable goods are traded.

The conjecture that more valuable goods are traded over longer distances is not new in the trade literature. Alchian and Allen (1964) describe how trade costs lead to different prices at home and abroad. The implied demand shift in foreign toward more expensive goods became known as the effect of "shipping the good apples out." Hillberry and Hummels (2002) develop

---

[7] Instead of taking the simple average of all unit values, one could also calculate an average weighted by the magnitude of trade flows. For example, since France is particularly important for the Bundesland Saarland, the unit value to France is attributed special weight.

a model that emphasizes the role of intermediate goods in production location in order to explain home bias in consumption. One of the model predictions is that final goods have a higher unit value than intermediate goods and are also more likely to be exported. This model feature translates into the result that in continuous space the unit values should increase in distance shipped. Using detailed US data on subnational shipments the authors find corresponding empirical evidence.

Hummels and Skiba (2004) try to prove empirically that trade costs are mainly not of iceberg, but of per unit type. Analyzing detailed import data of six countries, their study also provides empirical support for the effect of "shipping the good apples out." Even though their results are at the disaggregate level, the authors allude to a possible effect on the aggregate level. Finally, Helble and Okubo (2007) also report a positive relationship between unit values and distance when studying trade in manufactured goods within the European Union.

All of these studies focus on the effect of trade costs on a disaggregate level. However, the contributions of Hummels and Skiba (2004) as well as Helble and Okubo (2007) indirectly show that the same relationship holds at the aggregate level. As trade costs increase more and more high valued goods enter the export basket, which raises the unit values also at the aggregate level. In order to test this hypothesis empirically for our sample, we specify the following functional form:

$$\ln cont_{ij} = \alpha + \beta \ln dist_{ij} + \mu_{ij}. \tag{3}$$

In this equation $cont_{ij}$ denotes the unit value exported from region i to country j; $dist_{ij}$ measures the weighted distance between region i and country j (as explained below). The parameters α and β are to be estimated, and μ_{ij} denotes a Gaussian white noise error term. If we take the example of Bavaria, we have 14 observations of export flows leaving Bavaria and going to 14 EU countries. Running a simple OLS regression for the equation specified above we obtain the result presented in Table 2.

As Table 2 shows, there exists a close relationship between the unit value of trade and distance. The coefficient of $dist_{ij}$ is highly significant and its magnitude indicates that the content of trade changes considerably with distance. With reference to the gravity equation described above we find evidence that the forces of attraction literally become less important. Apparently, the further the trading partner is located the higher is the average value of one ton traded. Expressed differently, for short distances an average ton traded mainly contains low-value goods. The larger the distance

Table 2: *Content of Trade Gravity Model, the Case of Bavaria*

Variable	Coefficient	
Constant	0.255	(1.453)
Distance	***1.180	(0.210)
Number of observation	14	
Adjusted R^2	0.670	

Note: *** denotes significance at the 1 percent level; robust standard errors are in parentheses.

gets, the more high-value goods enter in the average ton. Distance does not only influence the trade volume, as predicted by the gravity equation, but distance also brings about a change in the composition of trade. We therefore call our model "content of trade gravity model".

One might expect that the distance coefficient is not identical for all regions in both countries. Estimating (3) for all regions in France and Germany separately yields the results presented in Table 3a and 3b, respectively.[8] For nearly all regions the same strong positive relationship between the unit value and distance is observed.

It might be interesting to observe that there also seems to be a relationship between the economic performance of a region and the steepness of the slope coefficient. Economically strong regions, such as Paris-Isle-of-France or Baden-Württemberg, display higher slope coefficients than regions with a low economic performance. However, this observation is not key to our problem, but might be worth future research efforts.

How does the observation of a positive relationship between unit values and distance help estimate the border effect? Knowing how the content of trade changes over distance allows us to estimate the nominal value of our intranational flows. We simply have to assume that the relationship between the composition of trade and distance also holds for intranational trade flows. This would imply for example that an average ton exported from

---

[8] Since we are mainly interested in the distance coefficient, only the distance coefficients are reported. It has to be noted that the statistical fit is not always as good as for the case of Bavaria. The reason for low values of Adjusted R-squared lies sometimes in special trade flows between one region and one EU country. For example, in the case of Bremen or Hamburg the value of an average ton leaving for France is exceptionally high. Evidently, the influence of the aviation industry on trade flows between both regions and France blurs the picture.

Table 3a: *Content of Trade Gravity Equation, French Regions*

Variable	Alsace	Aquitaine	Auvergne	Brittany	Burgundy	Center	Champ.-Ard.
Dist.	***1.049	**1.102	0.326	0.203	***0.597	***0.843	***0.725
	(0.221)	(0.469)	(0.285)	(0.268)	(0.111)	(0.239)	(0.148)
Adj. R^2	0.587	0.315	0.088	0.076	0.390	0.561	0.546

Variable	Franche-C.	Lang.-Rouss.	Limousin	Lorraine	Lower Norm.	Midi-Pyrén.	North-Calais
Dist.	***0.877	**0.487	***1.794	***0.904	*0.776	**1.662	**0.322
	(0.141)	(0.168)	(0.489)	(0.071)	(0.386)	(0.605)	(0.132)
Adj. R^2	0.535	0.394	0.638	0.866	0.230	0.303	0.305

Variable	Paris-Isle-Fr.	Pays de la L.	Picardy	Poitou-Char.	Prov.-Alps	Rhone-Alps	Upper Norm.
Dist.	0.201	**0.479	*0.841	**0.918	0.340	***1.032	**0.373
	(0.453)	(0.168)	(0.461)	(0.371)	(0.276)	(0.311)	(0.165)
Adj. R^2	0.020	0.440	0.206	0.245	0.070	0.609	0.186

Note: Parameters are estimated by fixed-effects regressions; ***, **, * denote significance at 1, 5, and 10 percent level, respectively; robust standard errors in parentheses.

Table 3b: *Content of Trade Gravity Equation, German Regions*

Var.	Bad.-Würt.	Bavaria	Berlin	Brandenb.	Bremen	Hamburg	Hesse	Meck.-Vo.
Dist.	***1.076	***1.180	***0.669	**0.729	**0.585	**0.648	***0.708	**−0.556
	(0.142)	(0.210)	(0.202)	(0.253)	(0.245)	(0.268)	(0.147)	(0.236)
Adj. R^2	0.751	0.670	0.515	0.308	0.249	0.180	0.542	0.220

Var.	Lower Sax.	N. Rh. We.	Rhine.-Pal.	Saarland	Saxony	Sax.-Anh.	Schl.-Hols.	Thuringa
Dist	***0.479	***0.750	***0.770	***0.817	***0.913	0.398	*0.596	**0.622
	(0.143)	(0.154)	(0.176)	(0.108)	(0.164)	(0.238)	(0.281)	(0.282)
Adj. R^2	0.503	0.720	0.607	0.659	0.671	0.152	0.265	0.250

Note: Parameters are estimated by fixed-effects regressions; ***, **, * denote significance at 1, 5, and 10 percent level, respectively; robust standard errors in parentheses.

Bavaria to Luxembourg has the same value than one average ton "exported" to Sachsen-Anhalt, which is located at about the equal distance.

The close relationship between content of trade and distance allows us to estimate the value of intranational trade flows. We simply use the coefficients (intercept and distance) of our content of trade gravity model (3), to add to each intranational trade flow recorded in weights a monetary value. Going through this exercise for each region enables us to approximate the trade in euros of all intranational trade flows. Putting together the trade flows obtained by this approach with the international trade flows, yields the necessary data to re-estimate the border effect.

3.3 Data Sources

For our gravity equation we need information about the distance between trading partners. Since the great-circle formula neglects the real geography of space, which becomes especially problematic for shorter distances, we use a weighted distance measure. This measure takes into account the economic geography of a country/region by calculating the bilateral distances between the biggest cities in the trade pair and weighting them by the population share. Similar to Head and Mayer (2002) the following formula is used:

$$d_{ij} = \sum_{k \in i} (pop_k/pop_i) \sum_{l \in j} (pop_l/pop_j) d_{kl} \,,$$

where pop_k stand for the population of the agglomeration k belonging to the exporting country i; and pop_l captures the population of city l of the importer j. In our sample, the distance is constructed taking into account the three biggest cities of each region.

Since we estimate the border effect using a fixed-effects gravity equation, we omit all country/region specific variables, but include the following bilateral variables: adjacency, common language, common currency, and business infrastructure. To construct the first three variables we exploit the databases of INSEE, "Statistisches Bundesamt", as well as of CIA's World Factbook (see Appendix). The data for two other bilateral variables is generated using various other sources. A more precise description of how the variables are constructed will be found at the corresponding place below.

Using the above-mentioned sources, we construct nine samples. In the following, we provide a short description of the two main samples used. The other seven samples are constructed in a similar way and further details are provided in the respective section. The first sample covers the aggregate trade between 21 French "Régions" (Table 3a) and 14 EU member countries in the year 2002. Thus, we have $21 \times 20 = 420$ observations for interregional trade, plus $21 \times 14 \times 2 = 588$ observations for "Régions"-EU trade flows, plus $14 \times 13 = 182$ observations for EU-EU trade flows (from EUROSTAT), which sums up to 1,190 observations.

The second sample consists of the aggregate trade flows between 16 "Bundesländer" (Table 3b) and 14 EU member countries in the year 2002 and comprises 870 observations. There are $16 \times 15 = 240$ observations for commodity flows between German "Bundesländer", plus $16 \times 14 \times 2 = 448$ observations for "Bundesländer"-EU-14 trade flows, plus again $14 \times 13 = 182$ observations of EU-EU trade (from EUROSTAT) flows. In 5 of the possible

870 trade relations, no trade was recorded in the year 2002. In order to
have a more precise estimation these zero observations are included in our
sample. In order to include these observations in our estimation, we follow
Eichengreen and Irwin (1993, 1998) and express the dependent variable as
ln ($t_{ij} + 1$) and run a Tobit estimation. The next section reports the results
of the various estimations made for the case of France and Germany.

4 Estimation Results

4.1 The Case of France

Applying the methodology described in Section 3, we obtain the results
summarized in Table 4 for France. Equation (1F) reports the border effect
when trade flows in weight units (tons) are considered. The value of the vari-
able "regions" states that French regions trade about 15 times (exp (2.730))
more with each other than predicted by the gravity equation.

In (2F)–(8F) the variable trade is now expressed in euros. As described
before, interregional commodity flows are only recorded in weight units.
In order to make a conversion in euros, we assume that one weight-value
of exports to EU-14 corresponds to a weight-unit of interregional trade

Table 4: *The Border Effect in the Case of France*

				Equation				
Variable	(1F)	(2F)	(3F)	(4F)	(5F)	(6F)	(7F)	(8F)
Constant	***23.064	***27.791	***26.394	***23.437	***25.111	***24.006	***21.384	***−0.938
	(0.371)	(0.362)	(0.426)	(0.591)	(0.622)	(0.398)	(0.565)	(0.083)
Dist	***−1.917	***−1.494	***−1.138	***−1.061	***−1.006	***−0.672	***−1.109	***−0.938
	(0.053)	(0.051)	(0.064)	(0.073)	(0.095)	(0.094)	(0.065)	(0.083)
Border	***2.730	***2.627	***2.167	***2.217	***4.002	***2.085	***2.119	***1.866
	(0.085)	(0.071)	(0.116)	(0.129)	(0.715)	(0.126)	(0.124)	(0.140)
Dist×Border	—	—	—	—	***−0.294	—	—	—
					(0.113)			
Cur	—	—	—	—	—	***0.339	***0.391	***0.369
						(0.083)	(0.080)	(0.085)
Adjac	—	—	—	—	—	—	***0.844	—
							(0.098)	
Day	—	—	—	—	—	—	—	***0.331
								(0.077)
No. of obs.	1190	1190	1190	994	1190	1190	1190	1190
Estimation	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Adj. R^2	0.897	0.896	0.841	0.843	0.842	0.843	0.852	0.846

Note: Parameters are estimated by fixed-effects regressions; ***, **, * denote significance at 1, 5, and 10 percent
level, respectively; robust standard errors in parentheses.

flows. Using these trade flows the border effect remains remarkably stable. Equation (2F) indicates that trade between French regions is about 14 times (exp (2.627)) larger than trade between a French region and a EU-14 country when adjusted for economic size and distance.

In (3F) we use the trade flows that have been obtained applying the conversion of the content of trade gravity model. The observed decrease in the border effect corresponds to our expectation since the different conversion brings down the values for intranational trade flows and hence leads to a smaller border effect. The mechanism behind lower nominal intranational trade flows is the following: Before, it has been simply assumed that the unit value exported to the EU-14 equals the unit value traded within a country. If our hypothesis of the change in the content of trade is correct, the conversion method applied for the estimation (2F) systematically overstates the nominal value of intranational trade flows. The conversion used in (3F) leads to lower nominal values for intranational trade and therefore results in a smaller border effect.

Equation (4F) estimates the border effect leaving aside all intranational transportation flows that might be overestimated because the goods are shipped further to other EU countries. For example, intranational transportation flows to the region Haute-Normandie might be overestimated since goods are transported to Haute-Normandie and then shipped to other destinations. In (4F) we leave out all those "dubious" intranational transportation flows and re-estimate the border effect using the remaining 994 observations. Applying the content of trade conversion we obtain a border effect of the magnitude 2.217 and therefore nearly identical to the border effect in (3F).

In (5F) we check whether distance plays a more prominent role for interregional trade than for trade between French regions and EU countries. The interaction dummy for distance and regional trade is negative and highly statistically significant indicating that distance appears to be more important for intranational trade compared to international trade.[9]

Equations (6F)–(8F) estimate the gravity equation with additional variables in order to identify possible reasons for the border effect. In (6F) the dummy variable for common currency is added. The estimation further indicates that the French regions do trade more with EU countries that

---

[9] When using the same interaction variable for trade flows in tons, we obtain a distance coefficient for intranational trade of 1.786, which is very similar to the one found in the study of Combes et al. (2005) who also use tonnage flows and report a coefficient of 1.76 for the year 1993.

are member of the EMU than with others.[10] It is interesting to observe
that when these dummy variables are included the border effect decreases
slightly to 2.085. A recent study of De Sousa and Lochard (2005) comes
to a similar conclusion that the border effect for countries within a cur-
rency union is indeed lower. In (7F) the adjacency dummy is added and, as
commonly observed in gravity equations, it has a positive sign. However,
the border effect does not further decrease when including this variable.
Finally, including the *day* variable in our gravity equation yields an interest-
ing result in (8F). The coefficient of the variable is highly significant and of
considerable magnitude. An excellent transportation infrastructure seems
to enhance trade by about 34 percent (exp (0.331)). It is also important to
notice that controlling for the business infrastructure reduces the border
effect to a larger extent than sharing the same legal tender; the border effect
now falls to 1.866.

In summary, our estimation results suggest that the French economy is
still very much inward biased and not very well integrated into the European
market. The transportation infrastructure, which seems to follow more
national than European concerns, helps explain part of the border effect.

4.2 The Case of Germany

The second sample comprises 870 observations and consists of the aggregate
trade flows between 16 "Bundesländer" and 14 EU member countries.
Applying the methodology described above we obtain the results presented
in Table 5.

In (1G) we bluntly use the trade flows denominated in tons in order to
estimate the border effect. Compared to France the border effect is surpris-
ingly low. However, the distance coefficient is similar to the one observed
for France and substantially higher than in the other equations estimated.

---

[10] Out of the 14 possible trading partners, Denmark, Sweden and the United Kingdom
have not adopted the euro. A fast growing number of recent empirical work—including
Baldwin (2006), Baldwin and Di Nino (2006), Baldwin et al. (2005), Baldwin and Taglioni
(2004), Barr et al. (2003), Berger and Nitsch (2005), Bun and Klaassen (2002, 2004), De
Nardis and Vicarelli (2003, 2004), De Souza (2002), Flam and Nordstrom (2003), Gomes
et al. (2006), and Micco et al. (2003)—investigate the impact of the euro on EU trade
flows. Most of these studies report a positive but small trade effect, typically in the range
of 5 to 20 percent. Our results corroborate these findings, even though one needs to be
careful in making such comparisons since our samples only cover the year 2002 neglecting
dynamic effects.

Table 5: *The Border Effect in the Case of Germany*

Variable				Equation				
	(1G)	(2G)	(3G)	(4G)	(5G)	(6G)	(7G)	(8G)
Constant	***27.333	***33.028	***31.130	***28.585	***26.158	***32.734	***28.260	***33.218
	(0.663)	(0.928)	(0.904)	(0.960)	(0.929)	(1.026)	(1.040)	(1.162)
Dist	***−2.332	***−2.025	***−1.722	***−1.708	***−1.215	***−1.719	***−1.532	***−1.776
	(0.095)	(0.133)	(0.130)	(0.134)	(0.175)	(0.129)	(0.158)	(0.144)
Border	***1.291	***1.213	***1.006	***0.917	***8.013	***1.000	***1.016	***1.038
	(0.162)	(0.230)	(0.224)	(0.244)	(1.581)	(0.223)	(0.223)	(0.230)
Dist×Border	—	—	—	—	***−1.176	—	—	—
					(0.261)			
Cur	—	—	—	—	—	0.272	0.183	0.279
						(0.494)	(0.495)	(0.494)
Adjac.	—	—	—	—	—	—	**0.439	—
							(0.219)	
Day	—	—	—	—	—	—	—	−0.127
								(0.153)
No. of obs.	870	870	870	762	870	870	870	870
Estimation	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit
Pseudo R^2	0.338	0.208	0.209	0.231	0.214	0.209	0.210	0.209

Note: Parameters are estimated by fixed-effects regressions; ***, **, * denote significance at 1, 5, and 10 percent level, respectively; robust standard errors in parentheses.

This result indicates that distance plays a particular trade preventing role when studying trade flows denominated in tons.[11]

Equation (2G) reports the border effect when the simple conversion using the average unit value is applied. In (3G) we use the content of trade conversion of intranational transportation flows into intranational trade flows. As expected, the border effect drops to 1.006. Trade between German "Bundesländer" is about 2.7 times (exp (1.006)) higher than with other EU countries when controlled for economic size and distance. Although German trade is biased significantly, the border effect is less than half of the one observed for France.

Equation (4G) leaves out again all trade flows that are potentially over-estimated since they might include flows that leave Germany. Taking the remaining 762 observations and estimating the border effect again, the border effect becomes 0.917, which shows the robustness of our results. In (5G), we interact the region dummy with distance in order to know whether distance plays a more important role for trade between "Bundesländer" than for trade between "Bundesländer" and the 14 EU countries. Like in the case

---

[11] This is also a hint to the evidence that the content of trade changes considerably with distance.

of France, distance seems to play a considerably more important role for intranational trade than for international trade.

Equations (6G)–(8G) try again to examine closer the reasons for the border effect. In contrast to France, the dummy variable for common currency is not statistically significant and therefore does not reduce the border effect. When adding adjacency in equation (7G), the border effect does not change either. Finally, (7G) presents the results, when the dummy variable *day* is included in the estimation. The dummy variable *day* is constructed in the same way as in the case of France, but in contrast to France, the coefficient is not statistically significant. The much more decentralized organization of the German State might explain this difference.

We can conclude that controlling for various influences, German "Bundesländer" trade around three times more with themselves as predicted by the gravity equation. Even when including several dummy variables, the border effect stays stable at the value of 1. Compared to France, they seemed to be much better integrated in the European market. The magnitude of the border effect for both countries is similar to the findings of Chen (2004), who estimates a border effect for France of 1.96 and for Germany of 0.94 for the year 1996.[12] However, the period from 1996 to 2002 was marked by further integration of the internal market of the European Union. The most visible step toward a unified market has certainly been the introduction of the euro as official currency in 1999. The results of Chen (2004) therefore seem to underestimate the magnitude of the border effect in 1996. In order to be able to give a more affirmative answer to this doubt, we study in the following section the evolution of the border effect for Germany for the time period 1997–2004.

4.3 Evolution of the Border Effect in the Case of Germany

Our approach to estimate the border effect by using intranational commodity flows also allows us to analyze its evolution. Learning more about the behavior of the border effect over time might yield important insights concerning the progress of integration of an economy into a common market,

---

[12] Nitsch (2002) uses a unique data set of trade flows between West German "Bundesländer" and East Germany for the years 1992–1994 and estimates a border effect toward 11 Western European countries of 0.86. The problem of his study resides in the fact that the data only covers a small fraction of intra-German shipments and that the shipments in the three years under consideration have been distorted due to the ongoing process of the German reunification.

such as the European Union. A falling border effect would indicate that the country becomes less focused on itself and more willing to substitute intranational trade relations with international trade relations. Previous studies (see Section 2) indeed find a declining border effect.[13]

In this section we study the evolution of the border effect in the case of Germany.[14] The time period studied covers the years 1997–2004. We choose this time period for two reasons: First, other studies on the border effect in the European Union (Head and Mayer 2000; Nitsch 2000) stop their analysis on the evolution of the border effect in the year 1995 and 1990, respectively. Our work therefore intents to provide insights on the most recent development of the border effect. Second, this period is marked by a further economic, financial, legal and political integration of the European Union. The introduction of the euro as legal tender in eleven EU countries was probably the strongest symbol for this process.

We construct seven additional samples for the years 1997, 1998, 1999, 2000, 2001, 2003, and 2004. It has to be noted that for the years 1997 and 1998 Belgium and Luxembourg documented their trade relations together. Since it therefore becomes impossible to disentangle the trade flows between the two countries, we choose Belgium as origin and destination of all trade flows during the two years.[15]

We estimate for each year the basic gravity equation with a dummy for intranational trade and fixed effects as defined in (1). In order to find a nominal correspondence to the commodity flows denominated in tons, we use the simplifying assumption that the value of an average ton exported from one Bundesland to an EU-14 country is equal to the value of an average ton shipped to another Bundesland.[16] Since for each year some few

---

[13] The lowest number in Table 1 does not necessarily denote the last year or pair of years of observation. Some studies (Head and Mayer 2000) observe the lowest border effect some years before the end of the period under observation.

[14] The reason for choosing only Germany and not France is the fact that, as mentioned before, data on intranational commodity flows are not freely available. The same is true for data that report on international trade flows at the regional level. Due to financial constraints we were forced to limit our analysis to the case of Germany.

[15] Another possibility to sidestep the data problem is to neglect all imports and exports of both countries for all eight years. Running the same econometric analysis as below yields the nearly the identical pattern, except that the border effect is on average 0.242 lower than for the other sample.

[16] This method might lead to a slightly inflated border effect as discussed in Section 4. However, since we are more interested in the evolution of the border effect than in its exact magnitude, we consider the simple conversion as sufficient for this purpose.

Table 6: *Evolution of the Border Effect in the Case of Germany*

| Variable	1997	1998	1999	2000	2001	2002	2003	2004
Constant	***34.223	***34.102	***32.257	***32.608	***31.528	***33.028	***33.340	***33.028
	(0.796)	(0.816)	(0.603)	(0.616)	(0.597)	(0.928)	(0.811)	(0.971)
Dist	***−1.962	***−1.941	***−1.949	***−1.979	***−1.828	***−2.025	***−2.076	***−2.005
	(0.090)	(0.092)	(0.087)	(0.089)	(0.086)	(0.133)	(0.117)	(0.138)
Border	***1.567	***1.418	***1.577	***1.479	***1.710	***1.213	***1.202	***1.220
	(0.152)	(0.156)	(0.147)	(0.151)	(0.146)	(0.230)	(0.199)	(0.245)
No. of obs.	812	812	870	870	870	870	870	870
Estimation	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit
Pseudo R^2	0.368	0.358	0.367	0.356	0.358	0.208	0.251	0.187

Note: Parameters are estimated by fixed-effects regressions; ***, **, * denote significance at 1, 5, and 10 percent level, respectively; robust standard errors in parentheses.

observations are again zero (maximum 5), a Tobit estimation is applied again. The estimation results are presented in Table 6.

For all years under observation, we find a strong and significant border effect with a declining trend. The only outlier is the year 2001. It might be that the terrorist attacks of September 11 which brought the growth of world trade nearly to a standstill also affected intra-European trade flows. As a consequence, Germany might have traded less with EU partners and more with itself.

Figure 1 depicts the evolution of the border effect graphically. As the economic integration of the EU-15 was gaining ground during this period, Germany was trading less with itself and more with its European part-ner countries. This result is in line with other major studies on the bor-der effect in the European Union. Head and Mayer (2000) as well as Nitsch (2000) find for the 1980s and beginning 1990s a considerable re-duction in the border effect. It is worth noticing that for the last three years the border effect was rather stable. It will be up to future stud-ies to answer the question whether the European integration has come to a standstill or has rather taken a break before coming even closer together.

Another interesting question to ask is whether the evolution of the Ger-man border effect has been related to the introduction of the euro in several member countries of the European Union. We would expect that the in-troduction of the common currency had a positive effect on the economic integration between member countries of the EMU. Increased trade between eurozone countries should hence translate into a fall of the German border effect. In contrast, the border effect between Germany and non-eurozone

Figure 1: *Evolution of the Border Effect in the Case of Germany, 1997–2004*
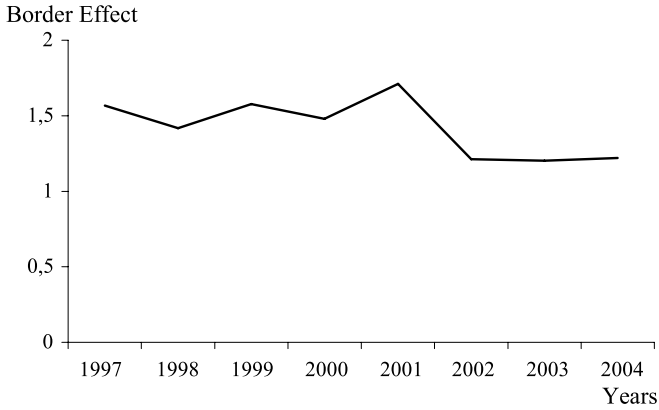
countries is supposed to remain stable or to even increase as trade might become redirected toward eurozone countries.

In order to analyze the impact of the euro introduction on the German border effect empirically, we split our sample into two and calculate the border effect for the two respective country groups: eurozone countries (Austria, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain)[17] and non-eurozone countries (Denmark, Sweden, and the United Kingdom). For both samples, we run separate regressions for all eight years following the same assumptions as above. The estimation results are summarized graphically in Figure 2.

First, it is interesting to observe that the border effect for the two country groups was considerably different over the entire time period. As one might have expected, Germany seems to be better integrated into the group of eurozone countries compared to the group of non-eurozone countries. The difference in the border effect might find its explanation in the fact that the euro countries include all founding members of the Common European market. For decades these countries have benefited from substantial policy efforts to remove trade barriers between them. The longer history of European economic integration, which experienced these countries, seems to play an important part in explaining the lower border effect for this country group.

---

[17] Since for Belgium and Luxembourg the above-mentioned data problem exists, all trade flows leaving and entering both countries are neglected. It further has to be noted that Greece joined the euro area only in 2001.

Figure 2: *Evolution of the Border Effect in the Case of Germany, 1997–2004, Eurozone versus Non-Eurozone Countries*
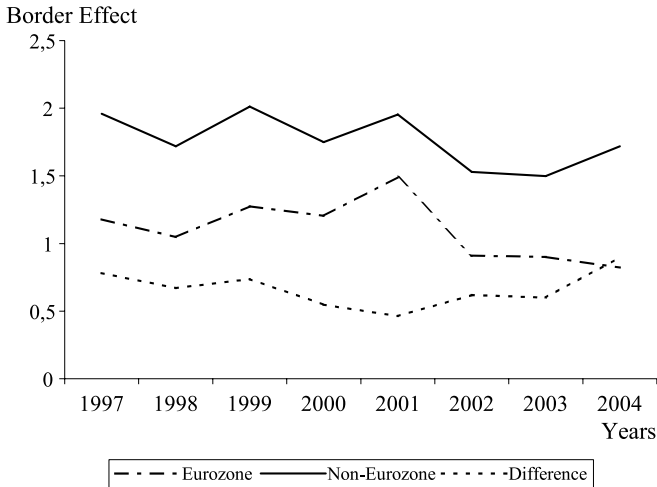
Border Effect

Figure 2 also depicts the evolution of the difference in the border effect for both country groups. For the first five years, 1997–2001, we find a continuous decrease in the difference of the border effects. This result indicates that up to 2001 the above-described integration gap between the two country groups was slowly narrowing down. In other words, measured against the benchmark of German trade flows, the three non-euro countries became better integrated into the EU Common market. This development continued through 1999 despite the fixing of exchange rates by members of the EMU.[18]

However, the trend reversed in 2002, the year of the introduction of the euro as legal tender and hence the completion of the EMU. Since then, the gap between the border effect of euro and non-euro countries has been widening, reaching a higher level in 2004 than in the first year under observation 1997. This trend reversal seems to indicate that the introduction of euro banknotes and coins substantially reduced transaction costs between German regions and eurozone countries. We can deduce that part of the above observed fall in the border effect for the years 2002 onwards is apparently explained by the introduction of the euro as legal tender. However,

---

[18] On January 1, 1999, eleven EU countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain) fixed the conversion rates of their currencies and thus created a de facto monetary union.

the largest part of the fall in the border effect concerned eurozone as well as non-eurozone countries and therefore must have other causes than the common currency.

The stronger fall in the border effect toward eurozone countries also implies that trade became redirected from non-eurozone countries toward eurozone countries. Previous studies which analyze more directly the euro trade effects, such as Micco et al. (2003) or Flam and Nordström (2003), do not find evidence of trade diversion. The major shortcoming of these investigations is that the majority of them cover only the first few years of the EMU neglecting the most recent trends. However, the empirical evidence for trade diversion provided in our study also needs to be taken with some caution for the following reasons: First, the sample used in our analysis covers only a short period of time. Second, the above-described trends might be related to other factors than the one described above. For example, diverging economic trends in EU countries might also influence the magnitude of the border effect. Finally, we might recall that our study only focuses on the border effect of Germany toward its EU neighbors and constitutes thus only one part of the entire picture.

Overall it has to be noted that the question of how the common European currency affects the economic integration of the European Union is a very relevant one, not only for economists. Especially in the current debate over the future of the European Union, the dynamics of integration need to be well understood by all decision makers. Our study provides empirical evidence that the introduction of the euro indeed fostered the economic integration of the European Union. We further find that German trade flows have become redirected toward eurozone countries in recent years. Future empirical research on the euro trade effect will certainly deliver additional empirical evidence on these questions. An interesting aspect to analyze would be the timing of the euro trade effect. It might well be that the euro affected the economic integration of Europe with greater delay as previously believed.

5 Summary and Conclusion

The main purpose of this paper was to develop a methodology that allows us to estimate border effects with greater precision using existing data. Applying this methodology to the case of France and Germany has yielded two main results. First, the German economy seems to be better integrated in

the EU market than its French counterpart. Second, in the case of Germany the border effect has been decreasing over the past eight years.

However, this study constitutes only a beginning. The availability of data on intranational commodity flows in EU countries offers the opportunity to estimate border effects for other countries. Since our methodology is a more direct way to determine border effects, it allows us to study closer the reasons for border effects. In our study we have identified new factors that contribute to the border effect, but much work remains to be done. However, we are now able to easily integrate more valuable data, for example on different consumer prices between regions (Engel and Rogers (1996) for the case of Canada-US trade) and come to a much richer analysis. Finally, a better understanding of the border effect would make it possible to know more about the welfare implications of border effects.

Future studies could apply our methodology to data that covers longer time periods than eight years. As our results suggest, knowing more about the evolution of the border effect can give us important insights in the dynamics of trade. Knowing whether an economy integrates and at which pace is not only a valuable piece of information for trade economists, but also for policy makers.

Appendix

- Arbeitskreis "Volkswirtschaftliche Gesamtrechnungen der Länder" http://www.vgrdl.de (accessed August 20, 2005)
- CIA World Factbook, http://www.cia.gov/cia/publications/factbook (accessed August 20, 2005)
- Direction générale des douanes et des droits indirects, http://www.douane.gouv.fr (accessed July 1, 2005)
- EUROSTAT, http://www.eu-datashop.de (accessed August 3, 2005)
- INSEE, http://www.insee.fr (accessed July 1, 2005)
- Kraftfahrt-Bundesamt, http://www.kba.de (accessed August 20, 2005)
- Statistisches Bundesamt, http://www.destatis.de (accessed July 1, 2005)
- United Nations Statistics Division, http://unstats.un.org/unsd/default.htm (accessed June 24, 2005)
- WTO Database, http://stat.wto.org/Home/WSDBHome.aspx?Language= (accessed July 1, 2005)

References

Alchain, A. A., and W. R. Allen (1964). *University Economics*. Belmont, CA: Wadsworth.

Anderson, J. E., and E. van Wincoop (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 20 (1): 170–192.

Anderson, M., and S. Smith (1999). Do National Borders Really Matter? Canada-US Regional Trade Reconsidered. *Review of International Economics* 7 (2): 219–227.

Baldwin R. E. (2006). The Euro's Trade Effects. ECB Working Paper 594. European Central Bank, Frankfurt a. M.

Baldwin, R. E., and V. Di Nino (2006). The Common Currency Effect on Trade in New Goods: Euros and Zeros. CEPR Discussion Paper 5973. Center for European Policy Research, London.

Baldwin, R. E., and D. Taglioni (2004). Positive OCA Criteria: Microfoundations for the Rose Effect. Graduate Institute of International Studies, March. Geneva.

Baldwin, R., F. Skudelny, and D. Taglioni (2005). Trade Effects of the Euro: Evidence from Sectoral Data. ECB Working Paper Series 446. European Central Bank, Frankfurt a. M.

Barr D., F. Breedon, and D. Miles (2003). Life on the Outside: Economic Conditions and Prospects Outside Euroland. *Economic Policy* 18 (37): 573–613.

Berger, H., and V. Nitsch (2005). Zooming Out: The Trade Effect of the Euro in Historical Perspective. *CESifo Working Paper* 1435. Ifo-Institute, Munich.

Bun, M., and F. Klaassen (2002). Has the Euro Increased Trade? Tinbergen Institute Discussion Papers 108/2. Amsterdam.

Bun, M., and F. Klaassen (2004). The Euro Effect on Trade Is Not as Large as Commonly Thought. Tinbergen Institute Discussion Papers 086/2. Amsterdam.

Chen, N. (2004). Intra-National versus International Trade in the European Union: Why Do National Borders Matter? *Journal of International Economics* 63 (1): 93–118.

Combes, P.-P., M. Lafourcade, and T. Mayer (2005). The Trade Creating Effects of Business and Social Networks: Evidence from France. *Journal of International Economics* 66 (1): 1–29.

Deardorff, A. V. (1998). Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World? In J. Frankel (ed.), *The Regionalization of the World Economy*. Chicago: University of Chicago Press.

De Nardis, S., and C. Vicarelli (2003). The Impact of Euro on Trade: The (Early) Effect Is Not So Large. European Network of Economic Policy Research Institutes 017. Brussels.

De Nardis, S., and C. Vicarelli (2004). Currency Unions and Trade: The Special Case of EMU. *Review of World Economics/Weltwirtschaftliches Archiv* 139 (4): 625–649.

De Sousa, L. (2002). Trade Effects of Monetary Integration in Large, Mature Economies. A Primer on European Monetary Union. Kiel Working Paper 1137. Institute for the World Economy, Kiel.

De Sousa, J., and Lochard, J. (2005). Do Currency Barriers Solve the Border Effect Puzzle? Evidence from the CFA Franc Zone. *Weltwirtschaftliches Archiv/Review of World Economics* 127 (3): 422–441.

Eichengreen, B., and D. A. Irwin (1993). Trade Blocs, Currency Blocs and the Disintegration of World Trade in the 1930s. Centre for Economic Policy Research Discussion Paper 837. London.

Eichengreen, B., and D. A. Irwin (1998). The Role of History in Bilateral Trade Flows. In J. A. Frankel (ed.), *The Regionalization of the World Economy*. Chicago: University of Chicago Press.

Engel, C., and J. Rogers (1996). How Wide Is the Border? *American Economic Review* 86 (5): 1112–1125.

Eurostat (2004). Road Freight Transport by Group of Goods 1999–2002. Catalogue number: KS-NZ-04-010-EN-N. European Communities.

Flam, H., and H. Nordstrom (2003). Trade Volume Effects of the Euro: Aggregate and Sector Estimates. Institute for International Economic Studies: unpublished.

Fontagné, L., M. Freudenberg, and N. Péridy (1998). Intra-Industry Trade and the Single Market: Quality Matters. Center for Economic Policy Research Discussion Paper 1959. London

Gomes, T., C. Graham, J. Helliwell, T. Kano, J. Murray, and L. Schembri (2006). The Euro and Trade: Is There a Positive Effect? Mimeo. Bank of Canada, Ottawa.

Head, K., and T. Mayer (2000). Non-Europe: The Magnitude and Causes of Market Fragmentation in the EU. *Weltwirtschaftliches Archiv/Review of World Economics* 136 (2): 285–314.

Head, K., and T. Mayer (2002). Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade. CEPII Working Paper. January. Centre d'Études Prospectives et d'Informationes Internationales, Paris.

Helble, M., and T. Okubo (2007). Heterogeneous Quality Firms and Trade Costs. HEI Working Paper. Graduate Institute of International Studies (forthcoming).

Helliwell, J. (1996). Do National Borders Matter for Queber's Trade? *Canadian Journal of Economics* 29 (3): 507–522.

Helliwell, J. (1997). National Borders, Trade and Migration. *Pacific Economic Review* 3 (3): 507–522.

Hillberry, R. (1998). Regional Trade and "the Medicine Line": The National Border Effect in US Commodity Flow Data. *Journal of Borderland Studies* 13: 1–17.

Hillberry, R., and D. Hummels (2002). Explaining Home Bias in Consumption: The Role of Intermediate Input Trade. NBER Working Paper 9020. National Bureau of Economic Research, Cambridge, Mass.

Hillberry, R., and D. Hummels (2003). Intra-National Home Bias: Some Explanations. *Review of Economics and Statistics* 85 (4): 1089–1092.

Hummels, D., and A. Skiba (2004). Shipping the Good Apples Out? An Empirical Confirmation of the Alchian–Allen Conjecture. *Journal of Political Economy* 112 (6): 1384–1402.

Leamer, E. (1997). Access to Western Markets and Eastern Effort. In S. Zecchini (ed.), *Lessons from the Economic Transition, Central and Eastern Europe in the 1990s.* Dordrecht: Kluwer Academic Publisher.

McCallum, J. (1995). National Borders Matter: Canada-U.S. Regional Trade Pattern. *American Economic Review* 85 (3): 615–623.

Micco, A., E. Stein, and G. Ordonez (2003). The Currency Union Effect on Trade: Early Evidence From EMU. *Economic Policy*: 316–356.

Nitsch, V. (2000). National Borders and International Trade: Evidence from the European Union. *Canadian Journal of Economics* 33 (4): 1091–1105.

Nitsch, V. (2002). Border Effects and Border Regions: Lessons from the German Unification. HWWA Discussion Paper 203. Hamburg

Wei, S.-J. (1996). Intra-National versus International Trade: How Stubborn Are Nations in the Global Integration? NBER Working Paper 5531. National Bureau of Economic Research, Cambridge, Mass.

Wolf, H. C. (1997). Patterns of Intra- and Inter-State Trade. NBER Working Paper 5939. National Bureau of Economic Research, Cambridge, Mass.

Wolf, H. C. (2000). International Home Bias in Trade. *Review of Economics and Statistics* 82 (4): 555–563.