On the Determinants of Regional Trade Flows

Rosella Nicolini [*†]

[*]Researcher at CODE, Universitat Autònoma de Barcelona, Edifici B, 08193 Barcelona (Spain), ph. +34935811720, fax +34935812012, e-mail:rnicolini@pareto.uab.es.

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Abstract

This paper proposes an empirical investigation of regional trade flows following a cross-section method. For this purpose we refer to a regional context looking at a chosen sample of European regions. We mainly intend to assess the role of the home market effect and the level of transport costs in driving regional export flows. In particular, we are interested in testing the importance of spatial components in regional trade analysis. By simply adapting the gravity model approach to our framework, we are able to prove that physical distance smooths the intensity of trading flows while local transport facilities as well as local demand foster them.

1 Introduction

In economic literature, there is an increasing interest in joining the theory of *comparative and competitive advantages* with that of the location of firms. This stream of literature finds its origins in one of the principal unsolved dilemmas of trade theory: why and where people decide to locate their production. For a long time, the empirical investigation in trade theory aimed at finding an empirical support for the Heckscher-Ohlin (HO) framework. Unfortunately, reaching this goal revealed not to be an easy task: some unsolved dilemmas still exist. Theoretic predictions do not match empirical results when researchers account for transport costs or intra-industry trade flows (while the location problem is handled quite well).

This paper aims at developing an empirical investigation on the determinants of export flows, accounting for the presence of transport costs and increasing returns. We concentrate on a sample of European regions and we test an econometric model with the purpose to disentangle the features that affect the intensity of regional trading flows. In this sense, our econometric applications rely on some of the main features belonging to *gravity models*. But, at the same time, we try to improve the technique by extending the range of topics these models may concern. We proceed by taking a first glance at gravity models; we then go beyond the gravity approach.

1.1 Gravity models: space and increasing returns in bilateral trade flows

An interesting solution for accounting both increasing returns and transport costs in the same framework relies on gravity models. A gravity model is typically a log-linear relationship, expressing bilateral trade flows between a pair of countries as a function of two trading countries' income level, population and distance.[1] In its general form, it includes also an adjacency dummy, a common language dummy and dummies for commercial preferences. In empirical applications, these kinds of models are able to state that the distance between trading counterparts matters. In particular, spatial distance entails a negative effect (via the hypothesis of the presence of transport costs) on the consistency of trade flows. In the past, one of the major defaults concerning gravity models was their lack of theoretical underpinnings; recently it is possible to get them starting from many theoretical frameworks. The gravity equation has been derived theoretically through the properties of the Cobb-Douglas function, when each good is produced just in one country. The assumption of monopolistic competition ensures this condition. In this sense, Anderson (1979) argues that a sufficient condition for obtaining a gravity equation is the perfect product specialization, which implies that each commodity is produced just in one country. According to this approach, when the product specialization is the result of increasing returns to scale (IRS), the gravity results may be obtained even in absence of factor proportion differences. In that case, gravity models succeed in explaining even the intra-industries conditions of trade. This contribution also states that the success of gravity prediction for international trade relies on the presence of IRS when product differentiation and intra-industry trade prevail. Conversely, Evenett and Keller (1998) argue that the previous thesis is not exclusive for explaining the success of the gravity equation. Indeed,

[1] Indeed, Krugman and Helpman (1985) note that countries similar in size display a volume of trade proportional to their own GDP.

these authors consider that the volume of the intra-industry trade exchanges is determined by the extent of product specialization which is due to IRS. Symmetrically, trading exchanges relying on factor proportion differences are compatible with the HO model. So, they conclude that factor proportion differences are the most important determinants of trade flows within the context of imperfect specialization models, whereas there is evidence that increasing returns are a cause of product specialization which pushes the intra-industry trade flows.

The idea that the gravity and HO approaches are not so incompatible is well discussed in Deardorff (1998), even if the gravity models reveal to be a more flexible instrument than the HO model in presence of trading impediments. When trading flows suffer from trade barriers, the HO model cannot achieve the factor-price equalization, and this dynamics prevents a country from a complete specialization. Keeping this issue in mind and supposing that each good is produced just in one country, Deardorff comes to the conclusions that the HO model essentially predicts the same outcomes as those of any other model with differentiated products, thereby driving the emergence of the gravity equation once again. The possible linkage between HO and gravity models passes through the *Armington Assumptions,* namely the hypothesis that consumers may distinguish each commodity according to its place of origin. Moreover, Deardorff adds that in presence of identical and homothetic preferences plus frictionless trade, a *simple* gravity model may emerge (with a constant of proportionality) from a HO setting. In this case, he labels it *simple* because distance plays no role since there are not transport costs.

Nevertheless, the difference between the HO and the gravity approach relies on the way in which trading advantages arise. In a setting of comparative advantages, the demand for goods that are not sufficiently produced in a country gives rise to flows of imported goods. Conversely, in presence of economies of scale and trade costs, a country that displays a strong demand for a good becomes an interesting site to locate the production of that good and it may became a net exporter of it. This last feature is well known as the *home market effect*, (i.e. local demand drives the patterns of trade) and this effect is useful for distinguishing the basic features of a world of comparative advantages from one of increasing returns. Extending this idea, we may conclude that large countries may be preferred locations for producers, since they are more likely to display a larger home market effect. Applying this concept, Weder (1995) comments that, *in the open economy equilibrium, each country is a net exporter of a group of differentiated goods where it has a comparative home market advantage.*

Basing themselves on the centrality of the home market effect (via the role of the home demand), Davis and Weinstein (1999) explore other directions for questioning on the possible relation between the economic geography theory and that of Heckscher-Ohlin. In their (debated) contribution, these authors conclude that the HO framework fits in well with the international structure of production, while economic geography reveals to be very important for understanding the regional one. *Regional data support better the economic geography hypothesis,*[2] *because of higher factor mobility and lower trade barriers.*

[2] Henceforth, by the expression *the economic geography hypothesis* a collection of hypothesis about scale economies, home market bias and transport costs is meant.

Finally, some recent studies try to push the empirical investigation in trade matters farther than the standard economic geography approach allows. A recent paper by Obsfeld and Rogoff (2000) posits the crucial role of trade costs, as barriers to the free exchange of goods. Still relying on the empirical evidence, they show that international trade costs can skew domestic consumption in favor of home-produced goods. Indeed, theoretically, they show that high elasticity of substitution among varieties can explain a large observed home trade bias even with low level of transport costs, but further empirical tests need to be dealt with. Furthermore, the deeper analysis of the level of shipping costs involves acquiring some suggestions on the possible relationship between local economic growth paths and adverse geography. In other words, as they suggest, should we account for a slower growth for countries (or regions) with adverse geography by implying high shipping costs ?

1.2 Beyond the gravity approach

Although the econometric results of gravity models are remarkable, a critique may be addressed to them. Gravity models are usually concerned with the total trade between pairs of countries. Conversely HO theory evaluates the directions of a country's trade flows *towards* the rest of the world and trading partners are selected on the base of a different set of factor endowments.

Nevertheless, a richer framework should better emphasize some particular features of the trading partners, notably accounting for the geographic dimension (not included in the HO approach).

As a consequence of that, thinking of accounting space implies referring to economic geography models that cannot but account for the key features arising from gravity models.

Yet, the present study differs from the previous quoted contributions, because we engage in an empirical approach focusing on the regional sectorial export flows avoiding the bilateral exchange specification (as in the tradition of the classical trade theory). Usually, dealing with bilateral trade flows allows to account for as much information as possible about two regional (or national) counterparts, while looking at total regional (or national) export flows makes us loose some information. Notwithstanding, concentrating just on total sectorial trade flows is noteworthy. Without loosing the opportunity of including the geographic dimension, an empirical investigation that addresses the attention exclusively to the total sectorial export flows permits to detect the basic determinants of the regional competitiveness of a selected sector. Our purpose is to develop an econometric study to point out how some geographic components affect the sectorial regional export flows for a sample of European regions. To our knowledge, until now no study has dealt with this theme following the same kind of approach we propose. Yet, our full specification recalls some basic features of the gravity models. We represent the home market effect (that includes the IRS feature) by a proxy that accounts for the size of the local market (i.e. total population or total revenues), but we do not synthesize the existence of local transport costs with the distance between two trading partners. Because of our choice to investigate on the total sectorial trade flows (for a sample of regions in the European Union), we intend rather to evaluate the surface of the exporting region as a proxy for the average level of transport costs.[3] *In gravity models, it is the bilateral correspondence between*

[3] This assumption should be refined if we include in our sample regions or areas that are not so quite adjacent

two trading partners that allows to choose the geographical proxies in a model of trading. Here, we want to look for some further results in another perspective.

Another important step of our analysis is to define the criterion to select the most international competitive sectors for each region of the sample. We evaluate the international competitiveness of a sector as the propensity of that sector to export its production. For instance, in a region, we may distinguish as the most competitive sector the one devoting the largest part of its production to export. Extending the comparison to a group of regions, for a given sector, a region turns out to be more competitive than the others when it accounts for the largest quota of export in the correspondent international trading flows. In an imperfectly competitive framework, it is important to figure out the sources of that competitiveness. A possible way to tackle this problem is to evaluate the international competitiveness of a regional sector as a consequence of some pecuniary advantages that firms belonging to that sector exploit. In an economic setting *à la* Krugman (1991), competitiveness may rely on the advantages associated with the existence of internal scale economies (as IRS). In that case, the corresponding externalities support the creation of agglomerations of firms and the spatial distribution of economic activities make firms agglomerate into the larger market. When a group of firms displays a tendency to concentrate in a bounded area, such agglomeration is the result of backward and forward linkages between firms. In that case, firms benefit from joining an industry agglomeration since they succeed in reducing their own costs

(for instance European regions and US counties). In addition, if it could be possible to select data by sector and by macro-area of destination, a way to satisfy our criterium should be to compute the average distance from the examined regions and its preferential destinations.

of production. As a consequence of that, firms are able to built competitive advantages that they can exploit on the local market as well as in the international marketplace. Therefore, we assume that the competitive advantages of a *regional* sector on the international market stem from IRS. Thus, according to the regional export flow data at hand, we produce a comparative econometric study among some European regions that contain some industrial agglomerations for testing some theoretical outcomes *à la* Krugman (1991). Focusing on the outgoing regional trade flows of the principal sectors of specialization, we expect to detect a positive elasticity between the trade flows and the local demand (via the home market effect), while transport costs and physical distance should produce negative effects on the intensity of the regional export flows.

The remainder of the paper is organized as follows. The theoretical model introduced in Section 2. In Section 3, we deal with the empirical investigation of the outgoing trade flows for a sample of European regions, and Section 4 concludes and discusses some possible extensions.

2 The theoretical framework

Let us consider a system in which we identify two trading counterparts: a *region (R) and the rest of the world (ROW).* As in Krugman (1991), we assume that both regions are endowed with local firms (in a setting of monopolistic competition) and each of them hires its workers from the local population (N_R, N_{ROW}). This hypothesis is fundamental for stating that firms may have an advantage in locating in a bounded area (Krugman, 1991). For our purpose no assumption on the mobility of the factors of production is necessary. Conversely, it is important to assume that each consumer of the two counterparts includes in its utility function the consumption of both local and foreign (i.e. imported) goods.

The utility function of a consumer is a combination of the consumption of local (in proportion μ) and foreign goods (in proportion $(1-\mu)$):

$$U_R = C_R^{\mu} C_{ROW}^{(1-\mu)} \text{ and } U_{ROW} = C_{ROW}^{\mu} C_R^{(1-\mu)},$$

where

$$C_R = \sum_{k=1}^{n} \left(c_k^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \text{ and } C_{ROW} = \sum_{k=1}^{n^*} \left(c_k^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

in which n and n^* are respectively the number of firms in region R and in ROW, while σ is the constant elasticity of substitution between the different varieties of goods (both for R and ROW).[4] This specification also implies that the consumer of each region devotes the same share μ of income to the home-produced good. For the sample of regions we are choosing, this hypothesis seems reasonable. Indeed, we are selecting a sample of homogenous regions displaying a similar level of GDP per-capita (see Table 1), and consequently we may posit that those consumers may share the same kind of preferences.

We also assume that there exists a single factor of production, i.e. labor and each firm hires workers (L_i) for its production (x_i) according to its marginal productivity (γ), as in the following

[4] As pointed out by an anonymous referee, since we concentrate on sectorial trade flows, we do not need to care about the differences in size that could exist between the number of firms of the *region* and of the *rest of the world.*

equation

$$L_{ij} = \beta + \gamma x_{ij}, \qquad j = R, ROW. \tag{1}$$

In the absence of unemployment, the number of firms in R and ROW corresponds to the following relation

$$n = \frac{N_R}{L_{iR}} \text{ and } n^* = \frac{N_{ROW}}{L_{iROW}}. \tag{2}$$

In a monopolistic competitive setting *à la* Dixit-Stiglitz, each firm produces a single variety of a good which is different from the others according to a degree σ. When σ becomes arbitrarily large, the differentiated varieties are closed substitutes while for σ approaching to one, they are poor substitutes. Each firm charges a monopolistic price as a mark-up over its costs. In particular, being labor the unique input, its costs are given by

$$c_{ij} = w_j L_{ij}, \qquad j = R, ROW$$

with w_j the level of wages [5] in region j, such that maximizing the profits, each firm fixes its price equal to

$$p_j = \left(\frac{\sigma}{\sigma - 1}\right) \gamma w_j, \qquad j = R, ROW.$$

Firms sell their good both on the local and foreign markets. When they export, they incur transport costs (defined as iceberg transport costs $\tau > 1$) and so the total demand facing the local

[5] It is assumed to be equal for all firms and all workers, independetely of their skill.

firms in R is equivalent to:

$$D_R + D_{ROW} = \frac{n_R\left(p_r^{-\sigma}\right)}{n_R\left(p_r\right)^{1-\sigma} + n_{ROW}\left(\tau p_{row}\right)^{1-\sigma}}\mu Y_R + \frac{n_R\left(\tau p_r^{-\sigma}\right)\tau}{n_R\left(\tau p_r\right)^{1-\sigma} + n_{ROW}\left(p_{row}\right)^{1-\sigma}}(1-\mu)Y_{ROW}, \quad (3)$$

where Y_j $(j = R, ROW)$ is the j-country's income.

Our empirical investigation focuses on the regional outgoing trade flows. Therefore, we uniquely concentrate on the second term on the right hand side of equation (3). Indeed, the exports of a single region to the *rest of the world* are exactly equal to

$$EXP_R = \underbrace{\frac{n_R\left(\tau p_r^{-\sigma}\right)\tau}{n_R\left(\tau p_r\right)^{1-\sigma} + n_{ROW}\left(p_{row}\right)^{1-\sigma}}}_{H}(1-\mu)Y_{ROW}. \quad (4)$$

Due to the scarcity of data at hand we are not able to estimate this expression directly, so we look for a possible approximation that enables us to capture the basic features embedded in (4). In particular, in a regional setting, the ratio H in equation (4) encapsulates the relative weight of the consumption of R's goods in comparison to the ROW's goods. Indirectly it stands for the degree of competitiveness of R's goods (determined by the price ratio) for constant prices and elasticities. As a consequence of that, we rely on the outcomes of some existing studies (see, for instance Storper (1992) and Musyck (1994)), according to which it is plausible to think of an approximation of (4) via an expression including some elements that contribute to create the degree of competitiveness and sectorial specialization of a region. These studies suggest that the regional competitiveness stems from the regional sectorial specialization. In other words, the sectors in which firms perform best are also those for which a region displays competitive advantages (IRS). So far, these contributions suggest to evaluate the competitive advantages of firms belonging to a region (or a country) as the combination of several components mostly related to the local environment of the region we are referring to. As a consequence of that, a *circular causation* movement takes place. Indeed, Storper (1992) argues that the dynamism of firms yields important development effects on their host regions but, at the same time, these macro effects help in stimulating the performance of firms (as *forward and backward* linkages). In other terms, the size of the market allows them to exploit increasing returns to scale in production (namely, the home market effect), while the facilities in reaching the final *foreign* consumers should improve the quantity of the production devoted to exports.

As we are interested in referring to a typical geographic setting in which the geographical dimension and the home market effect emerge, we assume that the ratio H is proportional to the following expression:

$$H \backsim (Geo_R)^{\beta_1}(HM_R)^{\beta_2}(SE_R)^{B_3}; \tag{5}$$

where GEO stands for a geographic feature of the region that captures the effect of the existence of transport costs, HM represents the home market effect and SE accounts for a series of specific (ad-hoc) regional features. The previous three components are considered as the principal sources of competitiveness of clustered firms.[6] Replacing expression (5) in equation (4) yields

$$EXP_R = \left[(Geo_R)^{\beta_1}(HM_R)^{\beta_2}(SE_R)^{B_3}\right](1-\mu)Y_{ROW};$$

[6]See Storper (1992) and Musyck (1994) for more details.

that is equivalent to the following logarithmic form

$$Log(EXP_R) = c + \beta_1 Log(Geo_R) + \beta_2 Log(HM_R) + \beta_3 Log(SE_R). \tag{6}$$

in which $c = Log[(1-\mu)Y_{ROW}]$. By the previous definition, we implicitly assume that the level of revenue of the rest of the world (ROW) is constant and not affected by the revenue of the examined regions. Equation (6) is the equation we use for our econometric implementation. Even if it recalls some basic features of the gravity models, since the intensity of the trade flows relies on the spatial dimension, *it distinguishes itself by not accounting explicitly for bilateral trade flows*. This expression gives us the opportunity to account for two main effects of the model: trading costs and home market effects. In particular it will be our interest to point out the possible similarities between the stylized facts and the outcomes of this specification.

The geographic component is embodied in the distance for reaching foreign markets. In that sense, the larger the region (i.e. the surface of a region), the more expensive its trading is. But, as far as we consider an index of the local system of infrastructures, a higher value of it should correspond to a higher intensity in the trade flows. Indirectly, these two interpretations suggest that even if we consider a large region, the presence of an efficient internal transport system is expected to sustain the intensity of the interregional and international trading flows.

The home market effect is expected to affect positively the trend of the trade flows, since it is evaluated as the real source of the competitiveness of a region. Here, it will be evaluated for by the size of the local demand, since the European market is rather fragmented.[7] In our estimation we

[7]Indeed, it even happens that goods produced in one region are sold just in that region and exported abroad,

will treat it by using the regional GDP.[8] Finally, the expected coefficients of the dummies depend on what we choose to insert in our regressions and we will address this below.

3 The determinants of the regional trade flows

In this section we estimate equation (6) for a sample of European regions. As argued by theorists in economic geography, the local competitive advantages mainly rely on the increasing returns to scale. Empirical evidence (as in Storper (1992)) shows that, at regional level, IRS are strictly associated with the existence of local agglomeration of firms. As discussed in Session 1, IRS affect the productivity of firms belonging to an agglomeration. When the size of these concentrations of firms assumes a quite important dimension inside a region or a nation, they are expected to affect the trend and tendencies of some macroeconomics indicators related to the international openess of the region or nation. One of these is the international competitiveness of the regional industrial sectors that can be tested directly by intensities of the regional sectorial export flows. So far, we select a sample of European regions that satisfy the condition on IRS as previously expressed, such to concentrate on the hypothesis that the agglomerations of firms are possible sources of competitiveness. In addition, in order to account for monopolistic competition, we chose a sample of regions that display a similar industrial structure as well as the same specialization of the export trade flows. Indeed, by assuming that firms belonging to the same industry jointly set in a bounded area, we indirectly posit that each of them produces slightly differentiated goods.

without being present on the whole market of the country that region belongs to.

[8] We obtained similar results replacing the regional GDP with the regional population.

Our sample is composed of a group of European regions belonging to a few European countries. These regions have been selected according to the European Classification NUTS.

Referring to Figure 1, the regions of the sample are :

1. Baden-Württemberg (Germany, "1"),
2. Emilia Romagna (Italy, "2"),
3. Lombardia (Italy, "3"),
4. Rhône-Alpes (France, "4"),
5. Veneto (Italy, "5")
6. West Vlaanderen [9] (Belgium, "6").

Table 1 and 2 include some descriptive statistics about the selected regions. Their size and population are quite different, but all of them exhibit a level of regional GDP per capita higher that the European average. The intensity of the total trade flows (by unit of surface) does not differ substantially across the sample. Moreover, all these regions account for an important share of trade flows of their respective countries and their exports result to be mainly shipped to other EU countries.

[Picture 1 about here]

[Table 1 about here]

[Table 2 about here]

For each of these regions, our data set contains the amount of *international sectorial regional*

[9] It is a part (a *province)* of the Vlaanderen region in Belgium.

export flows [10] (provided by the competent regional statistical offices, see appendix 5.2 for further details), the surface, the GDP and the density of the transport system come from the database NEW- CRONOS- REGIO, Eurostat.

According to the empirical evidence, these regions include local agglomerations of firms that belong to the textile and mechanical (with machineries) sectors (Musyck (1994), OECD (1996) and Storper(1992)). Therefore, we consider the outgoing trade flows of the previous six regions in the textile and mechanical sectors for a period that covers the years from 1988 to 1993.

We build the dependent variable of equation (6) (*LEXPO)* with the purpose to develop a panel data estimation with three dimensions (years, regions and sectors).[11]

Box 1 contains a description of all the variables we will consider in the estimations of equation (6). In the econometric specifications, we evaluate (in alternance) two different proxies for including a geographic component in the regression. With the *surface* of the region (intended as the total geographic area of a region), we want to test if the size of a region is a good proxy for the level of transport costs that firms incur in delivering their goods abroad. Indeed, the larger the region, the higher (on average) the distance and the cost of trading should be. This assumption implies to admit that consumers and/or industrial activities are uniformly distributed in each selected region.[12] On

[10] For each sector of activity, we dispose of the export flows shipped to the foreign countries both inside or outside the EU. Therefore, we do not account for the interregional trade flows that take place among regions of a same country.

[11] All these estimations are computed with the Eviews software package. In all the following estimations we apply the White methodology for correcting OLS estmations from the heteroskedastic errors.

[12] Indirectly, we assume that each selected region displays the same internal industrial specialization, via the un-

the contrary, if we introduce in our analysis a measure of the degree of the organization of the transport system (i.e. the density of the transport network in each region of the sample),[13] we expect to obtain an opposite effect. Indeed the density of transport networks reflects the regional facilities for travelling, and an efficient system of communication reduces the transport cost, encouraging international exchanges. To represent the home market effect, we use the level of the regional GDP corrected by the volume of the region (namely the GDP per kmq), since it accounts for the size of the local demand that entails the creation of increasing returns to scale. This variable allows us to capture the idea of increasing returns to scale better than the simple GDP level. Indeed it measures the *wealth* of each unit of the regional space and it is a good proxy for the degree of efficiency in production of firms installed there. The more those firms exploit increasing returns to scale, the more they get international competitiveness and the more they succeed in improving the level of the regional GDP. As a consequence of that, we may confirm that the smaller regions do not always trade less than the bigger ones. For instance, if one refers to tables 1 or 2, Lombardia records a higher level of regional wealth (per kmq) and export per capita than the Rhône-Alpes, which is the biggest region of the sample.[14] Finally, the regressions are performed including a series of dummies. We handle to introduce a dummy for defining better the regional spatial location.

derpinning hypothesis of constant elasticity of substitution among varieties that is invariant across regions.

[13]It is the ratio between the total length of the transport networks (railways, ways, highways etc) and the surface of each region.

[14]The same kind of results can be obtained also correcting the level of regional GDP with the size of the regional population. Nevertheless, because of the existing strong correlation between the surface of the region and the GDP per capita, the resulting outcomes are not so significative as the others.

Indeed, since all the regions of the sample belong to the EU, we introduce a dummy for detecting the existence of regional border sharing with other non EU countries.

In addition, dealing with a panel data with three dimensions, another hypothesis that turns out to be interesting to test is the existence of fixed effects at the regional and sectorial levels.

The statistical procedure is briefly explained in Appendix. Investigating on the existence of fixed effects means looking for some common features that can affect the behavior of a whole sample of regions in export matters. According to Egger (2000), fixed effects are due to hidden variables that are specific to cross sectional units. Some of the main forces behind the fixed effects should be tariff policy measures or export driving variables,[15] above all in samples that follow an ex-ante predetermined criterium of selection. In this setting, focusing on export flows, we tackle this problem by testing the significance of sectorial or regional components that make the differences in export performances across the regions of this sample. As a consequence of that, those versions are obtained by relaxing progressively the restrictions on the coefficients of the equations and introducing regional or sectorial dummies.

Firstly we report the results of our estimations of equation (6) introducing the 'surface' variable, then those with the regional densities of transport costs. As mentioned, in each table we offer three different specifications moving from the one which displays more restrictions on coefficients. Looking at equation (1) in tables 3 and 4, we are able to confirm the basic effects we proposed to test. All

[15] For instance, the Italian currency devaluation in 1992 for Emilia Romagna, Lombardia and Veneto.

the variables included in the regression are significant at 5% and the explicative power of the model increases as we introduce sectorial or regional dummies. As we expected, the surface negatively affects the size of the outgoing trade flows. Similarly, not being a region that shares its border with other countries seems to negatively affect the intensity of the exchanges.[16] The home market effect always has a positive effect on export flows, that indirectly means assuring a certain degree of competitiveness as derived in theoretical models. These results confirm that (i) the spatial location of regions seems to be important and (ii) the degree of competitiveness of a regional industry passes through the size of the trading flows that rely on the size of the local demand.

[Box 1 about here]

[Table 3 about here]

[Table 4 about here]

The augmented specifications of equation (1) (both in tables 3 and 4) including sectorial or regional dummies, turn out to be more performing than the basic specification. Indeed the $R^2 - Adj$ increases as we introduce a higher degree of differentiation in such a way that the LSDV (with changing *slope*) estimator reveals to be even more appropriate than the simple LSDV (see F-test2). Moreover, looking at the F-statistic tests in table 1, it seems evident that the export flows of this sample display fixed effects, either regional or sectorial.

[16] We obtain a constrasting result when we allow for the presence of the *D2* dummy in the third specification of table 3. We do not account for this dummy when we are in presence of all other regional dummies because of collinearity.

From the statistical tests of table 4 we draw some further conclusions. When we include in our estimations some regional dummies, we cannot reject the hypothesis of identical fixed effects across the sample. Allowing for the presence of regional dummies means detecting the existence of fixed effects in the model selected by regions, but they disappear at the moment we introduce other sectorial dummies (TWFE estimator). So far, regional effects alone are marginally significant, while regional and sectorial effects jointly are significant. Indeed, surface (which is invariant over time) seems to capture dichotomous regional effects and any other regional discrepancy is captured by other variables.

Briefly, it appears that the differences in the intensity of the trade flows inside our specification for our regional model arises just as sectorial matters and not regional ones.

Now, we replace the *surface* variable with the *density of the transport system* as an index of the local facilities a region supplies to the local firms for trading. We compute again all the previous specifications and the basic previous results are confirmed.[17] In the basic equation (equation (1) in tables 5 and 6), the incoming variable positively affects the export flows. Indeed, the easiness in reaching a foreign destination positively affects the trade flows, since it drops the transport costs for unit of delivered good. Symmetrically, it should also encourage the incoming of foreign goods and stimulate the competition between local and foreign firms.

Finally, looking at the statistical tests (F-test) in tables 5 and 6, we obtain the same results as before and the comments made for the previous two tables also apply.

[17] Except for the dummy variable D2 which changes of significance in correspondence of the third specification.

[Table 5 about here]

[Table 6 about here]

Regional export data, as we applied here, seem to be coherent with the findings of the theoretical economic geography framework.

4 Conclusions

This study offers an empirical approach of a subject widely treated theoretically, but not so well considered empirically. We concentrated on a group of European regions. The estimations we derived sustain the correctness of the inclusion of spatial components in the analysis of the intensity of trade flows, such as the distance from the final destination and the density of the transport networks. At the same time, the *home market effect* helps in explaining the intensity of the outgoing flows, confirming that competitive advantages should be created rather than inherited. All these results reinforce the idea that firms may be seen as active and strategic agents on the market. Given the availability of data, further empirical studies along these lines at a level of local agglomerations are warranted. For instance, it would be interesting to refine the variables that account for regional competitiveness by including other proxies that could better capture the presence of increasing economies of scale.

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5 Appendix

5.1 Econometric Estimations: some details

In addition to the classic goodness-of-fit test, in our exercises we propose a further test: F test. It enables the possibility to test the presence of fixed effects (by regions or sectors). Looking for the presence of fixed effects across our sample means checking for the possibility to include other variables that are constant over regions (or over sectors). In particular, applying an *F-test* we plan to test two main hypotheses, namely whether the individual effects (α_{ij})-constant overtime- are constant across all unities and, in the case they are not constant, if there may exist some effects that change the slope of the regression.

We consider the general regression form of equation (6) for our panel at three dimensions

$$y_{ijt} = \alpha_{ijt} + \underline{\boldsymbol{\beta}_{ijt}}\mathbf{x}_{ijt} + \epsilon_{ijt},$$

with $i = 1.....n$, $j = 1.....s$, $t = 1...T$, as index for regions, sectors and time.

When we estimate the previous equation by ordinary least squares, if we consider $\alpha_{ijt} = \alpha$ as a constant over all the three dimensions we obtain a *POLS* estimator. In addition, when we let α_{ijt} vary just across one dimension (for instance $\alpha_{ijt} = a_i$ or $\alpha_{ijt} = a_j$), we introduce $(n-1)$ regional or $(s-1)$ sectorial dummies variables in our specification and the estimation of this model is known as *least square dummy variable model* (*LSDV*). On the contrary, when we model the fixed effects including regional as well as sectorial specific dummies we are dealing with a *two-way fixed effects* (*TWFE*).

The *F-tests* we propose are useful for selecting which one of the previous estimators is the most efficient. In all our tables, when we apply the *F-test 1 we want to test the hypothesis that the constant terms are all equal (i.e. LSDV or TWFE estimators versus POLS estimators). This means that when this hypothesis is accepted, the most appropriate estimator is pooled least squares (POLS).* In other words, considering an F-function that corresponds to the following statistics

$$F(n-1, nT-n-k) = \frac{(R_u^2 - R_{Pols}^2)/(n-1)}{(1 - R_{Pols}^2)/(nT-n-k)},$$

in which k represents the number of regressors (excluding the constant), and R_u^2 and R_{Pols}^2 are statistics coming from the alternative and POLS estimations, we test the following hypothesis:

for regional effects

$$H_0 = \left\{\alpha_{ijt} = \alpha \text{ for all } i, j, t\right\} \text{ vs } H_1 = \left\{\alpha_{ijt} = \alpha_i \text{ for all } j, t\right\},$$

or for sectorial effects

$$H_0 = \left\{\alpha_{ijt} = \alpha \text{ for all } i, j, t\right\} \text{ vs } H_1 = \left\{\alpha_{ijt} = \alpha_j \text{ for all } i, t\right\}.$$

Each time the statistic $F-test$ leads us to reject H_0 (i.e. the value of our statistical test is larger that those accounted for the tables for a F distribution at 1% or 5% level of significance), we conclude that the sectorial or regional effects are not the same in our sample. This finding implies that the *LSDV, LSDV (slope)* or the *TWFE* [18] estimator is the most appropriate one.

[18] It depends if we are referring to equation 2 or 3.

In addition, applying the *F-test 2,* we want to detect which estimator among $LSDV$ and $TWFE$ or $LSDV$ and $LSDV(slope)$ is the most appropriate one. We keep the basic features of the $F-test1$ and our hypotheses to test (for instance) $LSDV$ versus $TWFE$ are the following ones:

for regional effects

$$H_0 = \left\{\alpha_{ijt} = \alpha_i \text{ for all } j,t\right\} \text{ vs } H_1 = \left\{\alpha_{ijt} = \alpha_{ij} \text{ for all } t\right\},$$

or, for sectorial effects

$$H_0 = \left\{\alpha_{ijt} = \alpha_j \text{ for all } i,t\right\} \text{ vs } H_1 = \left\{\alpha_{ijt} = \alpha_{ij} \text{ for all } t\right\}.$$

As before, rejecting the hypothesis H_0 means that the TWFE is more appropriate than LSDV as an estimator, so that our sample contains both regional and sectorial fixed effects.

In order to verify if the differences among the components in our sample may be included only in the constant term, or if they affect even others coefficients, we apply the *F-test* to the *LSDV* and *LSDV (slope)* estimators. The *LSDV(slope)* estimator is obtained for a specification that includes a series a dummies that affect contemporaneously the parameters α_{ijt} and $\underline{\boldsymbol{\beta}_{ijt}}$. In this case, our statistic test deals with the following form

$$\begin{aligned} H_0 &= \left\{\alpha_{ijt} = \alpha_i \text{ for all } i,t \ / \ \underline{\boldsymbol{\beta}_{ijt}} = \beta \text{ for all } i,j,t\right\} \text{ vs} \\ H_1 &= \left\{\alpha_{ijt} = \alpha_i \text{ for all } i,t \ / \ \underline{\boldsymbol{\beta}_{ijt}} = \beta_i \text{ for all } j,t\right\}, \end{aligned}$$

and the way to interpret the results is identical to the previous tests.[19]

[19] For any other detail, see Greene (2000).

5.2 Data

The sources of the data we used for our empirical estimation are different. Macro regional data come from the database NEW CRONOS-REGIO Eurostat that has been made available by Région Wallonne (and we acknowledge Mr. J.P. Duprez). Regional trade flow data have been granted by local regional sources. We acknowledge :

· *Douanes Françaises* (Mrs C. Ferrieux) for data on Rhône Alpes,

· *Institut National de Statistique Belge* (Mrs. Amand) for data on West Vlaanderen,

· Prof. *R. Helg* (LIUC) for his data on Italian Regions,

· *Statistisches Landesamt Baden-Württemberg* (Mr. V. Fritz) for data on Baden-Württemberg.

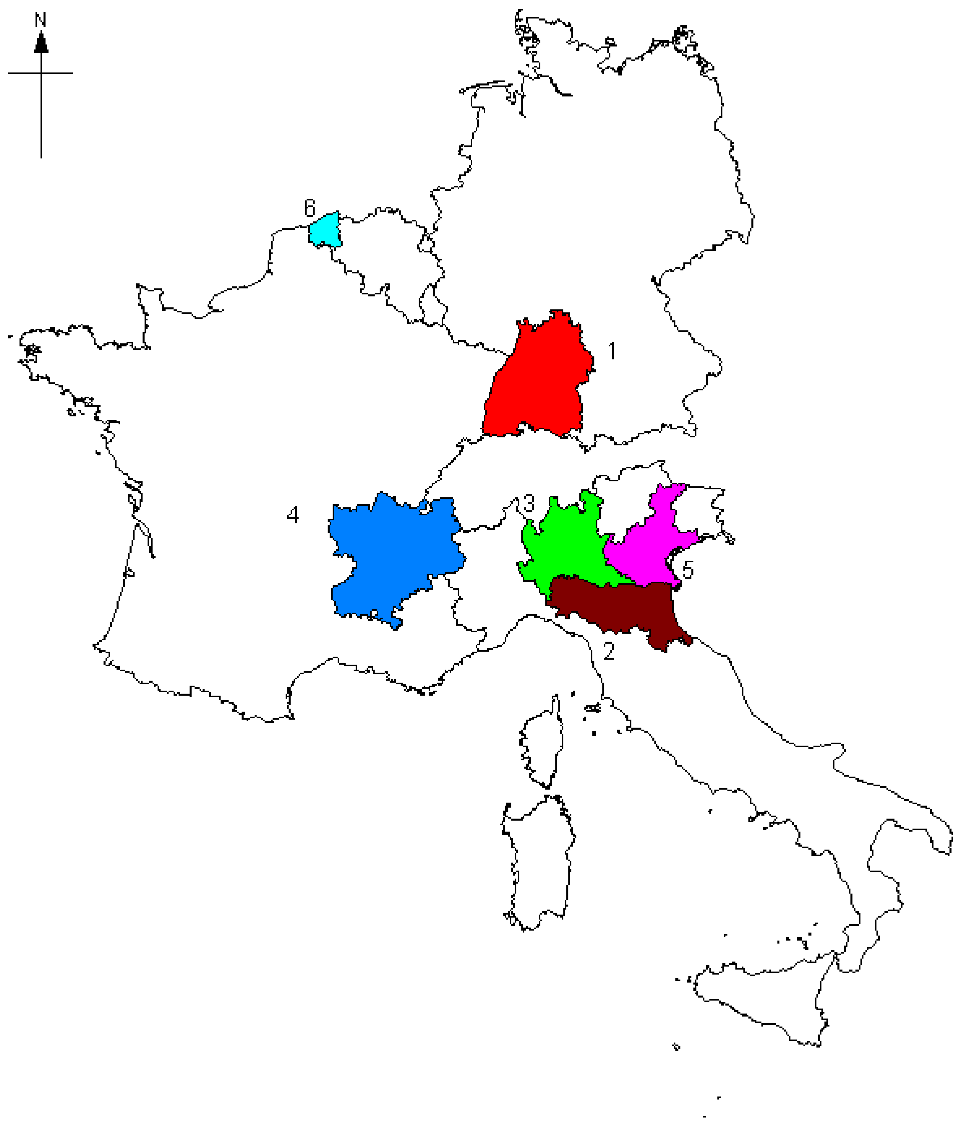

Figure 1: The sample of European regions (REGIOMAP-Eurostat).

TABLE 1

Regional features

(Data source: EUROSTAT)

	Surface(Km^2)	*Population (x1000)*	*GDP per capita (PPP)**
		(1996)	
Baden Württemberg	35751,3	10344	21854
Emilia Romagna	22124,4	4003	22740
Lombardia	23872	9106	22858
Rhône-Alpes	43698,1	5625	17763
Veneto	18364,6	4524	21260
West Vlaanderen	3134,4	1123	20504
EU-15			*17377*

*Average level 1994-1996, millions EURO

TABLE 2

Propensity to export

(Data source: Various Regional statistics)

	*Export per capita**	*Share in national exports*	*Export towards EU*
	(1996)	(1996, %)	(1996, %)
*Baden Württemberg***	6.5	11.89	56
Emilia Romagna	5.57	11.29	56.5
Lombardia	6.49	29.96	53.1
Rhône-Alpes	4.66	7.58	59.5
Veneto	6.09	13.95	56
West Vlaanderen[20]	11.69	9.5	....

*Thousand EURO, **1995

[20]Belgium is well known as a small open economy, such that a large part of goods and services produced inside the country are exported abroad.

BOX 1.

D2	Dummy for absence of regional adjacency with foreign countries
LDST	Logarithm of regional density of the transport network
LEXPO	Logarithm of regional exports (Millions ECU)
LGDPS	Logarithm of the regional GDP (Millions ECU) per Kmq
LSURF	Logarithm of the regional surface (Km^2)

TABLE 3

Regional trade flows:dependent variable **LEXPO**

Fixed effects: **Sectorial dummies**

Observations: 72

#	1	2	3
Dep. Var.	LEXPO	LEXPO	LEXPO
Method	POLS	LSDV	LSDV (slope)
Const	1.69 (0.04)	2.25 (0.00)	-0.41 (0.46)
LSURF	-0.64 (0.00)	-0.64 (0.00)	-0.58 (0.00)
LGDPS	1.13 (0.00)	1.13 (0.00)	1.30 (0.00)
D2	-1.20 (0.02)	-1.20 (0,00)	0.19 (0.01)
F-test1		42.15 [2.70]	36.22 [2.70]
F-test2			17.92 [2.70]
$R^2 Adj$	0.42	0.67	0.92

Values in round brackets: 2-tail statistics [21]

Values in square brackets: critical value

[21] These statistics represent the probability that the *t-stat* of each coefficient is greater than the correspondent *p-value.*

TABLE 4

Regional trade flows: dependent variable **LEXPO**

Fixed effects: **Regional dummies**

Observations: 72

#	1	2	3
Dep.Var.	LEXPO	LEXPO	LEXPO
Method	POLS	LSDV	TWFE
Const	7.53 (0.00)	3.70 (0.42)	4.27 (0.21)
LSURF	-0.93 (0.00)	-0.36 (0.37)	-0.36 (0.23)
LGDPS	1.44 (0.00)	0.70 (0.47)	0.70 (0.32)
F-test1		1.48 [1.92**]	7 [2.5*]
F-test2			4.03 [2.5*]
$R^2 Adj$	0.28	0.40	0.66

Values in round brackets: 2-tail statistics,

Values in square brackets: critical value,

F-value significance: *at 1%, **at 5%.

TABLE 5

Regional trade flows:dependent variable **LEXPO**

Fixed effects: **Sectorial dummies**

Observations: 72

#	1	2	3
Dep. Var.	LEXPO	LEXPO	LEXPO
Method	POLS	LSDV	LSDV (slope)
Const	7.53 (0.00)	8.09 (0.00)	7.99 (0.00)
LDST	0.80 (0.00)	0.80 (0.00)	1.11 (0.00)
LGDPS	0.75 (0.00)	0.75 (0.00)	0.77 (0.00)
D2	-1.36 (0.01)	-1.35 (0.00)	-0.01 (0.87)
F-test1		4.22 [2.70]	30,71 [2.70]
F-test2			14.29 [2.70]
$R^2 Adj$	0.42	0.67	0.91

Values in round brackets: 2-tail statistics

Values in square brackets: critical value

TABLE 6

Regional trade flows: dependent variable **LEXPO**

Fixed effects: **Regional dummies**

Observations: 72

#	1	2	3
Dep.Var.	LEXPO	LEXPO	LEXPO
Method	POLS	LSDV	TWFE
Const	6.78 (0.00)	7.68 (0.00)	8.24 (0.00)
LDTS	0.68 (0.00)	0.86 (0.37)	0.86 (0.37)
LGDPS	1.08 (0.00)	0.69 (0.47)	0.70 (0.32)
F-test1		1.86 [1.92**]	7.69 [2.5*]
F-test2			4.42 [1.92**]
$R^2 Adj$	0.23	0.40	0.66

Values in round brackets: 2-tail statistics,

Values in square brackets: critical value,

F-value significance: *at 1%, **at 5%.