Geographical interregional trade frictions: An approach based on municipal data[1]

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ABSTRACT

The border effect literature emphasizes the negative effect of distance on international trade flows between countries in relation to flows within national borders. However, recent works have shown that the border effect arises from a methodological error in measuring the distances within the international trade literature, having practically no effect when it is measured at the highest level of disaggregation (Hillberry and Hummels, 2008; Head and Mayer, 2002). In this context, and using a micro-database on shipments by road within Spain for the period 2003-2007, we decompose municipal trade flows (Nuts 5 level) into the intensive and the extensive margins using different measures of transport costs defined at the highest possible level of disaggregation: a) real distance covered by the truck; b) travel time; and c) generalized transport cost (Zofío et al., 2011). For all these alternative measures we observe that as transport costs increase, the number of shipments (extensive margin) drops more sharply than their average value per shipment counterpart (intensive margin). Additionally, in a second level of decomposition, the extensive margin is explained by the number of shipment per commodity (product intensive margin) while the average tons explain the intensive margin. At this very detailed geographical level we find that the difference between the intensive and the extensive margins is quite important regardless the measure of transport costs. Furthermore, within the same municipality the total value of trade is explained by the extensive margin. Nevertheless, alternative regional borders have different effects on trade, indeed provinces (Nuts 3 level) have a positive effect on all the trade decomposition variables, while regions (Nuts 2 level) have lower or even negative impact on trade flows. Finally, we observe that the variation in generalized transport costs, along this panel database, explains in a more significant way the variation in trade flows than the rest of transport costs. All these results are robust if we consider trade flows in quantities instead of monetary trade flows.

These findings provide further evidence about the so-called illusory border effect problems that arise if transport costs are assumed to be statistical aggregate measures between geographical points rather than considering more detailed geographical flows and measures of transport costs.

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1. Introduction.

Recent literature on international trade has coined the concept of *border effect* (and *home bias effect*) to describe the phenomenon by which countries (and other sub-national units) tend to trade more with themselves (or with close territorial units) than with other similar units in terms of economic size and distance. This concept was first used by McCallum (1995) who showed how, on average, Canadian provinces traded 22 times more among themselves than with other states from the U.S., after controlling for the size and the distance that separates them. Subsequently, many authors have tried to quantify this effect using data from international and interregional trade for several years and countries.

Within this broad literature, some authors have attempted to provide both economic and methodological reasons to explain this propensity to agglomerate trade within certain boundaries (regional or national) attending to the potential market and the impedance of the distance (market access). Among the former, some authors have put the emphasis on factors related to agglomeration of economic activity (*co-location of up-stream* and *down-stream industries*) or differences in consumer preferences for local varieties in detrimental to those produced abroad (*idiosyncratic demand, cultural differences*, and *trade inertias*). Also, it has been investigated the presence of additional trade frictions arising from the presence of limits on information flows and the presence of *social and business networks* (Rauch, 2001; Combes et al, 2005).

Other group of studies have focused their attention on methodological explanations, discussing to what extent the obtained effects are determined by particular econometric specifications (Anderson and van Wincoop, 2003, Egger and Paffermayr, 2003; Helpman, Melitz and Rubinstein, 2004; Baldwin et al, 2006), or the type of data used either to measure the transport cost (distance) between areas (Head and Mayer, 2002) or to quantify the trade flows between them (Hillberry, 2002; Hillberry and Hummels, 2008; Llano et al., 2011).

In regard to the latter group of studies, it has been shown that the elasticity of trade (international and interregional) in relation to distance, and consequently the factor that determines the border effect (and the home bias), depends largely on the way we measure distance (internal and external distance) as the proxy for transport costs, and the size of the exporter and importer territorial units. For example, Head and Mayer (2002), using the data about trade between US states in 1997, showed that only by incorporating different measures of the "internal distance", one obtains lower levels of the border effect, concluding the existance of a significant "illusory" border effect in the literature (a term coined by Head and Mayer, 2002).

Similarly, other articles focused on trade flows within the U.S. (Wolf, 2000; Hillberry, 2002; Hilberry and Hummels, 2008) have shown how the home bias decreases significantly (so as to eventually disappear) as we reduce the territorial unit of reference and more precised distance variables are defined. Additionally, in two recent articles studying the Spanish case, it has been seen shown that the size of the home bias and the international border effect reduces (even dissapears for some econometric specifications) when sectorial data is used (Requena and Llano, 2010) or when the measurement is carried out considering provincial level flows (Nuts 3) instead of regions (Nuts 2) (Llano et al., 2011).

In line with this work and coinciding with the emergence of the *new-new trade theory* (Melitz, 2003), some recent articles have tried to analyze the effect that the internal borders have on the extensive margin (number of shipments or exporters) and the intensive margin (average value of imports / shipments) using shipment data within a country. To do this, Hillberry and Hummels (2008) analyze the flows carried out by a large sample of *production establishments* within the U.S. They identify a greater impact of the home bias effect on the extensive margin than on the intensive margin; especially at very short distances. It is also showed that the home bias disappears when the analysis is performed at higher levels of spatial disaggregation. Breaking apart, and following a similar analysis for the global trade flows, Felbermayr and Kohler (2006) found a higher incidence of the distance on the extensive margin (new established trade relations).

Within this literature, the aim of this paper is to analyze the internal border effect in the case of the Spanish freight road trade, using micro-data with the highest possible level of spatial disaggregation (individual shipments) for the period 2003-2007. For this purpose we construct a novel database on road shipments within Spain, and proceed to decompose trade flows using defintions and concepts similar to those introduced by Hillberry and Hummels (2008) to approximate the intensive and extensive margin. However, in contrast to this latter study, where the information that was available about shipments refered to *production establishments* (wholesalers and retailers) within the U.S., in our case we employ micro-data for the *individual shipments* carried out by trucks between Spanish municipalities that are characterized by a large number of variables. Thus, although data are not available at the enterprise level because of the statistical secrecy, we remark the advantages that this database offers over those previously considered in the literature: a) the availability of three sub-national *nested* spatial levels (Nuts 5, Nuts 3 and Nuts 2) to quantify the effect of three internal administrative *borders* of quite different historical and administrative nature; b) the availability of very detailed measures of transport costs (real distance moved by the truck) to reduce the appearance of illusory border effect in our estimations; c) the availability of a panel structure to analyze the dynamic evolution of trade integration within Spain and the effect that each border has on the spatial distribution of trade over time.

Additionally, our approach presents three advantages from the perspective of the definition and measurement of transport costs. The first one is related with the distance as transport cost. As mentioned before, the database used provides the actual distance traveled by the truck, offering a new level for *intra-city* or *inter-city* transport cost (trade within municipalities). The second advantage is related with the road efficiency as a measure of transport cost. In this sense, we have resorted to programming techniques using Geographic Information System (Arc/GIS) to calculate optimal routes through the existing road network in Spain for the years 2003-2007. With this digitalized road network, we computed the minimum travel times for a half truck (14 tons) between all possible origins and destinations points taking into account the road capacity network and the main variables that affect the travel time: legislation on mandatory stops and tolls. Finally, we have added a new dimension to include real transport costs (as the counrterpart to its distance or time proxies), in the form of a Generalized Transport Cost including operating costs (see Zofío et al., 2011; Combes and Lafourcade, 2005). The GTC corresponds to the minimum cost route joining any origin and destination, defined as the sum of the cost related to distance (fuel, toll, tires…) and time (salaries, insurance, taxes…) between municipalities. As opposed to travel distance and travel times that exhibit very limited varitions over time as the improvements in road infrastruture have a limited impact on them, CGT exhibit additional variations associated not only to road infraestucture but most importantly to operating costs.

These three different measures of transport costs allow analyzing how trade flows are penalized attending to the geography (real distance), the road efficiency (travel time depending on the high/low capacity road characteristics of the network), and the economic costs (GTC). Also, we perform our analysis using the pseudo-poisson maximun likelihood estimator proposed by Santos and Tenreyro (2006, 2010, 2011) as it is supposed to be the most suitable technique to estimate trade flows.

In this sense, we have observed that the number of shipments (extensive margin) drops more sharply, as all transport costs increase, than the average value per shipment (intensive margin). Additionally, in a second level of decomposition, the extensive margin is explained by the number of shipment per commodity while the average tons explains the intensive margin. Municipal boundaries have a strong impact on trade flows and trade margins, i.e., trade inside municipalities are much more important than trade between municipalities. Nevertheless, the regional borders have different effects on trade, indeed the borders between provinces (Nuts_3) have positive effects on all the trade decomposition variables, but lowers than the municipal level (Nuts 5), while regional borders (Nuts 2) have no significant or even negative impact on trade flows. With these findings we can remark the idea that the border effect between high administrative boundaries is not as important as the trade literature has emphasized. In this sense, if we decompose the border effect between high administratives boundaries (i.e., national units) resorting to lower regional borders, we can obtain a border effect which is lower than expected, indeed it is only significative for a very reduced administrative boundary (municipal level), which also explains the main part of the border effect found in previous studies.

As a final step, we perform two novel analysis to study the dynamics of trade flows taking use of the panel structure. First, we propose a set of cross-section regressions to analyze whether the internal border effect is constant over time to conclude that administrative boundaries do not agglomerate the same amount of trade whithin themselves, i.e., they do not have the same negative impact on trade flows if we attend to different years in the sample. Second, we analyze which of the three measures of transport costs is the most relevant to explain trade flows variations. According to this, variations in distance and travel time reflect no significative effects on trade flows along the years, while the GTC has negative and significative effects on trade flows variations. It would be indicating that the GTC is the most suitable measure of transport cost when we consider time series.

The structure of the article is as follows. The next section presents a review of the literature on the home bias and the possible illusory border effects which have appeared on the literature when transport costs are not measured attending to the exact geographical level (unit) where trade flows are taking place. In this context, we remark the necessity of using more detailed spatial dissagregated measures of transport costs in order to avoid illusory border effect problems in the sense that the border effect is much lower than expected when we attend to more dissagregated geographical areas. Section 3 explains the database and Section 4 describes the decomposition of shipments and provides a first analysis of trade flows based on nonparametric estimations. Section 5 shows the results obtained by different specifications of the gravity model considering the pseudo-poisson distribution and applying it to the trade flows and our proxy variables for the intensive and extensive margins of trade. Additionally, we perform an analysis based on growth rates to determine which transport cost has the most significative effect on trade flows. The last section draws relevant conclusions.

2. Review of the literature.

Traditionally, the international trade literature has resorted to the gravity model methodology to quantify the *border effect* because of its satisfactory results in the empirical analysis (Baldwin and Taglioni, 2006). However, many of these analyses are carried out considering aggregate flows between countries without attending to lower regional levels. The seminal work by McCallum (1995) had the advantage of having bilateral trade flows between regions of two different countries, allowing him to study to what extent these flows crossed the border, having the possibility to differentiate flows between provinces or states (inter-state flows) in the gravity model.

However, this first estimate of the *border effect* turned out to be biased, leading to many explanations about this phenomenon. On the one hand, some authors (Anderson and van Wincoop, 2003) have focused their attention on the existence of specification errors in

McCallum´s estimation because of an omitted variables bias, i.e. the model underlying the specification is incomplete. On the other hand, other authors have analyzed the role of distance in the gravity model. With this purpose, Head and Mayer (2002) propose a measure of the “effective internal” distance both between and within geographical units, in the belief that using aggregate measures of distance create “illusions” about the border effect, especially because this aggregate distance overestimates the country´s internal distance, or the fact of having two adjacent countries. With this distance, they reduce the value of the border effect (11.2) for the U.S. inter-state flows and the importance of having two adjacent countries in the case of the European Union.

Hillberry (2002a), using disaggregated trade flows within the U.S., estimates that the border effect is much lower than the one obtained in previous estimations, thereby concluding that the border effect induces changes in trade much lower than those reported by McCallum (1995). The underlying hypothesis is based on the fact that the border effect considers all flows equivalently, without taking into account if they take place between places nearby or distant to the country´s frontier. This leads him to control for two types of biases that can result in an overestimation of the border effect and the belief that long-distance flows should be less sensitive to the lowering of barriers (borders) between two countries. Thus, the first of these biases takes into account firms location patterns. According to this, industries close to the border of the neighboring country should have higher trade volumes and lower production costs because they try to reduce travel costs by locating near the foreign firms in the other country (i.e., Michigan-Ontario). The second type of bias relates to the high fixed costs entailed by the existence of a border between countries. For very spatial disaggregated trade flows, these high fixed costs translate into a large number of commodities with zero value, i.e., there are many goods that are not traded. The removal (or reduction) of the border reduces the fixed costs associated with trade flows and thereby increase the number of bilateral exchanges between the regions. Thanks to the correction of these biases, Hillberry (2002a) reduces the border effect from 20,9 (McCallum´s estimation) to a value of 5.7.

Attending to global flows, Felbermayr and Kohler (2006) aim to analyze the *distance puzzle* whereby the elasticity of bilateral trade to distance has grown in absolute terms for several decades. To do this, they decompose international bilateral flows into their intensive margin (incresing export levels —in tons and value— with places where commercial relations already exist) and extensive margin (establishing new trade business relations) with the intention to solve the specification error in the traditional gravity models (Felbermayr and Kohler, 2006; Chaney, 2008). This error in the gravity model arises because traditional gravity models do not differentiate between the two trade margins. With this methodology and applying non-linear estimation techniques (*tobit regressions*) which correct the bias caused by zero valued trade flows, they solve the *distance puzzle* and find that the "*distance puzzle*" relates mainly to the extensive margin, i.e., the opening or closing of trade relations.

Finally, Hillberry and Hummels (2008) used a micro-dataset on shipments carried out by U.S. establishments in 1997. With this database, they do not find evidence of the *home bias* effect at a municipality level (Nuts 5) when they consider shipments within a country instead of the aggregate trade flows between countries, and the distance is measured at the highest level of disaggregation. These authors decompose trade flows resorting to the extensive and the intensive margin. In this case, they consider the number of shipments between each pair *ij* as the extensive margin, while the average value per shipment is considered as the intensive margin. They find that the extensive margin (number of shipments) is much more important than the intensive margin (average value per shipment) over very short distances especially within municipalities[2].

Within the framework, this article aims to elaborate further on these findings considering different detailed measures of transport costs, taking advantage of the temporal dimension and the three administrative boundaries inside Spain, in order to determine the existence or not of an *internal border effect* and how it evolves along the years. In this sense, we follow the analysis by Hillberry and Hummels (2008) using equivalent definitions for the extensive margin (number of shipments) and for the intensive margin (average value per shipment). Furthermore, we extend the analysis by including different types of transport costs, i.e., travel time between Spanish municipalities through the road network and the generalized transport costs which measures the economic costs of going from one area to the other. Finally, taking advantage of the availability of a panel database, we analyze the effect that the growth rates of transport costs have over the trade flows in order to determine which is the most suitable measure of transport cost when studying the negative effect of transport costs on the trade flows.

3. Data.

For this study we rely on a micro-database on shipments by road within Spain during the period 2003-2007 elaborated within the research project C-intereg[3]. This micro-database is based on the annual survey performed by the tranport division of the Ministry of Public Works (*Ministerio de Fomento*) randomly surveying a sample of trucks, over 3.5 tons, that operate within the national territory. The database includes information about the characteristics of

[2] Particularly, Hillberry and Hummels (2008) examine the case for the 3 digit and 5 digit zip-codes and they find a greater effect of distance on trade for the 3-digit zip-code, which is closely related to the number of shipments. Also, in both cases the number of shipments becomes constant ("flat") over long distances.

[3] A complete description of the methodology and relevant data is presented in www.c-intereg.es

vehicle and shipments, such as the number of tons carried out by the truck[4], the number of shipments, the type of product[5], the operations performed by the truck in each shipment[6], as well as the actual travel distance in meters between the geographical origin and destination of each shipment (also recorded by 5-digit ZIP codes). In this way, for each shipment, we do not need to approximate the distance as done in other studies working with databases that record the origin and destination of the shipment by municipal or ZIP codes (e.g., distance between the centroids of these areas), but do not include the *true* distance travelled by the vehicle; i.e., the *door-to-door* distance.[7] Therefore, and thanks to this distinctive feature of the database, we can research intramunicipal trade flows; a relevant micro level flow that is normally left out of the analysis when the database does not record the real distance of shipments.

For the 2003-2007 period, the database contains more than 1.890.000 records involving , on average for all these years, 7.178 municipalities of origin from where a freight services is made and 7.913 destination municipalities. However, most of these origins and destinations are municipalities with little relevance in terms of population and trade volumes, so estimation results would be biased. Therefore, the sample has been filtered to consider only municipalities that, on average for the period, had over 10.000 inhabitants. As a result, we get a sample of 633 municipalities whose trade volume by road represents a 75.5% of the total trade value[8].

Since the survey does not provide information about the value of the traded goods, product prices (in euros per tons) are needed so as to obtain a magnitude of the total value moved once they are multiplied by the tons carried. These prices are not available at the municipal level (Nuts 5) in any of the official databases because of statistical confidenciality. To overcome this limitation, we rely on an alternative database that contains bilateral trade flows within Spain compiled by the C-intereg project[9].With this database we calculate a price vector, measured in euros per ton, for the whole period. This price vector is measured at the province level (Nuts 3), which is the most dissagregated administrative level with official database about prices. That is why we assume that prices at the municipal level (Nuts 5) are equal to the provincial level (Nuts 3). This assumption implies that the pricing rules determining their level at municipal level, i.e.,

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[4] This corresponds is the real load of the truck in tons. Note that the truck load may range from zero to 100%, so the database may record empty truck movements as a results of the vehicle moving to a destination where it will be eventually loaded.

[5] In the micro-database, commodities are classified attending to the Eurostat classification NST-R which differenciate between 180 products.

[6] "Operations" refers to loads or downloads carried out by the truck in each shipment.

[7] Unfortunately, the database does not compile any information on the firms involved in the shipments. However, since we know the type of product being shipped we can approximate the particular economic activity involved in the trade.

[8] In this sample, we eliminate the trade flows with the Spanish islands and the autonomous cities Ceuta and Melilla in the north of Africa, because we are focusing only on trade flows by road.

[9] This database is supposed to be, as far as we know, the largest database on interregional trade flows estimated in Spain. It includes bilateral trade flows specifying the region (Nuts 2) and the province (Nuts 3) of origin and destination, both in tones and euros. For further information see Llano et al. (2010).

costs and mark-ups over costs, are similar to those observed at provincial level, e.g., similar labor and intermediate costs.

Another novel aspect of this study is the use of additional measures of transport costs to that normally used as an approximation, and corresponding to geographical distance. These are a Generalized Transport Cost (GTC) measure in euros associated to the minimum cost itineraries, and the real travel time through the Spanish road network between the 633 municipalities. Both variables are calculated using a GIS software with the digitalized Spanish road network, as discuss in Zofío et al. (2011)[10]. With regard to the GTC, we differentiate economic costs related to both distance and time. The distance economic cost (euros per kilometer) includes the following variables: Fuel costs (fuel price); Toll costs (unit cost per km, multiplied by the length of the road); Accommodation and allowance costs; Tire costs; and Vehicle maintenance and repairing operating costs. On the other side, the time economic cost (euros per hour) include the following variables: Labor costs (gross salaries); Financial costs associated to the amortization; Insurance costs; Taxes; Financing of the truck (assuming that it remains operative only for a certain number of hours/year); and Indirect costs associated to other operating costs including administration and commercial costs[11]. The GTC is calculated considering prices at the provincial level; specifically those observed in the province where the shipments originates.

The time taken to travel the distance reported in the database is computed taking into consideration the physical attributes of the arcs belonging to the itinerary between the origin and the destination, including distance, road type and road gradient[12]. We also consider relevant legislation such as speed limits, mandatory stops that truck drivers must observe so as comply with European Union safety regulations, etc. As a result, we obtain a discrete time variable which varies throughout the years because of the improvement in road infrastructure and changing regulations. These last parameters are related with the road´s accessibility, so the travel time variable reflects how infraestructures impede road freight trade. Indeed, we note that the distance measure itself does not vary significantly since it is unaffected by road improvements (e.g., enlarging roads with 2x1 lanes to 2x2 highways) and time regulations. Because of this lack of variability in the distance variable, even if they may constitute a good

[10] We have used the economic database compiled by Zofío et al. (2011). In this paper, the authors, differentiated 678 transport zones in Spain (each one comprising about four municipalities), in order to simplify the software calculations. Using these transport zones, we have calculated the travel time and the generalized transport costs associated to each pair of transport zones. Specifically, using the GIS software, we create three origin-destination matrices corresponding to 2000, 2005 and 2007, for which the digitalized road network is available. The matrices contain the GTCs (in euros), travel times (in minutes), and distances, respectively, between the 678 transport zones[10]. However, as we have a panel data on shipments for all years in the 2003-2007 period, we have interpolated the database in order to get a complete time series for the GTCs, the travel times and distances.

[11] For a detailed description on how GTCs are defined in terms of index number economic theory, and how their change in the specified period can be decomposed into quantity (road infrastructure) and price (economic costs) indices see Zofío et al. (2011).

[12] The road gradient refers to slope. It differentiates between three degrees of slope, flat: 0%-5%; mild moderate: 5%-15%; high: more than 15%.

proxy for transportation costs in cross section studies, it is certainly inadequate in panel data studies where transport costs may vary significantly. In these studies the use of GTCs is the only variable really capturing the actual change transport costs. The correlation between the three types of transport costs: Distance, time and GTC, is represented in *Table 1*. As expected, the three types of transport costs are highly correlated, but each of them captures different dimensions of transport costs, i.e., geography (distance), road efficiency (travel time) and actual economic costs (GTC).

Table 1. Correlation between Distance, Travel Time and GTC.

	Distance	Travel Time	GTC
Distance	1,00	---	---
Travel Time	0,90	1,00	---
GTC	0,91	0,95	1,00

4. Trade Flows Decomposition.

Taking advantage of this detailed micro-dataset, we decompose trade flows (shipments) into the extensive and the intensive margins using *proxies* for both margins; these are, the number of shipments between the *ij* origin-destination pair for the extensive margin, and the average value per shipment for the intensive one. This procedure allows solving potential specification errors in the gravity model when trade flows are not decomposed into these two margins trying to analyze how trade barriers (*frictions*) affect them (Melitz, 2003; Felbermayr and Kohler, 2006; Chaney, 2008).

With this purpose in mind, we rely on Hillberry and Hummels (2008) and define the total value of shipments (T_{ij}), where *s* represents a single shipment, ehich can be decomposed in the following way:

$$T_{ij} = \sum_{s=1}^{N_{ij}} N_{ij}\overline{PQ}_{ij} , \qquad (1)$$

where N_{ij} represents the total number of shipments (extensive margin) between each origin-destination pair and $\overline{PQ}_{ij}$ is the average value per shipment (intensive margin). At a second level, the previous expression can be broken down so that the total number of shipments (N_{ij}) equals the number of commodities (*k*) sent within the same pair *ij* (N_{ij}^{k}) , multiplied by its frequency or *trading pair* (*F*); that is, the average number of shipments per commodity per *ij* (N_{ij}^{F}):

$$N_{ij} = \sum_{k=1}^{K} N_{ij}^{k} N_{ij}^{F}. \qquad (2)$$

With this expression, the extensive margin is decomposed according to the *product extensive margin* (N_{ij}^k) and the *product intensive margin* (N_{ij}^F) (Mayer and Ottaviano, 2007). Meanwhile, the intensive margin can be separated into the average price $\overline{(P}_{ij})$ and the average quantity ($\bar{Q}_{ij}$) per each pair *ij*:

$$\overline{PQ}_{ij} = \frac{\left(\sum_{s=1}^{N_{ij}} P_{ij}^s Q_{ij}^s\right)}{N_{ij}} = \frac{\left(\sum_{s=1}^{N_{ij}} P_{ij}^s Q_{ij}^s\right)}{Q_{ij}} \frac{\left(\sum_{s=1}^{N_{ij}} Q_{ij}\right)}{N_{ij}} = \bar{P}_{ij}\bar{Q}_{ij} \ . \quad (3)$$

Additionally, to control for the price inflation caused principally by the housing bubble in Spain during this period in the analyzed period , and as a robust check, we propose an alternative trade decomposition based on physical units instead of monetary units, so:

$$T_{ij} = \sum_{s=1}^{N_{ij}} N_{ij}\bar{Q}_{ij}. \quad (4)$$

That is, total trade equals the total number of shipments (extensive margin) multiplied by the average quantity per shipment (intensive margin). In this case, the extensive margin in (4) is the same as in expression (2), although the intensive margin changes in this expression since only the average quantity per shipment is considered, instead of the average value per shipment[13].

In the database the observations are recorded according to each origin-destination pair (*ij*), type of commodity transported[14] and year. To obtain yearly values of trade for each *ij* we aggregate observations such that, following (3), we calculate the average quantity ($\bar{Q}_{ij}$) and the average price ($\bar{P}_{ij}$) for all the shipments between each *ij*, thereby obtaining the average value per shipment by multiplication, ($\overline{PQ}_{ij}$). Afterwards, we multiply the average value per shipment by the total number of shipment (N_{ij}) between *ij* obtaining the total value of shipments (1). Additionally, we calculate the maximum number of different commodities transported between each *ij* and multiply it by its frequency (average number of shipments per commodity), so as to obtain (2). For the total trade in quantities (4), we multiply the extensive margin (2) by the average quantity moved between *ij*. Finally, in order to get a single value of distance, we calculate the maximum mode and the minimum mode of the distances between *ij* and, for extreme distance values, we apply the mean. As we mentioned before, we remark that the

[13] The average quantity is equal to: $\overline{PQ}_{ij} = \frac{\left(\sum_{s=1}^{N_{ij}} Q_{ij}^s\right)}{N_{ij}} = \bar{Q}_{ij}$.

[14] Commodities are classified in ten groups, from agricultural products to manufactured goods, including products such as metallurgical, minerals, chemicals and fertilizers, and heavy machinery.

distance used can change for an intra-municipal shipment because it represents shipments from one facility (establishment) to another within the same municipality. Also, this distance varies along the period, because it is, for a single year, an average value between all the *ij* shipments ($\bar{d}_{ij(t)} \neq \bar{d}_{ij(t+1)}$).

With this aggregation procedure we obtain 75,897 observations for the whole period after removing empty shipments[15]. However, we have fulfilled the matrix with zeros in order to get all the possible origin-destination flows between the 633 municipalities. To sum up, for each origin-destination and year, in the first level of decomposition we obtain the variables related to the total value of shipments, the total number of shipments (extensive margin) and the average value per shipment (intensive margin); meanwhile in the second level, we obtain for each *ij* the average tons (quantity), the average price, the number of differents commodities shipped and its frequency per commodity.

4.1.Descriptive analysis and Kernel regressions

Map 1 in the Appendix shows the 633 municipalities that have been considered in the final regressions. The map shows the standard deviation of the municipal total trade, i.e., exports plus imports, both in average values during the whole period. This sub-sample represents trade between the largest cities in Spain. It also includes municipalities where main ports are located, as areas with high levels of trading activity. The largest agglomerations of trade are located in the most populated areas with the highest levels of economic activity (Madrid, the Mediterranean, and Basque Country), while low population density areas (south-west and north-west areas) only reflect trade around the large cities. Also, trade volumes follow the corridors correponding to major roads, indicating the strong inertia between trade and road infrastructures, i.e., firms choose locations with large accesibility defined in terms of market potential.

Focusing on the regional distribution and the type of product traded, *Table 2* shows these distributions in 2003 and 2007, differentiating by intervals the number of commodities shipped and the number of regions (municipalities) with which shipments take place. Data are given as percentage over the total number of municipalities, indicating the amount of municipalities which trade a determined number of different commodities and the number of different regions with which they export. It can be oberved that the largest number of municipalities export between 10 to 50 commodities with 10 to 50 regions interval, although this trend has changed in

[15] At this level of disaggregation, zero trade flows does not represent trade as they represent empty truck trips. Similarly, we eliminate zero price observations representing special goods for which no value is reported. These products include: packaging, empty boxes, weapons. Empty flows represent a large percentage of the observations in the sample (around 44%), as a result of unbalanced trade flows within locations, while special goods reprsent only the 4,5%.

2007 as the number of commodities shipped to the same number of regions has increased, showing a diversification in the *shipments' product mix*, i.e., the shipments´ product composition. For its part, in 2007 there are more municipalities which have increased both the number of regions and commodities. Finally, there has been an increase in the number of municipalities that export more than 100 different commodities to more than 100 regions.

Table 2. Shipments distribution by regions and products.

2003		Number of municipalities (Nuts 5)					
		1	**(1-5]**	**(5-10]**	**(10-50]**	**(50-100]**	**More than 100**
Number of commodities	**1**	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
	(1-5]	0,00%	0,16%	1,12%	**3,19%**	0,00%	0,00%
	(5-10]	0,00%	0,32%	1,44%	**5,42%**	0,16%	0,00%
	(10-50]	0,00%	0,00%	0,32%	**38,60%**	11,00%	0,16%
	(50-100]	0,00%	0,00%	0,00%	1,91%	**17,38%**	2,71%
	More than 100	0,00%	0,00%	0,00%	0,00%	1,91%	**14,19%**

2007		Number of municipalities (Nuts 5)					
		1	**(1-5]**	**(5-10]**	**(10-50]**	**(50-100]**	**More than 100**
Number of commodities	**1**	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
	(1-5]	0,00%	0,16%	1,12%	**1,60%**	0,00%	0,00%
	(5-10]	0,00%	0,00%	0,64%	**3,83%**	0,00%	0,00%
	(10-50]	0,00%	0,00%	1,12%	**42,17%**	8,31%	0,00%
	(50-100]	0,00%	0,00%	0,00%	1,76%	**19,17%**	1,60%
	More than 100	0,00%	0,00%	0,00%	0,00%	3,04%	**15,50%**

Source: own elaboration from shipments´ database by road.

In addition, we use a non-parametric estimation (kernel analysis) to study how each trade variable in the decomposition behaves when considering the alternative measures of transport costs, i.e., the actual distance travelled by the truck (in kilometers), the travel time (in minutes) and the GTCs (in euros) between the 633 municipalities. In the Appendix, we present the figures considering each variable, and whose temporal evolution is shown in three years intervals: 2003, 2005 and 2007.

The first level of the trade decomposition is illustrated in *Figures 1*, *2* and *3*. The first one (*Fig.1*) shows lower trade levels in 2003 than in 2007, falling sharply in density as long as we increase the three types of transport costs. This same pattern is observed in the extensive margin (*Fig. 2*), where the number of shipments drops rapidly for all years using either distance, time or GTC as proxies to transport costs (until the 100 km, 100 minutes and 100 euros thresholds respectively), while the intensive margin (*Fig. 3*) shows a trend which increases along all transport costs, but later on begins to decline for distance (around 1.000 km), while it remains constant for time and GTC. This increasing behavior indicated by the intensive margin is due to its composition. As we will see below, prices increase according to distance, time and GTC, while tons drop in density from 1.000 km onwards, reducing the effect of the high prices at very long distances. Particularly, the GTCs reflect a reduction for middle values because of the discrete travel time variable that is used to calculate them.

Fig.1. Kernel Regression: Total Value of Trade on Distance, Time and GTC

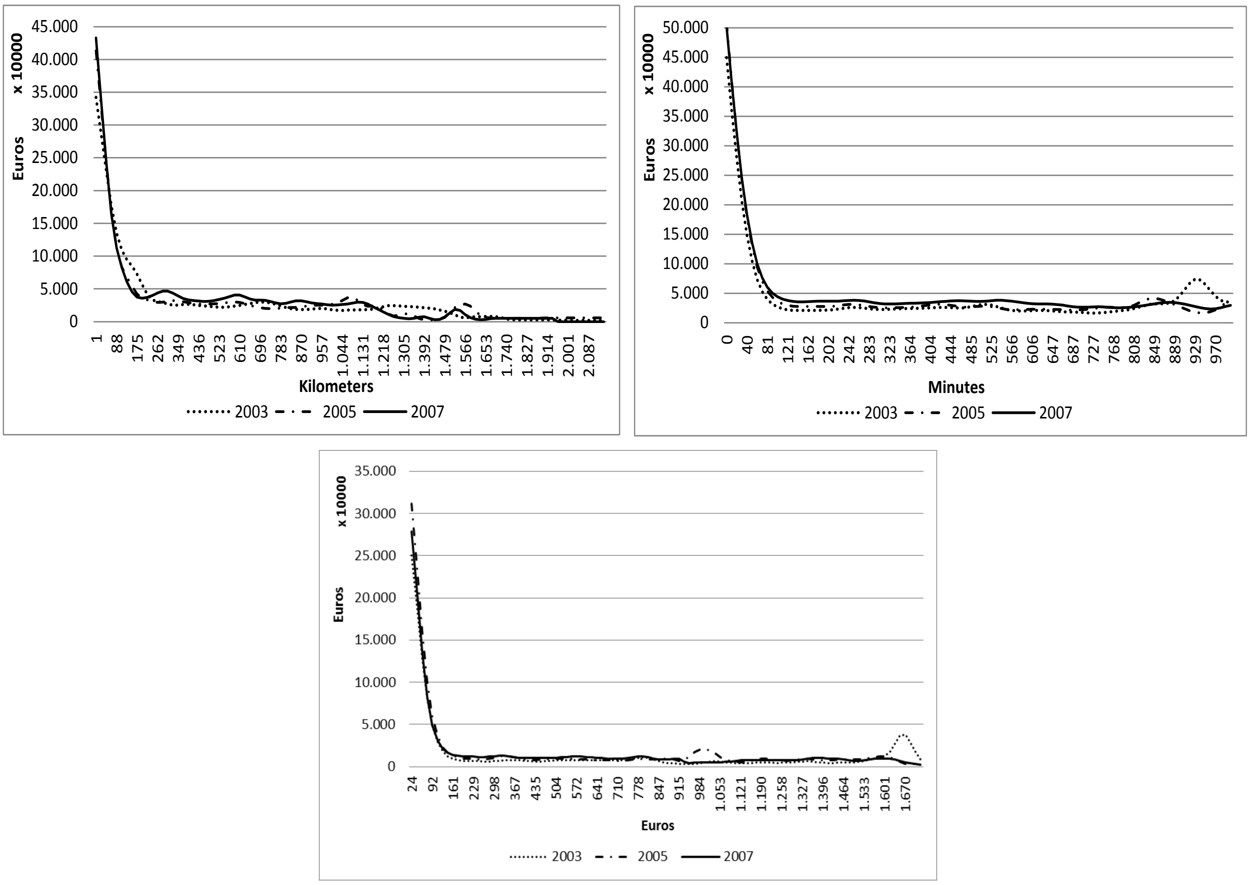


Fig.2. Kernel Regression: Number of shipments (Extensive Margin) on Distance, Time and GTC

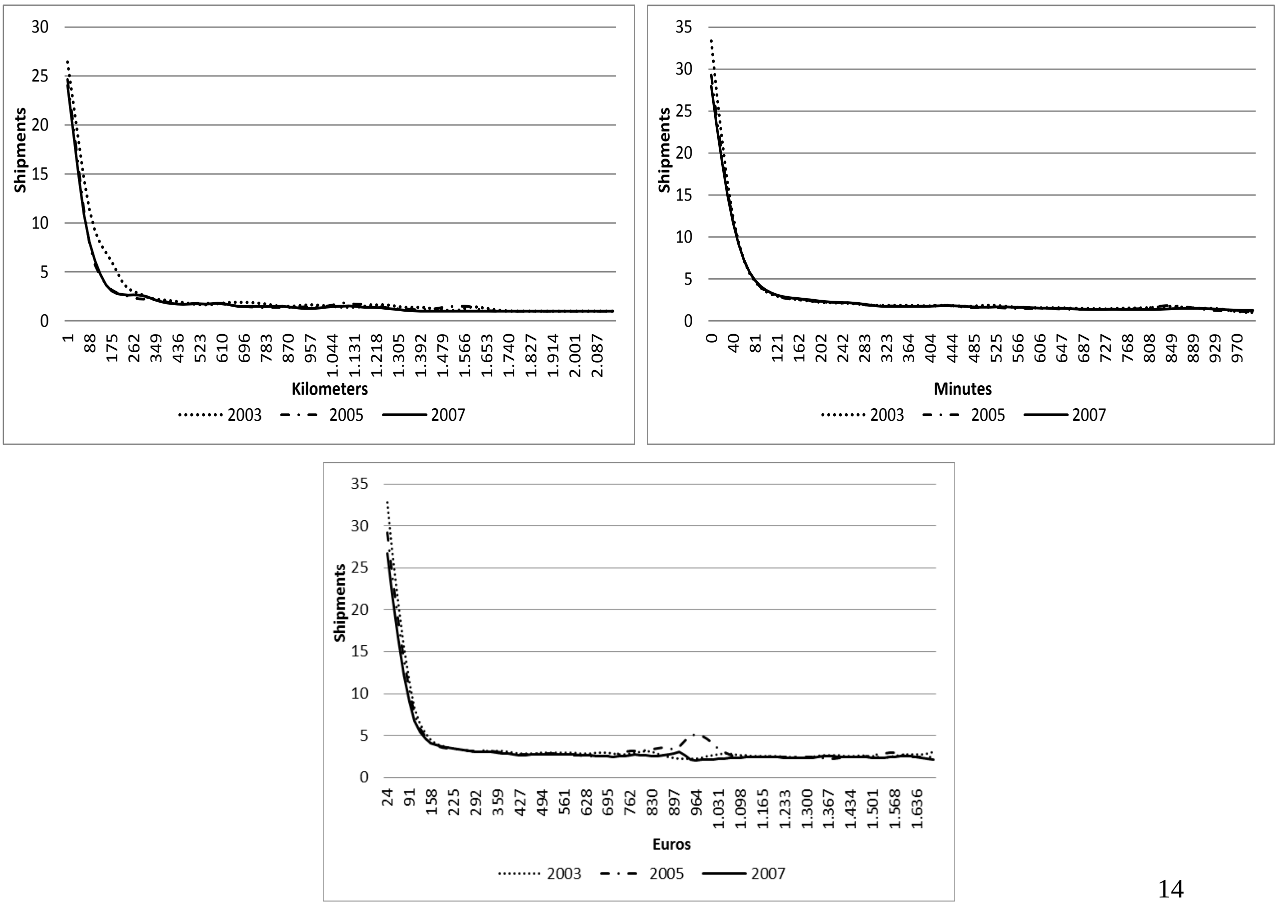
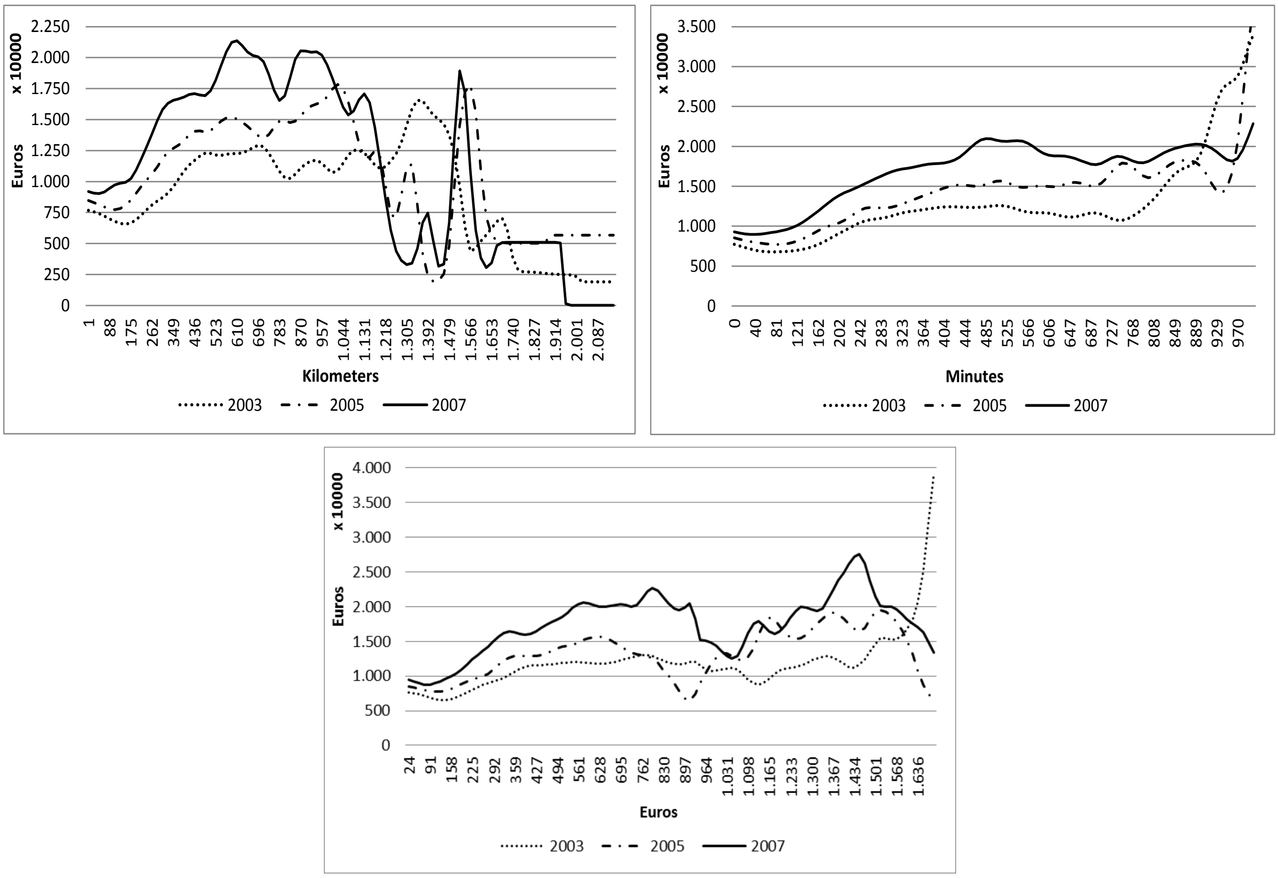


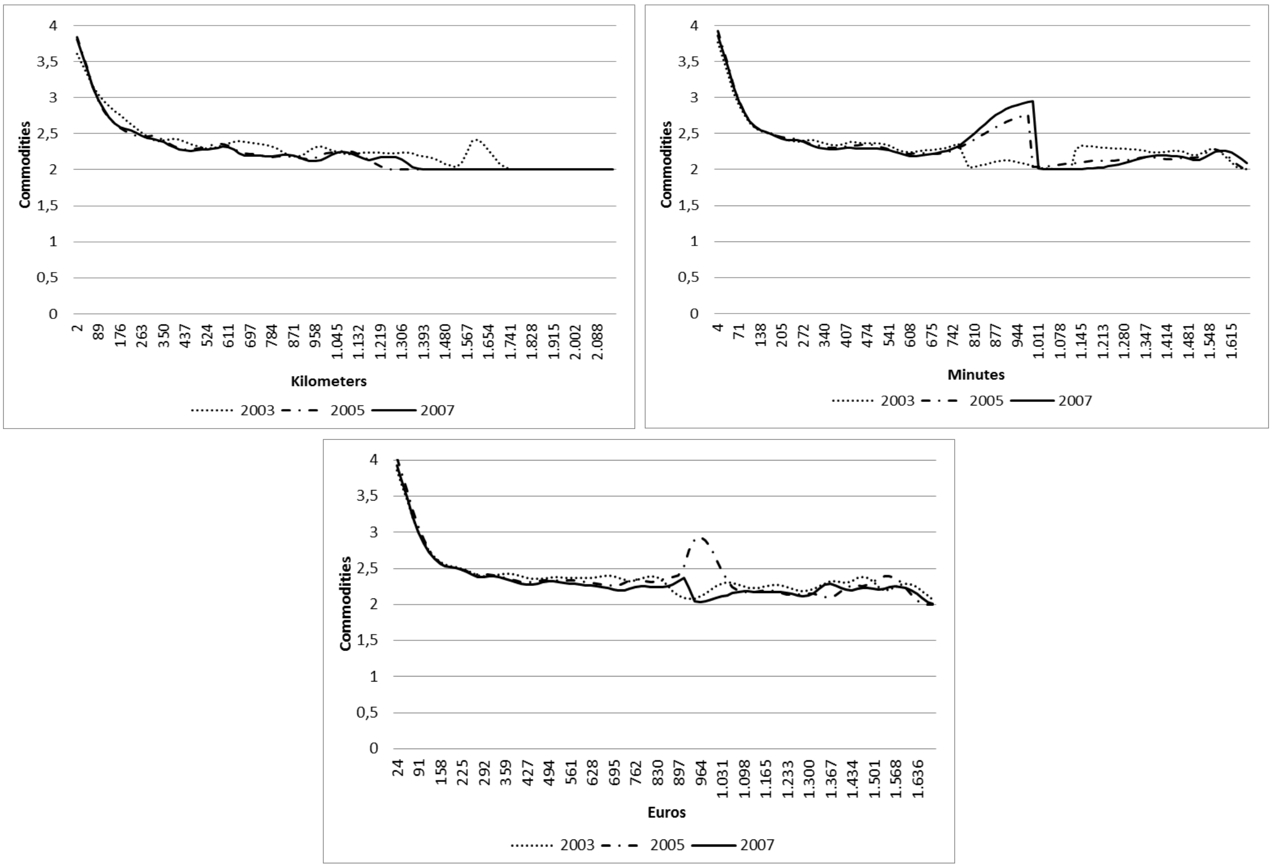
Fig.3. Kernel Regression: Average value per shipment (Intensive Margin) on Distance, Time and GTC



Figures 4, *5* and *6* show the Kernel estimations for the second level decomposition. Attending to the extensive margin decomposition, the number of commodities (*Fig. 4*) and its frequency (*Fig. 5*) present a remarkably similar pattern and evolution, i.e., they rapidly reach their minimum values for distance but, for time and GTC, there is an increase in density either at middle or high values. Decomposing the intensive margin into its price and its average quantity allows us to observe greater price variability (*Fig. 6*), either between years or only in one year. This variability may result from the *shipments´ product mix*, which results in increasing prices as a result of transport costs increases; a sensible result for goods where transport costs make up a large proportion of overall costs, which later on are passed on to prices. Paying attention to tons (*Fig. 7*) and taking into account all types of transport costs, a relevant fact appears. Basically, all series show a greater density of tons at very short distances (including time and GTC). Then, they drop sharply to increase again at medium distances (time and GTC). As we understand it, this trend could be reflecting the accumulation of shipments within the main Spanish metropolitan areas (Madrid, Barcelona and Valencia), while once outside of them, the number of tons reduces until they reach middle times and distances from where they increase again. This middle distance corresponds to the average distance between

the largest cities in Spain. Additionally, it could be indicating that, for long distances it is more profitable from a logistics perspective to group shipments and send trucks with a higher capacity and fully loaded, than making many individual shipments with low volume of tons (a behavior reflecfting the existance of increasing returns to scale in transportation, McCann, 2005[16]). Finally, *Fig. 8* shows kernel regressions for the total trade in physical quantities. It reflects the same evolution and behavior as total trade in monetary units (*Fig. 1*), i.e., the total amount falls steeply with increasing transport costs.

Fig.4. Kernel Regression: number of commodities on Distance, Time and GTC



[16] In the econometric section we study the existence of increasing returns in transport in the intensive (tons) margin.

Fig.5. Kernel Regression: Number of Shipments per commodity (frequency) on Distance, Time and GTC

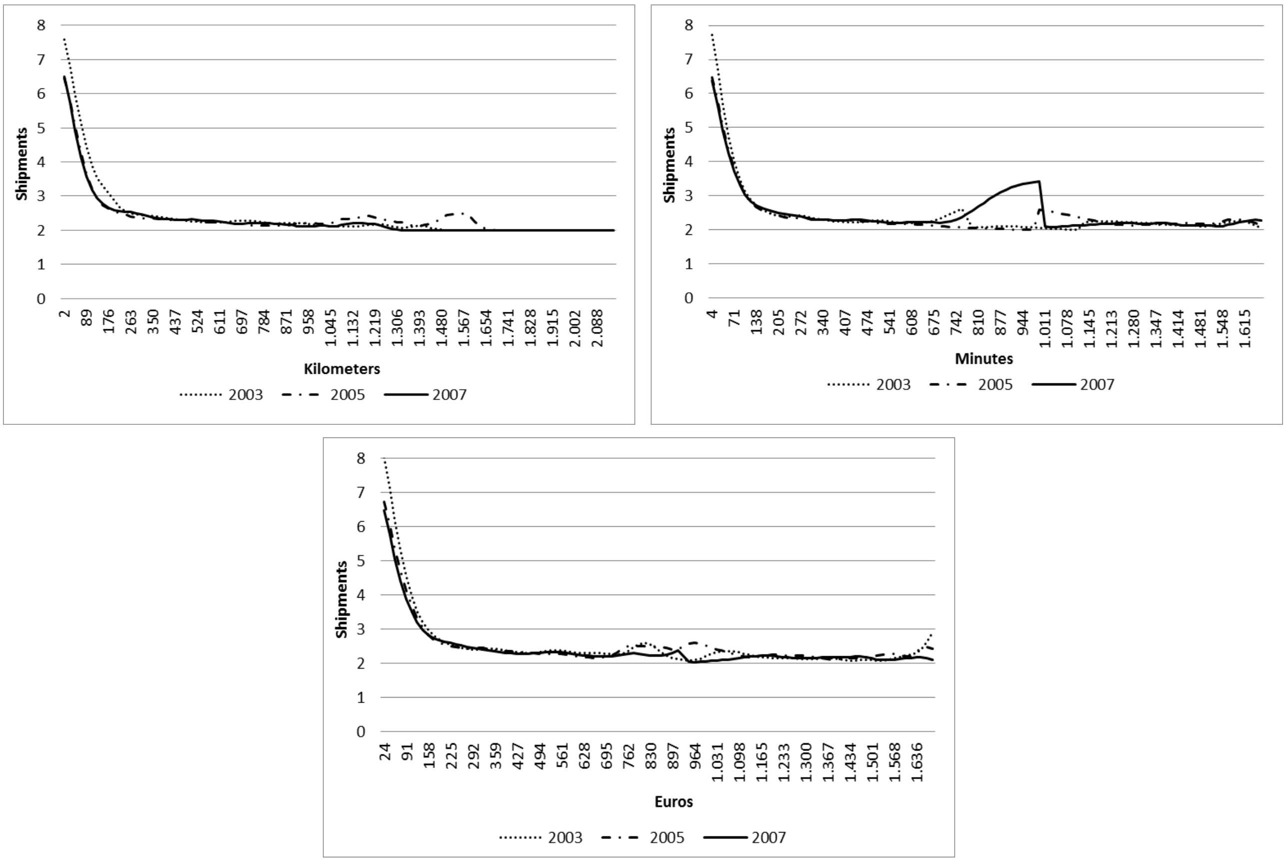


Fig.6. Kernel Regression: Price on Distance, Time and GTC

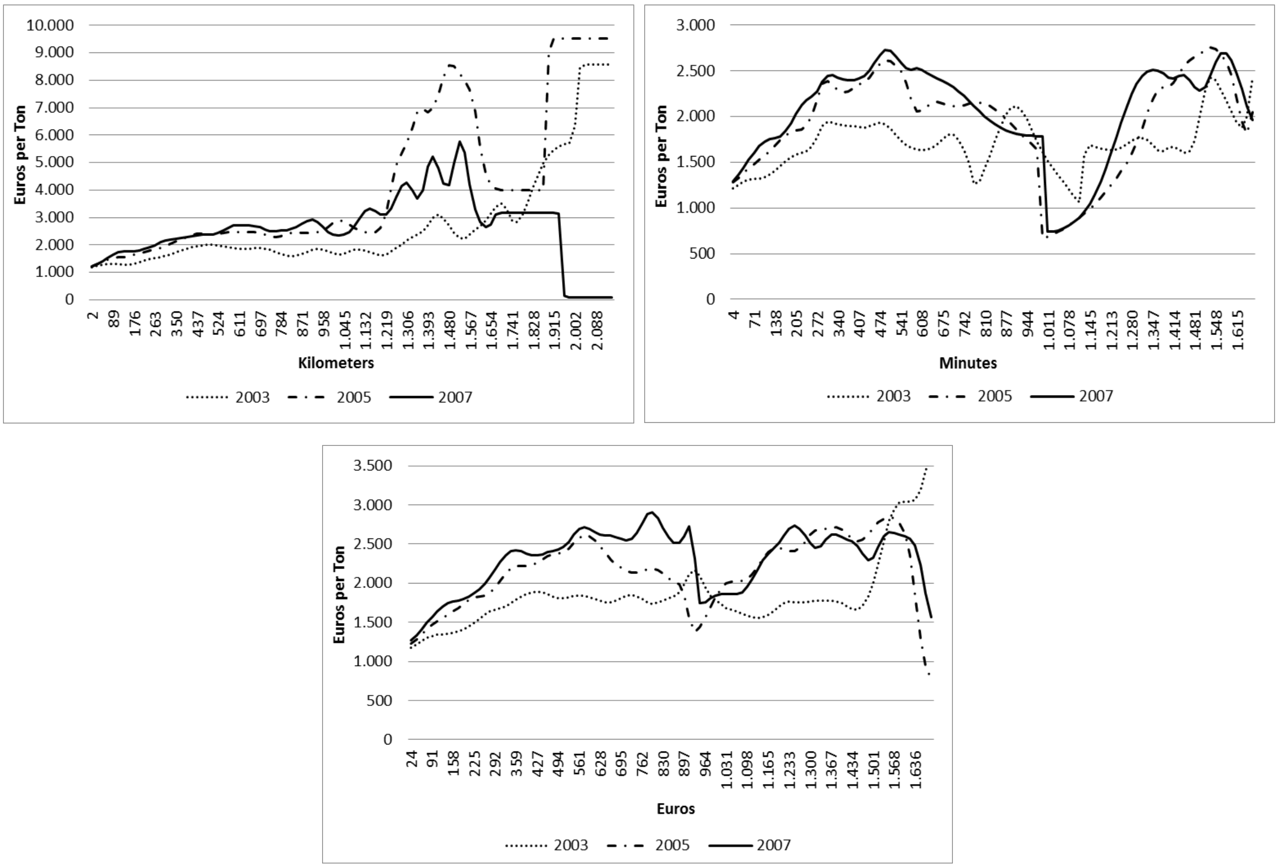


Fig.7. Kernel Regression: Tons on Distance, Time and GTC

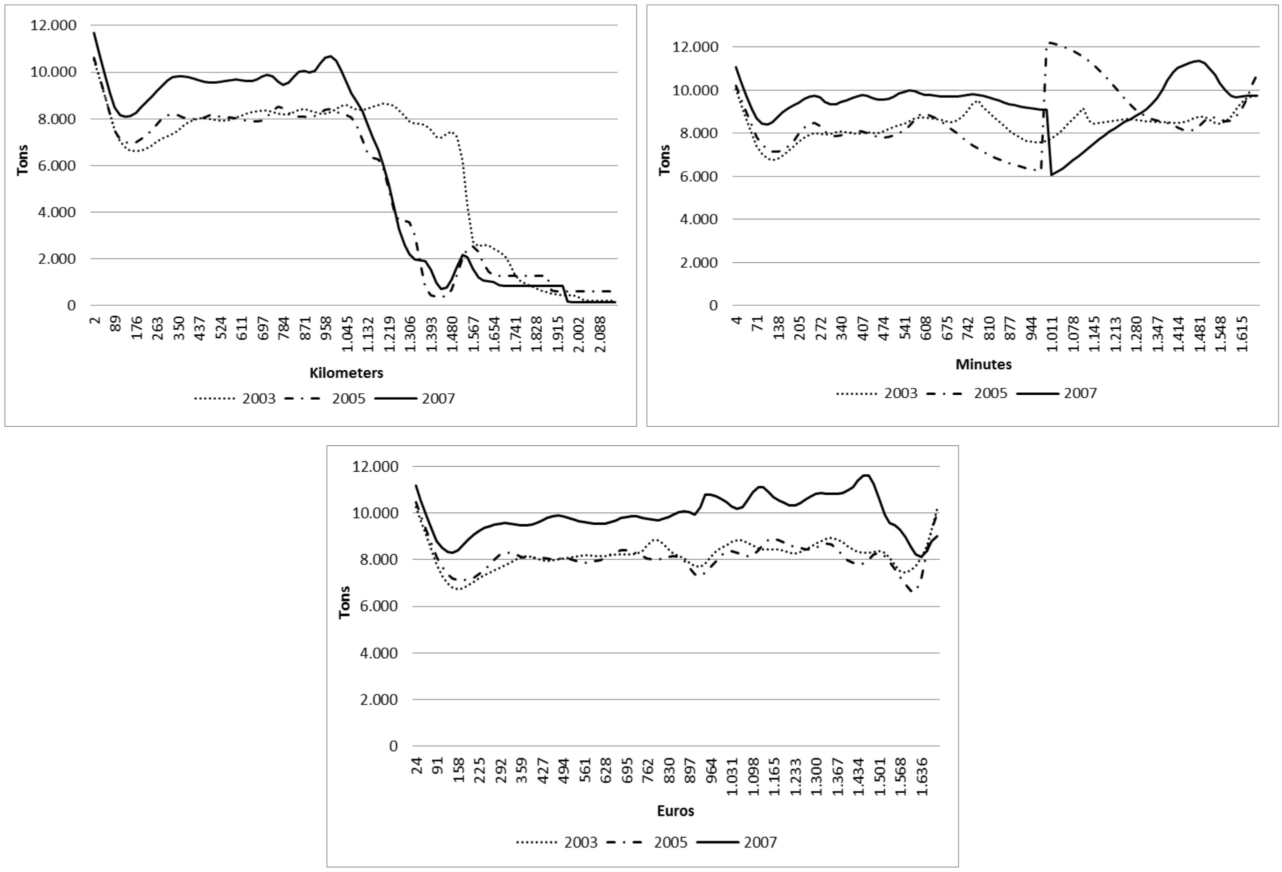
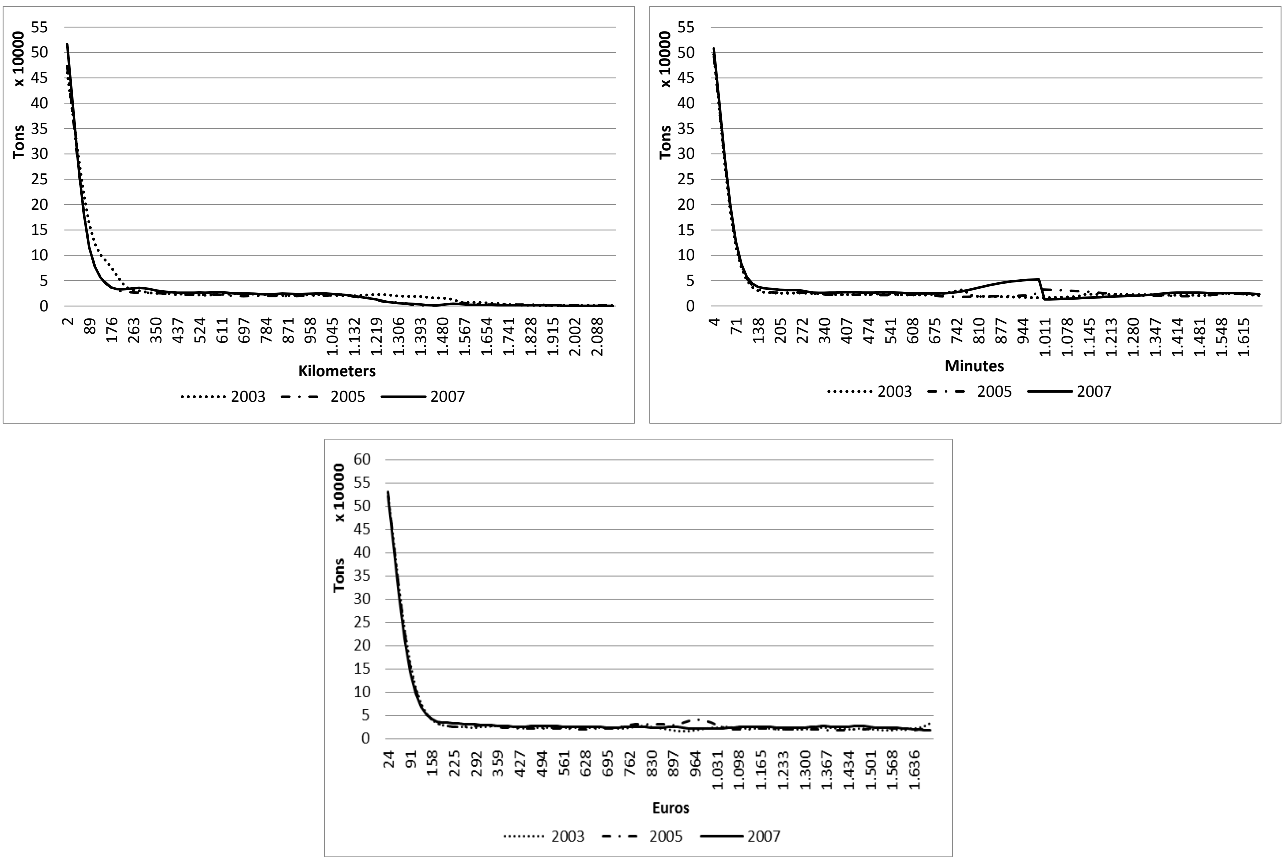


Fig.8. Kernel Regression: Total Trade in Tonnes on Distance, Time and GTC



5. Econometric specification and results.

In this section we investigate the relationship between the different decomposition of trade flows and the negative impact of transportation costs on them. We propose a set of regressions using specifications (1) and (4). With these regressions we try to study how geographical frictions shape trade flows while taking into account different administrative boundaries and measures of transport costs, and test whether these frictions may end up inducing a border effect in each of the different trade margins.

To achieve this goal, we regress each variable in expressions (1) and (4), against geographical variables considering, as such, all transport costs, a municipal contiguity variable, the municipal GDP by origin and by destination, and the three types of administrative boundaries: Regions *(Comunidades Autónomas*, Nuts 2), provinces (Nuts 3), and municipalities (Nuts 5). The three types of transport costs are considered separately, specifiying each cost as a quadratic function; that is, distance (*dist*) and distance squared (*dist_sq*); time (*time*) and time square (*time_sq*); GTC (*gtc*) and GTC square (*gtc_sq*). All of them are entered in levels to correct for the non-linearity effect of the distance over trade flows.

To calculate the contiguity variable we use the GEODA software which analyze if the municipalities shared a common border (*first-order contiguity*) or not. It takes the value one if the origin and the destination of the shipment share a border, and also if the shipment is carried out within the same municipality to correctly isolate the effect of the municipal boundary (*Nuts 5*), which represent how important are intra-municipal shipments over inter-municipal ones (Hillberry, 2002b). With respect to municipal GDP, we obtain this variable from the *Servicio de Estudios de la Caixa* (La Caixa's Research Unit). This agency elaborates an index based on business (commercial, industrial and services) and professionals taxes collected in each municipality. The index value reflects the share of economic activity of each municipality over the total national GDP (in per 100,000 terms). Indeed, this index has a strong correlation with the municipal´s market share. Finally, in order to obtain the municipal GDP, we have multiplied this index by the nominal Spanish GDP in each year in the period.

For the administrative boundaries, we define three dummy variables as in Requena and Llano (2010). In this sense, the *Nuts_5* variable (municipal boundary) takes the value one if the shipment is performed whitin the same municipality, and zero otherwise. The *Nuts_3* (province) takes the value one if the shipment is carried out between two municipalities which are in the same province but the origin and destination is not the same[17]. The *Nuts_2* variable (the region boundary or Comunidades Autónomas) captures if the shipment is performed between two municipalities which are located in diferent provinces but they belong to the same *Nuts_2*

[17] If the shipment is within the same municipality, the Nuts_5 variable will take the value one while the Nuts_3 variable is assigned a value of zero.

region; in this case, it will take the value of one and zero otherwise. Besides, the time dimension is reflected by a dummy variable for each year in the sample (Baldwin et al., 2006). Finally, we include fixed effects by origin and by destination (Anderson and Van Wincoop, 2003). As for the estimation method we rely on the pseudo-poisson maximun likelihood distribution (PPML, Santos and Tenreyro, 2006, 2010, 2011)[18] considering the endogenous variables in levels. Thus, the final specification to be estimated has the form:

$$X_{ij} = \beta_0 + \beta_1 Cost_{ij} + \beta_2 Cost_{ij}^2 + \beta_3 Contiguity + \beta_4 GDP\_i + \beta_5 GDP\_j + \beta_6 Nuts\_5 + \beta_7 Nuts\_3 + \beta_8 Nuts\_2 + Year + \eta_i + \eta_j + \varepsilon_{ij} \quad (5)$$

In this specification, the variables *Cost* and *Cost_sq* denote each type of transport cost; Y*ear* corresponds to each dummy year variable in the period; and X_{ij} represents, separately, all the trade decomposition variables already mentioned.

By resorting to the PPML distribution we can correct for heterocedasticity and for the zero trade flows problem. Additionally, we include the squared distance to control for the non-linearity between trade flows and transport cost, especially at very short distances as shown by the kernel regressions. Thanks to this specification of transport costs, we examine whether there are increasing returns in transport, that is, whether a shipment has a positive cost but marginally decreasing with distance. In that case, we would expect a negative sign in the first term of the transport cost variable but a positive sign in the quadratic one (Combes, 2005a).

Table 3 shows estimates for the first level of trade decomposition variables (the extensive and the intensive margin) taking into account the three types of transport costs: actual distance, travel time and GTC, plus the additional treatment of trade flows in quantities (tons) to compare it with trade flows in monetary units (total value of trade) [19].

Table 3. Fixed Effects Estimation with Distance, Time and GTC (First level decomposition)

VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
Distance	-0.00445***	-0.00535***	-0.000387***	-0.00722***
Dist. Square	2.34e-06***	2.76e-06***	1.90e-08	3.71e-06***
Contiguity	1.338***	1.164***	0.464***	1.276***
GDP Origin	8.22e-09*	2.17e-09	9.58e-10	9.56e-09**
GDP Destination	1.11e-09	4.12e-09	-1.93e-09	9.99e-11
NUTS 5	3.371***	2.996***	0.957***	3.203***
NUTS 3	1.327***	1.147***	0.290***	1.097***
NUTS 2	0.121*	0.151***	0.00573	-0.141**
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,708**	**0,874**	**0,086**	**0,618**

[18] OLS specifications result in bias estimations (Santos and Tenreyro, 2006; Martin and Pham, 2008).
[19] We are still working on these regressions to include origin time-variant and destination time-variying fixed effects.

VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
Time	-0.00601***	-0.00757***	-0.000539***	-0.00966***
Time Square	3.17e-06***	4.03e-06***	2.39e-07***	5.33e-06***
Contiguity	1.330***	1.147***	0.463***	1.263***
GDP Origin	6.79e-09	1.18e-10	9.56e-10	6.84e-09
GDP Destination	-1.95e-09	1.18e-09	-1.97e-09	-4.45e-09
NUTS 5	3.219***	2.781***	0.979***	3.092***
NUTS 3	1.222***	0.998***	0.318***	1.056***
NUTS 2	0.0157	0.0161	0.0346	-0.198***
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,7**	**0,878**	**0,086**	**0,615**

VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
GTC	-5.34e-05***	-6.70e-05***	-4.19e-06***	-8.67e-05***
GTC Square	2.90e-10***	3.65e-10***	0***	4.96e-10***
Contiguity	1.312***	1.128***	0.463***	1.238***
GDP Origin	6.60e-09	-1.19e-10	9.77e-10	6.62e-09
GDP Destination	-1.87e-09	1.34e-09	-1.91e-09	-4.29e-09
NUTS 5	3.288***	2.861***	0.996***	3.152***
NUTS 3	1.290***	1.077***	0.334***	1.117***
NUTS 2	0.0987	0.107**	0.0534**	-0.119**
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,701**	**0,879**	**0,086**	**0,616**

Robust standard errors. Significance level: *** p<0.01, ** p<0.05, * p<0.1

According to the results, the total value of trade developed within the same municipality (*Nuts 5*) is much greater than inter-municipal trade flows, especially if we consider GTC and distance instead of travel time. In addition, the higher *Nuts_5* coefficient in the regression of the extensive margin (number of shipments) is indicating that this margin drives intra-municipal trade to a larger extent than the intensive margin (average value per shipment) for all types of transport costs. Apart, if we attend to the other administrative levels, provincial boundaries (*Nuts 3*) have a much more reduced effect on trade than the *Nuts_5* level, while regions (*Nuts 2*) lose importance as administrative boundary, signalling negligible effects. As we are using PPML and fixed effects by origin and by destination, we can correct for the gravity problems evidenced by the literature (Baldwin and Taglioni, 2006), that is why, our results are higher than those obtained by Hillberry and Hummels (2008), indicating a higher impact of the municipal boundary on the trade flows and its margins.

Looking at the coefficients corresponding to transport costs, all of them present the expected signs in all trade decomposition variables, indicating the existence of increasing returns in transport. However, the intensive margin shows a very small values (even zero) for the quadratic term, which suggests a low increasing return effect on transport. The contiguity variable is significative in all the regressions, that is, contiguous municipalities trade more among themselves than with more distant municipalities. Besides, the GDP by origin and by destination are not significant when we consider panel data, except GDP by origin when we using distance.

All estimations are robust to the three measures of transport costs, being travel time the most penalizing cost as it is related to road´s accessibility and efficiency. Also, thanks to the inclusion of total trade in physical quantities, we confirm the robustness of the coefficients to changes in the units of measure, specially for the regional dummy (*Nuts_2*) which shows a negative sign, i.e., inter-regional flows are higher than intra-regional ones. Finally, note the good fit achieved by the model (R^2) in explaining the total trade flows and the extensive margin, although it is smaller when explaining the intensive margin. With this first estimation we conclude that the GTC and the road network efficiency (travel time), reduce the importance of intra-municipal flows and the volume of trade developed within it. Hence, a geographical "*stationary*" or constant measure of transport costs, as it is distance, is not the most suitable variable for measuring the border effect between administrative boundaries. It also shows that the provinces and, particularly regions, become less important when GTC and travel time are used, indicating the existence of a weak internal border effect or only relevant at the municipal level. With these results, we remark the necessity of dissagregating regionally the trade flows and the transport costs if we want to measure the "real" border effect between areas.

Table 4 shows the regressiones for the extensive and intensive margin decomposition against the three measures of transport costs.

Table 4. Fixed Effect Estimation with Distance, Time and GTC (Second level decomposition)

VARIABLES	Extensive Margin		Intensive Margin	
	Number of shipments per commodity	Number of commodities	Price	Tons
Distance	-0.00394***	-0.00341***	-0.000754***	-0.00181***
Dist. Square	2.17e-06***	1.71e-06***	4.82e-07***	9.23e-07***
Contiguity	0.896***	0.724***	0.0995***	0.652***
GDP Origin	4.61e-09**	-2.28e-09*	-3.71e-09	3.24e-09*
GDP Destination	6.40e-09**	-2.12e-10	-5.06e-09*	3.41e-09*
NUTS_5	1.842***	1.401***	0.397***	0.962***
NUTS_3	0.578***	0.696***	0.322***	0.267***
NUTS_2	-0.0433	0.0933***	0.133***	-0.147***
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,325**	**0,494**	**0,075**	**0,136**

VARIABLES	Extensive Margin		Intensive Margin	
	Number of shipments per commodity	Number of commodities	Price	Tons
Time	-0.00426***	-0.00399***	-0.000860***	-0.00156***
Time Square	2.24e-06***	1.98e-06***	4.04e-07***	7.83e-07***
Contiguity	0.919***	0.737***	0.104***	0.675***
GDP Origin	4.05e-09*	-2.46e-09*	-3.69e-09	3.21e-09*
GDP Destination	5.35e-09**	-8.50e-10	-5.12e-09*	3.18e-09*
NUTS_5	1.880***	1.378***	0.350***	1.080***
NUTS_3	0.652***	0.704***	0.283***	0.401***
NUTS_2	-0.0255	0.0641***	0.0801***	-0.0622***
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,325**	**0,492**	**0,076**	**0,134**

VARIABLES	Extensive Margin		Intensive Margin	
	Number of shipments per commodity	Number of commodities	Price	Tons
GTC	-3.71e-05***	-3.45e-05***	-6.82e-06***	-1.36e-05***
GTC Square	1.98e-10***	1.70e-10***	0***	6.89e-11***
Contiguity	0.909***	0.727***	0.103***	0.670***
GDP Origin	4.35e-09**	-2.51e-09*	-3.63e-09	3.38e-09*
GDP Destination	5.79e-09**	-5.41e-10	-5.01e-09*	3.48e-09*
NUTS_5	1.944***	1.439***	0.373***	1.102***
NUTS_3	0.718***	0.764***	0.306***	0.425***
NUTS_2	0.0528*	0.139***	0.106***	-0.0293*
Dummy Year	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	195.225	195.225	195.225	195.225
R-squared	**0,325**	**0,491**	**0,134**	**0,616**

Robust standard errors. Significance level: *** p<0.01, ** p<0.05, * p<0.1

In the three cases the number of shipments per commodity (frequency) explains to a larger extent the extensive margin as it shows higher coefficients for all administratives boundaries than those showed by the number of different commodities shipped. Again, the importance of intra-municipal flows is reduced in the two decompositions of the extensive margin when we use GTC and travel time instead of distance. The *Nuts_3* and *Nuts_2* variables reflect the same pattern as in *Reg.1*, i.e., provinces (*Nuts 3*) reduce its importance as trade border while regions (*Nuts 2*) have not an important impact on trade flows, although it is higher than in *Table 3*. Besides, both variables show the expected signs for the transport costs (increasing returns in transport).

For the intensive margin, the coefficient associated to tons (physical quantities) is the most relevant to explain this margin. Tons are very important at the municipal level, although they show a decreasing trend among the borders, showing a negative impact at the regional level (*Nuts 2*). Apart, the *contiguity* variable and the GDPs are highly significant in the tons´ regression, indicating that movements of tons are very localized at the municipal level and that they are driven mainly by the municipal GDPs, reflecting an important share of trade only developed around and between cities (provision shipments). Indeed, this reduced effect of the regional levels on tons, would indicate that, if we measure trade flows in physical units rather than in monetary ones (Combes et al, 2005a), the border effect losses its relevance, being relatively insignificant, or even negative, for huge administrative units, i.e., trade flows crossing the regional borders are higher than those developed within them. Consequently, including prices to obtain monetary trade flows, introduces an upwards bias in the negative effects of regional borders (*Nuts 2*). Finally, and attending to prices, we can observe that the effect of increasing returns in transport over prices is very limited, being its linear fit (R^2) and value in each administrative level quite low. Concretely, municipalities are not as important as in the other trade decompositions variables. Also, provinces (*Nuts 3*) and regions (*Nuts 2*), although significant, have mostly the same impact on the average price of the shipments.

Next, we are interested on studying the dynamics of the internal border effect within Spain. To achieve this goal, we estimate the same econometric models as in *Table 3* resorting to a cross-section analysis instead of pooling the data in a whole panel database. In *Table 5* we regress our previous model (5) dividing the database by years but only attending to expression (1), that is, the total value of trade, the extensive margin and the intensive margin. However, in order to summarize the output table, we present only the results for the three administrative boundaries as we are interested on the dynamics of the border effect on the trade margins. Appart, in all the regression, although they are not included, the *contiguity* variable and the *GDP* by *origin* and by *destination* are highly significant.[20]

[20] For further details about the significance of the variables, in the Annex, *Table 8* presents all the estimations for distance, time and GTC.

Table 5. Cross-section regressions by years (First level decomposition)

Distance		2003	2004	2005	2006	2007
Total Value of Trade	NUTS_5	3.851***	2.974***	3.323***	3.135***	2.921***
	NUTS_3	1.560***	0.932***	1.238***	1.146***	1.145***
	NUTS_2	0.146	-0.194**	0.117	0.0383	0.0215
Extensive Margin	NUTS_5	3.265***	2.786***	2.805***	2.891***	2.748***
	NUTS_3	1.191***	0.941***	1.028***	1.039***	1.055***
	NUTS_2	0.171***	-0.00696	0.0532	0.114**	0.0997*
Intensive Margin	NUTS_5	0.878***	0.943***	1.030***	0.970***	0.880***
	NUTS_3	0.269***	0.195***	0.351***	0.287***	0.327***
	NUTS_2	-0.0937	-0.110*	0.0812	0.0703	0.0286
Travel Time		**2003**	**2004**	**2005**	**2006**	**2007**
Total Value of Trade	NUTS_5	3.721***	3.030***	3.273***	3.185***	2.931***
	NUTS_3	1.505***	1.035***	1.261***	1.223***	1.166***
	NUTS_2	0.0834	-0.180*	0.0895	0.0571	-0.00232
Extensive Margin	NUTS_5	3.040***	2.649***	2.702***	2.845***	2.645***
	NUTS_3	1.074***	0.890***	1.006***	1.034***	0.986***
	NUTS_2	0.0645	-0.0875*	-0.00130	0.0768*	0.0184
Intensive Margin	NUTS_5	0.936***	1.003***	1.045***	1.003***	0.843***
	NUTS_3	0.341***	0.259***	0.371***	0.323***	0.294***
	NUTS_2	-0.0277	-0.0477	0.0951	0.105**	0.0195
GTC		**2003**	**2004**	**2005**	**2006**	**2007**
Total Value of Trade	NUTS_5	3.795***	3.167***	3.458***	3.196***	2.835***
	NUTS_3	1.581***	1.168***	1.438***	1.235***	1.079***
	NUTS_2	0.179*	-0.0494	0.245**	0.108	-0.0313
Extensive Margin	NUTS_5	3.151***	2.806***	2.846***	2.871***	2.555***
	NUTS_3	1.184***	1.042***	1.146***	1.064***	0.906***
	NUTS_2	0.174***	0.0570	0.138**	0.136***	-0.00365
Intensive Margin	NUTS_5	0.958***	1.043***	1.041***	1.020***	0.841***
	NUTS_3	0.363***	0.297***	0.369***	0.341***	0.291***
	NUTS_2	0.00161	-0.0145	0.0976*	0.126***	0.0201

All administratives boundaries and transport costs reflect the same pattern for the total value of trade, i.e., there exist a slowdown tendency between 2003 and 2004; afterwards, there is a "pick" in 2005 leading again to a slow reduction during 2006 and 2007. It is reflecting that the internal border effect is not constant along the years. Indeed, administrative levels do not agglomerate the same amount of trade whitin themselves during all the years. The *Nuts_5* is the one with the highest impact on trade flows, even larger than in the panel data regression. Meanwhile, the *Nuts_2* level exhibits a not significant, or even negative, effect on trade flows, indicating again that regional borders are not as important as trade literature used to remark.

The extensive margin shows, for the three measures of transport costs, the same pattern as the total value of trade but with a lower reduction between 2005 and 2006. Finally, the intensive margin is increasing between 2004 and 2006, but the effect of administratives boundaries on this margin is quite reduced in relation to the extensive margin and the total value of trade.

Once we have analyzed the response of trade flows to geographical frictions, we propose an analysis based on the effect that transport costs have on the trade flows and its margins along the years, in order to determine which is the most suitable measure of transport cost when we have a panel data.

Table 6 shows the mean and the whitin variation of each transport cost, on average for the period 2003-2007 and for the individual years 2003, 2005 and 2007. We are only interested on the within variation (standard deviation) because it allows us to study the trade cost variability between years for the same pair *ij*. Additionally, the Pearson Coefficient (the standard deviation divided by the mean) is included to eliminate problems related to units of measurement to easily compare the different transport costs, to know which one has changed to a larger extent during the period. Appart, we include another measure of the distance, calculated with the GIS software as the optimal path between two municipalities, to show that the actual distance that we use from the micro-database presents even more variability along the years that the usual "stationary" distance considered previously on the literature.

Table 6. Transport Costs: Variation along the period.

Transport Costs	Average 2003-2007			Mean by years		
	Mean	Std. Dev.	Pearson Coefficient	2003	2005	2007
Real Distance	319,16	19,11	**5,99%**	318,85	319,31	319,38
Travel Time	293,43	9,92	**3,38%**	298,45	292,36	289,86
GTC	341,53	41,39	**12,12%**	361,71	354,36	304,24
Distance GIS	292,08	1,97	**0,67%**	292,47	291,85	292,00

As anticipated, *Table 6* shows that the GTC is the cost measure with the highest variation while travel time and distance have not diminished significantly. By individual years, again the GTC has reduced more than the other transport costs measures. As a result, we should expect a higher impact of the GTC on trade flows along the period, i.e., distance and travel time have a lower variation during 2003-2007, while the GTC has shown an important reduction in levels (represented by the anual mean) and has experimented the highest variability (Pearson Coefficient). Because of these characteristics, we should expect that variation in the series of trade flows should be explained to a larger extent by the variation in the GTC, while the rest of transport costs should not have a significant impact on trade flows variation as they have not experimented an important reduction. As a result, the distance variable, as it may constitute a good proxy for transportation costs in cross section studies, it can be considered as inadequate in panel data where transport costs may vary significantly. Also, the travel time variable only can be modified because of improvements in roads infraestructure. These improvements, from one year to the other, are not as significative as we should expect (low Pearson Coefficient) if we want to get real positive impacts of road infraestructure on trade flows. That is why we remark the use of GTCs as the only variable which actually captures the effect of transport costs in a panel data.

To achieve this idea, we perform a regression based on growth rates, to study to what extent variability on trade flows (total value of trade) is explained by variability on transport costs. Indeed, and according to the previous table, we should expect a more significant and negative impact of the GTC on the trade flows in comparison to the rest of transport costs. *Table 7* shows the results of regressing the growth rates of trade flows (and its margins) against the growth rates of transport costs. The regressions include, separately, as endogenous variables, the total value of trade, the number of shipments (extensive margin) and the average value per shipment (intensive margin), transformed in first differences, and as exogenous variables, the transport costs, in first differences too, and dummy variables for each year in the period plus dummy variables by origin and by destination to correct for unobserved heterogeneity and the effect of business cicles. With these regressions we can determine which is the transport cost that influences to a larger extent the interregional trade flows during the period 2003-2007.

Table 7. Variation effect of transport costs over the trade flows growth rates

VARIABLES	Total Value Growth Rates	Extensive Margin Growth Rates	Intensive Margin Growth Rates
Distance Growth Rates	-0.00181	-0.00336	0.00433
Travel Time Growth Rates	0.00281	-0.000761	0.00461
GTC Growth Rates	-0.0296**	-0.0355**	-0.0275*

Robust standard errors. Significance level: *** p<0.01, ** p<0.05, * p<0.1

As expected, distance and travel time have no significant effects either on trade flows variations (growth rates) or its margins, because their changes from one year to another are quite reduced. By contrast, the GTC has a negative and significant impact on the three endogenous variables, as we expected. Indeed, a reduction in the GTC leads to an increase in trade flows, that is, only reductions in the shipment´s aggregate economic cost, particularly those related to truck efficiency increases resulting in fuel cost savings, as well as the reduction of salaries—both the main components of trucking operating costs—brings larger trade flows. That is why we consider GTCs as the only adequate measure of transport costs when dealing with panel data, while distance and time are only suitable *proxies* of trade costs when there are cross-section data.

6. Conclusions.

In this study we have analyzed the structure of the internal border effect within Spain and the role palyed by transport costs in trade flows, making use of two novel databases in the literature on international and interregional trade flows. The first one compiles information about shipments transported by trucks between the Spanish municipalities for the period 2003-

2007. The second one involves the development of alternative and very precise measures of transport costs. In this sense, we have considered the actual distance travelled by the truck, reported in the shipments database and, additionally, using GIS methods we calculate the travel time and the generalized transportation cost of each itinerary between the Spanish municipalities (grouped by transport zones).

Thanks to the detailed information on shipments we decompose aggregate trade flows into their extensive and intensive margin, so as to know what are the effects of the geographical frictions on each one of them; particularly, the role played by the alternative measures of transport costs and the three territorial boundaries existing in Spain. Using this detailed information about the municipalities´ trade pattern, we conclude that the internal border effect varies in sign and magnitude depending on the administrative boundary and by each margin. Specifically, the results on the effects of the internal administratives levels on trade flows are higher than the findings by Hillberry and Hummels (2008), although they are in line with them. Likewise for all the cases studied, a decreasing influence of the border effect on trade is observed as goods are shipped to destinations located in regions differents from their own region of origin. In this sense, regional borders have a very reduced, or even negative, impact on the trade flows taking place within them.

Hence, we conclude that the estimations of the border effect in the literature tend to be upwardly biased, as it has been shown that the effect of a country's internal border is much smaller than those reported previously in the literature; particularly if trade is measured in tonnes (physical units). That is why we emphasize the need for using the most detailed measures of transport costs available, trying to take into account the exact places from where trade flows depart and arrive. Specifically, the most relevant measure of transport cost is the generalized transport cost (GTC) as it has been shown that it is the only measure capturing the real dynamic and negative effects on trade flows along the years. In fact, these findings lead us to recommend policy measures that seek greater integration between administrative boundaries in order to reduce the accumulation effect of shipments at short distances, so that they can be carried over longer ones. In this sense, an improvement of the roads that connect the most distant regions will reduce the border effect at the provincial and regional levels and, at the same time, it reduces the importance of intra-regional shipments by favoring trade (shipments) over a longer range. However, in a short run it would have more effects on the economic integration within a country if there exist higher reductions on economic costs variables (fuel, salaries, tolls…) through higher competition markets, than investing on road infraestructures which only ha effects on trade flows on the long run.

All these results call for future studies based on the effect that the road network efficiency has over the trade flows. It is necessary to expand the analysis to cover the endogeneity problem between trade and infrastructures as hinted by the previous conclusion, so as to try to understand in what sense it has led to the specialization of the economic structure of Spanish cities. Finally, focusing on sectorial analyses, it would be worth explaining the existence of large trade flows between cities located far away and presenting high transport costs, poses a challenge so as to establish the determinants of this pattern in trade, as well as trying to determine what are the goods that are shipped far away (heterogeneous goods) against goods which are traded over very short distances.

7. Bibliography.

Anderson, J.E. and Van Wincoop, E. (2003). "Gravity with Gravitas: A Solution to the Border Puzzle", *American Economic Review*, **93**, 1, 170-192.

Baldwin, R. and Taglioni, D. (2006). "*Gravity for Dummies and Dummies for Gravity Equations", NBER Working Papers*, 12516.

Baltagi, B., Wiley, J., and Sons (2008). "Econometric Analysis of Panel Data", Chichester, 4th edition.

Baltagi, B., Egger, P., and Pfaffermayr, M. (2003). "A generalized design for bilateral trade flow models", *Economics letters*, **80**, 391-397.

Chaney, T. "Distorted Gravity: The Intensive and Extensive Margins of International Trade." *American Economic Review,* **98,** 4, 1707-21.

Combes, P. P., Mayer, T. and Lafourcade, M. (2005a) "The trade-creating effects of business and social networks: evidence from France", *Journal of International Economics*, **66**, 1–29.

Combes, P. P. and Lafourcade, M. (2005b). "Transport costs: measures,determinants and regional policy implications for France", *Journal of Economic Geography*, **5**, 319-349.

Combes, P. P., Mayer, T. and Thisse, J., (2008). "Economic geography: The Integration of Regions and Nations", Princeton University Press.

Duranton, G., Morrow, P. and Turner, M. (2011). "Roads and Trade: Evidence from the US", *Working paper series*, University of Toronto.

Egger, P. and Pfaffermayr, M. (2003). "The proper panel econometric specification of the gravity equation: A three-way model with bilateral interaction effects", *Empirical Economics*, **28**, 571-580.

Feenstra (2004). "Advanced International Trade: Theory and Evidence". Princeton University Press.

Felbermayr, G. and Kohler, W. (2006). "Exploring the Intensive and Extensive margins of World Trade", *Review of World Economy*, **142**, 642-674.

Gil-Pareja, S., Llorca-Vivero, R., Martínez Serrano J.A. and Oliver-Alonso, J. (2005). "The Border Effect in Spain", *The World Economy*, **28**, 11, 1617-1631.

Head, K. and Mayer, T. (2002). "Illusory Border Effects: Distance mismeasurement inflates estimates of home bias in trade", *CEPII Working Paper 2002-01*.

Head, K., Mayer, T. and Ries, J. (2010). "The erosion of colonial trade linkages after independence", *Journal of International Economics*, **81**, 1-14.

Hillberry, R. (2002a). "Aggregation bias, compositional change and the border effect", *Canadian Journal of Economics*, **35**, 517-530.

Hillberry, R. (2002b). "*Commodity Flow Survey Data Documentation*", U.S. International Trade Commission, Forum for Research in Empirical International Trade (F.R.E.I.T.).

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

Hillberry, R. and Hummels, D. (2008). "Trade responses to geographic frictions: A decomposition using micro-data", *European Economic Review*, **52**, 3, 527-550.

Jann, B. (2007). "Univariate kernel density estimation", Boston College Department of Economics, Statistical Software Component, No. S 456410.

Llano, C., Esteban, A., Pulido, A., Pérez, J (2010): "Opening the Interregional Trade Black Box: The C-intereg Database for the Spanish Economy (1995-2005)". *International Regional Science Review*, 33, 302-337.

Mayer, T. and Ottaviano, G. (2007). “The Happy Few: The internationalisation of european firms. New facts based on firm-level evidence”, CEPR, Bruegel Blueprint Series, 3.

McCann, P. (2005). "Transport Costs and New Economic Geography." *Journal of Economic Geography,* **5**(3), 305-18.

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

Melitz, J. (2003). “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity”, *Econometrica*, **71**, 6, 1695-725.

Requena, F. and Llano, C. (2010). “The Border Effects in Spain: An Industry-Level Analysis”. *Empirica,* **37**, 455–476.

Santos Silva, J.M.C. and Tenreyro, Silvana (2011). “Further Simulation Evidence on the Performance of the Poisson Pseudo-Maximum Likelihood Estimator”, *Economics Letters*, 112(2), pp. 220-222.

Santos Silva, J.M.C. and Tenreyro, Silvana (2010), “On the Existence of the Maximum Likelihood Estimates in Poisson Regression”, *Economics Letters*, 107(2), pp. 310-312.

Santos Silva, J.M.C. and Tenreyro, Silvana (2006). “The Log of Gravity”, *The Review of Economics and Statistics*, 88(4), pp. 641-658.

Stack, M.M. (2009). “Regional Integration and Trade: Controlling for Varying Degrees of Heterogeneity in the Gravity Model”, *The World Economy*, doi:10.111/j.1467-9701.2009.01180.x

W Martin, CS Pham (2008), “Estimating the Gravity Equation when Zero Trade Flows are Frequent”, *MPRA Paper*, University Library of Munich.

Wolf, H.C. (2000). “Intranational home bias in trade”, *Review of Economics and Statistics*, **82**, 4, 555-563.

Wong, D. W. y Lee, J. (2005). “Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS”, Ed. John Wiley & Sons Inc., New Jersey (USA).

Zofío, J.L., Condeço-Melhorado, A.M., Maroto-Sánchez, A., Gutiérrez-Puebla, J. (2011). "Decomposing generalized transport costs using index numbers: A geographical analysis of the economic and infrastructure fundamentals", Economic Analysis Working Paper Series Nº 201106, Universidad Autónoma de Madrid.

Appendix

Map 1. Standard deviation of the Total Trade for the 633 municipalities. Average Values (Exports+Imports). Period 2003-2007.

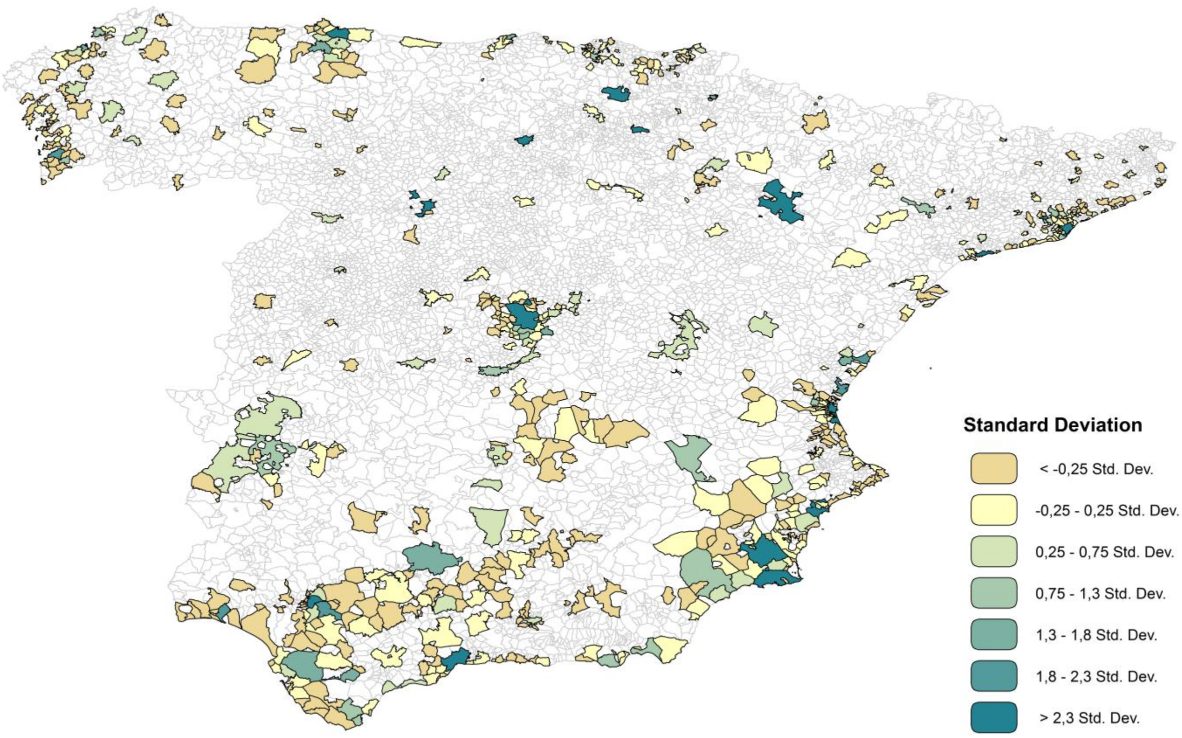


Table 8. Complete cross-section regressions by years for Distance, Time and GTC (First level decomposition)

YEAR	VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
2003	Distance	-0.00407***	-0.00556***	-0.000763***	-0.00754***
	Dist. Square	2.16e-06***	2.90e-06***	1.22e-07	3.97e-06***
	Contiguity	1.201***	1.113***	0.468***	1.168***
	GDP Origin	2.85e-07***	1.77e-07***	8.49e-08***	1.59e-07***
	GDP Destination	4.52e-08**	9.05e-08***	5.34e-08**	2.33e-08**
	NUTS_5	3.851***	3.265***	0.878***	3.437***
	NUTS_3	1.560***	1.191***	0.269***	1.096***
	NUTS_2	0.146	0.171***	-0.0937	-0.199**
2004	Distance	-0.00542***	-0.00604***	-0.000247	-0.00803***
	Dist. Square	2.95e-06***	3.17e-06***	-1.59e-07	4.09e-06***
	Contiguity	1.480***	1.193***	0.497***	1.399***
	GDP Origin	9.53e-08***	1.17e-07***	5.26e-08*	7.79e-08***
	GDP Destination	4.62e-08***	6.45e-08***	6.40e-08***	3.28e-08
	NUTS_5	2.974***	2.786***	0.943***	2.898***
	NUTS_3	0.932***	0.941***	0.195***	0.813***
	NUTS_2	-0.194**	-0.00696	-0.110*	-0.464***
2005	Distance	-0.00561***	-0.00617***	-0.000551***	-0.00873***
	Dist. Square	3.13e-06***	3.27e-06***	3.63e-07***	4.58e-06***
	Contiguity	1.391***	1.116***	0.510***	1.208***
	GDP Origin	1.57e-07***	1.27e-07***	1.14e-07***	8.94e-08***
	GDP Destination	1.66e-07***	1.27e-07***	6.90e-08**	9.89e-08***
	NUTS_5	3.323***	2.805***	1.030***	3.062***
	NUTS_3	1.238***	1.028***	0.351***	1.038***
	NUTS_2	0.117	0.0532	0.0812	-0.245***
2006	Distance	-0.00519***	-0.00569***	-0.000567***	-0.00752***
	Dist. Square	2.68e-06***	2.96e-06***	1.57e-07	3.86e-06***
	Contiguity	1.146***	1.136***	0.421***	1.119***
	GDP Origin	1.58e-07***	1.46e-07***	5.78e-08***	1.05e-07***
	GDP Destination	1.98e-07***	1.51e-07***	3.90e-08	1.03e-07***
	NUTS_5	3.135***	2.891***	0.970***	3.328***
	NUTS_3	1.146***	1.039***	0.287***	1.072***
	NUTS_2	0.0383	0.114**	0.0703	-0.0341
2007	Distance	-0.00506***	-0.00586***	8.04e-05	-0.00778***
	Dist. Square	2.65e-06***	2.96e-06***	-3.72e-07**	3.91e-06***
	Contiguity	1.324***	1.173***	0.431***	1.294***
	GDP Origin	2.13e-07***	1.84e-07***	9.95e-08***	2.12e-07***
	GDP Destination	1.99e-07***	1.60e-07***	7.76e-08**	1.85e-07***
	NUTS_5	2.921***	2.748***	0.880***	2.807***
	NUTS_3	1.145***	1.055***	0.327***	0.843***
	NUTS_2	0.0215	0.0997*	0.0286	-0.239***

YEAR	VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
2003	Time	-0.00511***	-0.00744***	-0.000875***	-0.00942***
	Time Square	2.68e-06***	3.96e-06***	3.89e-07***	5.17e-06***
	Contiguity	1.197***	1.103***	0.471***	1.176***
	GDP Origin	2.80e-07***	1.73e-07***	8.50e-08***	1.50e-07***
	GDP Destination	4.56e-08**	8.98e-08***	5.31e-08**	2.24e-08**
	NUTS_5	3.721***	3.040***	0.936***	3.284***
	NUTS_3	1.505***	1.074***	0.341***	1.093***
	NUTS_2	0.0834	0.0645	-0.0277	-0.234***
2004	Time	-0.00583***	-0.00780***	-0.000299	-0.00973***
	Time Square	3.00e-06***	4.14e-06***	7.49e-08	5.34e-06***
	Contiguity	1.499***	1.185***	0.497***	1.401***
	GDP Origin	9.36e-08***	1.15e-07***	5.27e-08*	7.51e-08***
	GDP Destination	4.51e-08**	6.50e-08***	6.37e-08***	3.09e-08
	NUTS_5	3.030***	2.649***	1.003***	2.897***
	NUTS_3	1.035***	0.890***	0.259***	0.909***
	NUTS_2	-0.180*	-0.0875*	-0.0477	-0.449***
2005	Time	-0.00678***	-0.00794***	-0.000559***	-0.0106***
	Time Square	3.68e-06***	4.28e-06***	3.41e-07***	5.93e-06***
	Contiguity	1.158***	1.138***	0.425***	1.136***
	GDP Origin	1.61e-07***	1.49e-07***	5.79e-08***	1.05e-07***
	GDP Destination	2.00e-07***	1.54e-07***	3.90e-08	1.04e-07**
	NUTS_5	3.273***	2.702***	1.045***	3.081***
	NUTS_3	1.261***	1.006***	0.371***	1.158***
	NUTS_2	0.0895	-0.00130	0.0951	-0.213**
2006	Time	-0.00596***	-0.00700***	-0.000688***	-0.00946***
	Time Square	3.11e-06***	3.68e-06***	3.37e-07***	5.24e-06***
	Contiguity	1.401***	1.126***	0.512***	1.208***
	GDP Origin	1.69e-07***	1.41e-07***	1.14e-07***	1.10e-07***
	GDP Destination	1.65e-07***	1.27e-07***	6.90e-08**	9.97e-08***
	NUTS_5	3.185***	2.845***	1.003***	3.321***
	NUTS_3	1.223***	1.034***	0.323***	1.124***
	NUTS_2	0.0571	0.0768*	0.105**	-0.0182
2007	Time	-0.00593***	-0.00770***	-0.000358*	-0.00893***
	Time Square	3.09e-06***	4.07e-06***	9.37e-08	4.85e-06***
	Contiguity	1.339***	1.172***	0.419***	1.313***
	GDP Origin	2.20e-07***	1.91e-07***	9.96e-08***	2.21e-07***
	GDP Destination	2.02e-07***	1.63e-07***	7.77e-08**	1.87e-07***
	NUTS_5	2.931***	2.645***	0.843***	2.934***
	NUTS_3	1.166***	0.986***	0.294***	0.975***
	NUTS_2	-0.00232	0.0184	0.0195	-0.178**

YEAR	VARIABLES	Total Value	Extensive Margin	Intensive Margin	Trade in Quantity
2003	GTC	-4.63e-05***	-6.51e-05***	-7.33e-06***	-8.26e-05***
	GTC Square	2.50e-10***	3.50e-10***	0**	4.62e-10***
	Contiguity	1.177***	1.082***	0.468***	1.152***
	GDP Origin	2.80e-07***	1.73e-07***	8.50e-08***	1.50e-07***
	GDP Destination	4.53e-08**	8.96e-08***	5.30e-08**	2.24e-08**
	NUTS_5	3.795***	3.151***	0.958***	3.398***
	NUTS_3	1.581***	1.184***	0.363***	1.204***
	NUTS_2	0.179*	0.174***	0.00161	-0.129
2004	GTC	-4.90e-05***	-6.57e-05***	-9.39e-07	-8.26e-05***
	GTC Square	2.53e-10***	3.52e-10***	-0	4.63e-10***
	Contiguity	1.488***	1.173***	0.501***	1.388***
	GDP Origin	9.37e-08***	1.15e-07***	5.27e-08*	7.51e-08***
	GDP Destination	4.50e-08**	6.48e-08***	6.33e-08***	3.09e-08
	NUTS_5	3.167***	2.806***	1.043***	3.061***
	NUTS_3	1.168***	1.042***	0.297***	1.066***
	NUTS_2	-0.0494	0.0570	-0.0145	-0.305***
2005	GTC	-5.59e-05***	-6.88e-05***	-5.56e-06***	-9.09e-05***
	GTC Square	3.11e-10***	3.84e-10***	0***	5.29e-10***
	Contiguity	1.148***	1.121***	0.421***	1.122***
	GDP Origin	1.60e-07***	1.48e-07***	5.80e-08***	1.05e-07***
	GDP Destination	1.99e-07***	1.53e-07***	3.91e-08	1.04e-07**
	NUTS_5	3.458***	2.846***	1.041***	3.243***
	NUTS_3	1.438***	1.146***	0.369***	1.314***
	NUTS_2	0.245**	0.138**	0.0976*	-0.0705
2006	GTC	-5.52e-05***	-6.37e-05***	-5.62e-06***	-8.86e-05***
	GTC Square	3.01e-10***	3.46e-10***	0**	5.18e-10***
	Contiguity	1.375***	1.101***	0.510***	1.173***
	GDP Origin	1.69e-07***	1.40e-07***	1.14e-07***	1.10e-07***
	GDP Destination	1.65e-07***	1.27e-07***	6.90e-08**	1.00e-07***
	NUTS_5	3.196***	2.871***	1.020***	3.306***
	NUTS_3	1.235***	1.064***	0.341***	1.116***
	NUTS_2	0.108	0.136***	0.126***	0.0230
2007	GTC	-5.94e-05***	-7.54e-05***	-3.03e-06	-8.75e-05***
	GTC Square	3.31e-10***	4.26e-10***	0	5.08e-10***
	Contiguity	1.308***	1.137***	0.419***	1.272***
	GDP Origin	2.20e-07***	1.91e-07***	9.95e-08***	2.21e-07***
	GDP Destination	2.02e-07***	1.63e-07***	7.76e-08**	1.87e-07***
	NUTS_5	2.835***	2.555***	0.841***	2.833***
	NUTS_3	1.079***	0.906***	0.291***	0.884***
	NUTS_2	-0.0313	-0.00365	0.0201	-0.208**