The empirics of spatial competition: Evidence from European regions

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Abstract:

The contributions of the New Economic Geography literature allow analyzing with detail the factors that determine the location decisions in integrated markets, but in these models the competitive process is modelled in a rudimentary way. Besides, empirical evidence has usually been obtained from econometric specifications in reduced form. In this work a structural model is developed where strategic interactions among firms are taken into account. Hence we investigate the relationship between the degree of perceived competition, not only locally but also with respect to industries located in other regions, with geographic concentration. Preliminary results indicate that, in aggregate terms, the intensity of local competition is stronger than the competitive pressure exercised by distant industries. Moreover, it is confirmed that a greater geographical concentration of production reduces market power due to the intensification of local competition, but at the same time its impact on production costs is ambiguous.

Key words: spatial competition, agglomeration, conjectural variations.
JEL classification codes: F15, L11, L22, L23, L60, R15, R32

1 Introduction

In the context of industrial change that characterizes the last two decades, one of the corporate strategies developed, in order to achieve a bigger capacity of adaptation to the uncertainty of the markets and the reduction of production costs, consists on the disintegration of the productive process in a growing number of phases. These stages are usually carried out in separate establishments with decreasing average size, belonging to the same multiplant firm or to separate productive entities. This split in the value chain dissociates tasks previously integrated and increases the technical, functional and spatial division of labour. At the same time it favours the emergence of small specialized firms that act as suppliers and/or clients, creating networks of inter and intra-firm linkages. This phenomenon is identified with the concept of productive decentralization, vertical disintegration or fragmentation. It is, therefore, a new model of industrial organization that has a clear impact in the spatial distribution of productive activities: the location of new production units.

Since the second half of the eighties international trade and, most importantly, flows of foreign direct investment have arisen as new forms of international cooperation among firms. These characteristics of the internationalization of the economy are inherent to the globalization process and arise because of the reduction of tariff barriers, the progressive elimination of commercial restrictions and advances in transports and communications that facilitate the dispersion of economic activities, accelerate the diffusion of knowledge and technology and promote world scale integration. In the specific case of the European Union, the emergence of new competitors in the international markets and the opening and reorientation of East European countries has accelerated even more the globalization pressures, while greater integration has

eliminated commercial barriers among member countries, has created a single market and, in its last phase, has allowed the adoption of a common currency.

Both the processes of European integration and globalization have radically modified the competitive environment of EU industry. Not only the scope of competition has changed but also its nature: the search of cost reductions has been hindered while the pressure to produce (and sell with competitive prices) high quality goods has increased, forcing firms to achieve a continuous improvement of its products and processes, to face a bigger innovative effort and to the establishment of cooperation agreements both with suppliers and clients. In this context, firms' location decisions are more and more determined by the external context of the company and scale economies that tend to promote geographical concentration.

From the theoretical perspective, the new economic geography (NGE) analyzes the centripetal forces that induce firms to agglomerate in space and the centrifugal forces that incite them to separate. As Krugman (1995) argues, the main difficulties of traditional location theory lie in the relevant market structure. The analysis of economic geography requires the existence of imperfect competition and returns to scale that can be better described using the new tools provided by the theory of industrial organization.

In particular, in this work we wonder if the greater European integration will tend to preserve the existing asymmetries among the local conditions of production or on the contrary it will tend to equal them when strategic interdependence between firms is considered. Besides, it is interesting to ask if the envisaged changes in the productive conditions will affect location decisions, thus promoting a greater geographic concentration within EU member states or, on the contrary, it will generate dispersion forces that will tend to equate the spatial distribution of economic activities. Regional

differences in wages and productivity are also critical when studying location decisions and difficult to overcome due to the scarce labour mobility in Europe.

This work is organized in the following way. Section two offers a brief review of the literature on vertical linkages and agglomeration, as well as the NGE and spatial competition, with the objective of mixing both approaches. The third section presents the model to be estimated. In the fourth section different estimation methods are discussed and some hypotheses to contrast are developed. Section five describes the database and the variables employed in the estimation. The last two sections present the results and the conclusions, respectively.

2 Competition, vertical linkages and agglomeration

In his contribution to the phenomenon of industrial location, Marshall (1890) suggested that the geographical concentration of an industry allows the emergency in the vicinity of specialized producers of intermediate goods. An idea closely related, discussed by Stigler (1951), is that the spatial concentration of an industry can motivate vertical disintegration, that is to say, the tendency to obtain the inputs through market exchanges with specialized suppliers instead of manufacturing them inside the company.

Stigler (1951) demonstrated, following the famous theorem of A. Smith on the division of labour and the size of the market that there are efficiency gains when buyers and sellers concentrate geographically, via a greater specialization in the production of intermediate goods. Fujita (1990) formalized the argument using a model in which the production of final goods exhibits preference for variety of intermediate goods produced with decreasing average costs. A large industrial scale reduces production costs by means of a wide variety of specialized intermediate inputs.

The ideas of Marshall and Stigler that geographic concentration facilitates the emergency of a variety of specialized suppliers have played a key role in the development of an important theoretical literature. However, empirical evidence to validate these ideas has not seen a similar pace[1]. Some case studies and other so many anecdotes illustrate the emergence of specialized suppliers and they characterize the phenomenon of the vertical disintegration for concrete cases of industries highly agglomerated in the territory. Nevertheless, it is complicated to determine if these examples are common practices or, on the contrary, they represent isolated cases.

Firm's location decisions depend on the trade-off between production costs and access to markets. When trade costs are low, for example when a certain degree of integration exists among the different territories under study, firms are highly sensitive to production costs differences. On the contrary, in the presence of high trade costs, i.e. before the adoption of measures of commercial liberalization, firms are tied to markets and their location decisions are much less sensitive to costs differentials. At intermediate levels of trade costs, the firms' distribution of an imperfectly competitive industry is biased toward locations with better market access. These locations can, therefore, maintain greater real wages than other less central territories, as Krugman (1980) and Krugman and Venables (1990) have demonstrated.

Nevertheless, this observation is of moderate interest until combined with the actions of other economic agents. For example, Krugman (1991a, b) adds labour mobility to the picture. That enables locations close to bigger markets to offer higher real wages than those paid by firms in distant regions because they face more transport costs to sell their products in more dense markets. Thus, a

[1] Duch (2004) offers a survey on the empirical literature on the relationship between vertical integration and location.

higher real wage attracts workers, what causes that the size of the market increases and this, in turn, cause a greater concentration of economic activities.

However, this explanation is not very creditable in the case of the European Union, since the degree of labour mobility is low, not only among the different member states but also within regions of the same country. As Venables (1996), Ekholm and Forslid (1997) and Amiti (2001) have demonstrated, labour mobility is not the only reason that explains market size in different locations. If industries are vertically related trough an input-output structure, then final producers form the market for intermediate goods. In this situation, market access considerations will push intermediate firms toward those regions with a relatively high share of final firms. In the same way, a high concentration of intermediate firms in a region will act as a centripetal force for final firms, because of the savings in transporting the necessary inputs for production.

Although the mechanisms of attraction and repulsion are clear in the models of the NGE, the process of local (as well as spatial) competition is modelled in a rudimentary way. We know from spatial competition models that strategic interactions among firms are a fundamental piece in the competition process in spatial markets. In the basic model of Hotelling (1929) when there is not price competition and the decisions are simultaneous, market share rivalry induces firms to agglomerate. On the other hand, in the Hotelling model with quadratic costs [d'Aspremont et al. (1979)] where firms choose location in the first stage and compete in prices in a second stage, the incentives to move away from competitors with the objective of relaxing price competition dominates the market share effect, driving firms to maximize their spatial differentiation (dispersion). Therefore, a basic conclusion in this approach is that price competition acts like an important centrifugal force.

If competition is relaxed, for example when products are imperfect substitutes by means of differentiation, firms can find strategically profitable to

agglomerate. On the contrary, if competition is defined by a Cournot setting and strategic interactions are less aggressive than under a Bertrand assumption, agglomeration is a general result, as shown by partial equilibriums models of Anderson and Neven (1991) and Krugman and Venables (1990).

In this way, the analysis of location patterns of vertically related firms not only requires to study the mechanisms of attraction and repulsion in terms of production costs and access to the markets, but rather it should also consider the type of competition and the strategic interactions among firms, both horizontally and vertically. Therefore, the balance of centrifugal and centripetal forces has as much a horizontal as a vertical component. Moreover, each one is defined from market access and production costs considerations as well as from strategic interactions among vertically related firms.

In this paper we rely on the NEIO[2] literature to analyze the characteristics of spatial competition on regional industries along the European Union (EU). It is necessary to keep in mind that the theoretical approach in which we move corresponds to the ideas advanced by the different models of spatial competition. From this perspective, we know that the formation and the size of agglomerations depend on the relative balance of three different forces: i) the magnitude of agglomeration economies, mainly due to localization economies arising in a vertically integrated industry; ii) the intensity of spatial competition and, iii) the magnitude of transport costs.

It is well known from the theory of industrial organization that geographical proximity hardens competition, inducing firms to disperse in space. This implies that firms' agglomeration or dispersion decisions depend on the relative intensity of localization economies and competition. Even if competition is relaxed, either through product differentiation in the case of price competition

[2] This is the abbreviation of New Empirical Industrial Organisation, as termed by Bresnahan (1989) and others.

or by means of any form of collusive agreement (tacit or not) if the competition is defined by market shares, firms will still want to be dispersed if transport costs are high. In a context where trade costs are decreasing, location decisions then will be defined by the balance between economies of agglomeration and the intensity of competition, not only with neighbouring firms, but also with distant firms that can penetrate the local market by means of exports.

If firms and consumers are dispersed geographically and the number of firms is small in relation to the demand, for example due to the existence of indivisibilities in production, each firm can exploit a certain degree of market power in its local market. In other words, the presence of returns to scale prevents that regional markets are perfectly competitive because the differences in consumption location and, therefore, transport costs, are a source of market power. Spatial competition is necessarily imperfect and should be studied in the appropriate context and with the appropriate models. Having recognized this fact, the balance of forces between transport costs and increasing returns is fundamental for the determination of the number of firms that compete in a region with a given population.

The essence of spatial competition has been probably better described by Kaldor (1935), who argues that firms' location decisions determines the nature of competition among them in a specific way: independently of the number of firms that operate in the industry from an aggregate point of view, the competition is localised: each company competes more intensively with its neighbours than with distant firms. Thus, spatial competition is inherently strategic since each firm should worry about the behaviour of a reduced number of direct competitors independently of the total number of firms in the industry. This does not imply that the industry is formed by independent clusters of firms. Given the strategic interdependences between the firms and the input-output complementarity relationships among them, all the clusters are interrelated by a complex net of interactions.

From these observations and making use of the methodology proposed by the empiric literature on conjectural variations, we estimate the degree of perceived competition in some European regions and industries. We separate what refers to conjectures related to horizontal competition, both local or with firms located in other regions (what we term "external"), and those formed by the vertical relationships between final and intermediate firms.

3 Spatial competition and agglomeration: the model

The starting point of the empirical analysis is an industry distributed geographically in different regions. In the region j, there are Nj firms that produce a final homogeneous good $\boldsymbol{q}$ from a homogeneous intermediate good $\boldsymbol{x}$. The inverse demand function for final goods in region j is given by

$$p_j = p(Q, z)$$

where p_j is the final good price in region j, Q is total quantity produced by industry, composed by the quantity of the final good produced in region j (Qj) and the quantity produced in other regions (Q-j), $\boldsymbol{z}$ is a vector of demand shifters. It is assumed that the technology used for the transformation of the intermediate input into a final good is one of fixed coefficients where a 1:1 relationship is established, so that the production of final and intermediate goods can be represented by the same variable[3].

The technology of the final stage of production is represented by means of the cost function $\boldsymbol{k(q,w)}$, where $\boldsymbol{w}$ is the vector of factor prices and $\boldsymbol{q}$ the quantity produced by the individual firm. The intermediate good is produced in a vertically related industry characterised by a quantity setting oligopoly with a

[3] This allows us to obviate the problem from the scarce availability of statistical data at regional level.

cost function ***c(x,w)***. As shown in Duch (2004), this industry sets prices according to a mark-up over industry's average marginal cost, $\bar{\mu} + c'(x,w)$. In this context, the profit function of each final producer located in j is

$$\pi_{ij} = \left[p_j - \bar{\mu} - c'(x,w) \right] q_i - k(q,w)$$

Assuming that each final producer chooses ***q*** to maximize profits, first order conditions would be

$$p_j - k'(q,w) = \bar{\mu} - q_i \frac{\partial p_j}{\partial Q}(1+\phi_i) + q_i c''(x,w)(1+\theta_i) + c'(x,w)$$

where ***c''(x,w)*** is the second derivative of the intermediate firm cost function, ϕ_i is firm's i conjectural variation parameter with respect to local and external competition, θ_i is firm's i conjectural variation parameter with respect to intermediate firms.

If we multiply the first order condition for profit maximisation by q_i/Q_j, we sum over all firms and divide by p_j, we have the following relationship

$$M_j = \bar{\mu}^* - \frac{S_j H_j}{\eta_j}(1+\Phi) + Q_j H_j \frac{c''(x,w)}{p_j}(1+\Theta) + \frac{c'(x,w)}{p_j} \qquad (1)$$

where Mj is the industry's weighted price cost margin in region j, Sj is the regional share in total industry's production, Hj is Herfindhal's industrial concentration index in region j, η_j is the price elasticity with respect to industry's total quantity demanded, Φ is the firms' share weighted conjectural variation in the final goods market. This conjecture is composed by the weighted conjectural variation with respect to firms located in the same region

($\partial Q_j / \partial q_i$) and by the weighted conjectural variation with respect to external competition (firms located outside the region, $\partial Q_{-j} / \partial q_i$). The parameter Θ is the weighted conjectural variation in the (local) intermediate market[4].

For the empirical implementation, we assume that the corresponding intermediate goods cost function adopts the Generalized Leontief functional form and therefore becomes

$$c(x,w) = x\sum\sum \alpha_{ij}(w_i w_j)^{1/2} + x^2 \beta_i w_i \tag{2}$$

where, by symmetry, it is assumed that $\alpha_{ij} = \alpha_{ji}$. Substituting (2) in (1), and using the equality $\boldsymbol{q} = \boldsymbol{x}$ (1:1 relationship between intermediate and final goods) we obtain the industry's aggregate price cost margin equation as the equilibrium relationship in region j as

$$M_j = \bar{\mu}^* - \frac{S_j H_j}{\eta_j}(1+\Phi) + 2QS_j H_j \sum \beta_i \frac{w_i}{p_j}(1+\Theta) + \sum \alpha_{ij} \frac{(w_i w_j)^{1/2}}{p_j} + 2Q_j S_j H_j \sum \beta_i \frac{w_i}{p_j} \tag{3}$$

The first term on the right hand side of the equation represents the margin over marginal cost that intermediate firms charge when taking advantage of market power. The second term measures the oligopolist distortion in the final goods market. We see that this distortion is positively influenced by the region's share in industry's total. The third term shows the possibility that final firms can exercise some type of oligopsony power in the intermediate market, measured by the corresponding conjectural variation parameter. The rest of the expression represents the parameters of the intermediate stage cost function.

[4] It has been supposed, basically because of the lack of detailed statistical information at regional level that the purchases of intermediate goods are carried out exclusively in the same region in which the company is located.

In order to identify the parameters of the price cost margin equation in region j, it is necessary to jointly estimate the corresponding demand function:

$$\ln Q = \eta_0 + \eta_j \ln p_j + \eta_1 \ln p_1 + \eta_2 \ln p_2 + \eta_3 \ln y_j + \eta_4 \ln y_t \qquad (4)$$

where η_0 is the intercept, p_j the price in region j, p_1 the price of complements, p_2 the price of substitutes, y_j is per capita income in region j and y_t is average per capita income in the EU. Equations (3) and (4) form the spatial competition model to be estimated.

4 Estimation and hypothesis testing

As it has already been pointed out, parameter identification requires the joint and preferably simultaneous estimation of the price-cost margin equation and the demand function. Given the non-linearity of the margin equation and the endogeneity of some variables composing the system, concretely the relationship between the price-cost margin and the local concentration index, non linear three stage least squares (N3SLS) method is the most appropriate for estimation purposes[5]. We use lagged values of the variables as instruments.

The model outlined in the previous section allows analyzing the competitive behaviour of firms in space. However, the conjectural variation parameter in the final stage is composed by firms' conjectures with regard to the reactions of its local competitors and also by the expectations about the reactions of the firms located in other regions. Therefore, to be able to identify the parameters associated to each type of conjecture, it is necessary to design additional specifications that allow obtaining more information on the essential features of spatial competition. Thus, the first and simplest modification that is introduced

[5] It is also possible to use a recursive method. This would consist on estimating the demand function in the first place and with the price elasticity estimated parameters estimate in second place the transformed price cost margin equation.

is to parameterise the final stage conjectural variations to include the market share of firms located outside of the reference region that play a decisive role in local firms' competitive behaviour. Hence, the following relationship captures the required modification

$$\Phi = 1 + \lambda_0 H_j + \lambda_1 (1 - S_j)$$

The equation shows that the weighted conjectural variation regarding the local market depends on the local Herfindhal index, while the weighted conjectural variation that captures the degree of external competition is captured by means of the share of the rest of locations different to region j in total industry's production.

Another important element is the identification of some effects that can play an important role in the location decisions and for the industry's vertical organization and geographical concentration. Differentiating the price cost margin equation with respect to region j's share of production in total industry, Sj, we obtain the effect of spatial concentration on the margin (assuming that conjectural variations are constant in time):

$$\frac{\partial M_j}{\partial S_j} = -\frac{H_j}{\eta_j}(1+\Phi) + 2QH_j \sum \beta_i \frac{w_i}{p_j}(1+\Theta) + 2QH_j \sum \beta_i \frac{w_i}{p_j} \qquad (5)$$

The first term on the right hand side of equation (5) is the effect of a change in geographical concentration on the market power that final firms can exert. The second term represents the distortion between price and marginal cost in the intermediate goods market, derived from oligopsonist behaviour of final firms over the intermediate ones. Finally, the third term on the right hand side of equation (5) is the effect of geographic concentration on production costs.

5 Data and variables

The model to be estimated is composed of the price-cost margin equation, the demand function and the definition of the conjectural variations parameter. For estimation purposes, the following variables have been built:

Price – cost margin: as in most of empirical studies, this is approximated by the quotient of the difference of value added and compensation of employees over the value of production:

$$M_j = \frac{VAB - R}{VBP}$$

Value added and wages and salaries were obtained from REGIO database for each sector and region. The value of production (VBP) it is the sum of value added and intermediate consumptions. As it was assumed a 1:1 relationship between final and intermediate goods, VBP is just twice the value added.

Herfindhal concentration index: given that there is no sufficiently detailed statistical information on individual firms' production shares, this variable is approximated by its numbers equivalent, this is the number of identical firms that generate a given value of the index. Thus, the index is

$$H = \frac{1}{n}$$

The number of firms by region and sector is obtained from Eurostat's Structural Business Statistics.

In the case of the demand function it was not possible to obtain prices at regional level. Therefore, prices are national averages by sector and are the

same ones for all the regions of the same country, but they differ by sectors. Moreover, regional and EU's average per capita income is included in the demand function. Specifically we have the following

Price of the good: Consumer price index for each country and each sector, from Eurostat.
Price of complements: Weighted average consumer price index for all sectors excluded that of reference in a given country.
Price of substitutes: Weighted average consumer price index for all countries excluding the one of the reference region.
Regional per capita income: obtained directly from REGIO database.
EU average per capita income: obtained directly from REGIO database.

The cost function requires the use of variables that approximate factor prices. It is assumed that the production of intermediate goods only requires labour and capital. These variables have been approximated by:

Price of labour: the quotient between compensation of employees and the number of workers by sector and region, index 1985=1.

Price of capital: to approximate this price we follow the methodology proposed by Oliveira-Martins et al. (1999) based on the following formulation:

$$r = \left[(i - \pi^e) + \delta\right] p_k$$

where r is the price of capital, i is the long run nominal interest rate, π^e is expected inflation, δ is the depreciation rate (fixed at 5%) and p_k is the capital formation deflator. Since many required variables were not available at regional level, they were used at national level. Data have been obtained from OECD Economic Outlook.

In addition to these variables, market shares of each region (regional value added over total industry's value added) are used as well as the quantities of final and intermediate goods, both approximated by value added. A database has been created with 104 regions from 11 countries of the EU for the period 1985-1995 and for 9 manufacturing sectors. The regions included are listed in table A.1 and the different sectors in table A.2 in the appendix.

6 Results

The estimation results are presented in table 1. Recalling that it has been assumed that the intermediate goods market is perfectly integrated, the number of parameters to estimate reduces considerably. Thus, it will be estimated only a average margin above marginal cost for intermediate goods, represented by μ. Moreover, a single sectoral conjectural variation parameter for the vertical relationships in the industry will be considered, to try to measure if the final producers enjoy some oligopsony power over intermediate firms.

From the results in table 1 we see that the estimated parameters associated to the intermediate margin are statistically significant and intuitively interesting. In general, intermediate firms apply margins over marginal costs of about 20 and 30%, being the greatest one equivalent to 29,86% in the Ferrous and non-ferrous ores and metals sector. On the other hand, the smaller is similar to 21,6% in the Paper and printing sector. Also, it is possible to confirm that in most sectors, final firms are price takers in the market of intermediate goods as the parameters associated to weighted conjectural variations in the intermediate goods market is statistically similar to -1, the value for the conjecture associated to price taking behaviour. In four cases (Non metallic minerals and mineral products; Food, beverages and tobacco; Paper and printing and Products of various industries) the obtained parameters are not statistically different from zero, so it is not possible to discard that in these sectors other types of

behaviour are taking place (Cournot or collusion), which means that final firms expect that intermediate firms don't react to their strategic movements. In this situation it is observed, except for the Products of various industries sector, that price cost margins in the intermediate goods market are smaller than in the rest, where final firms are price takers.

Results also reveal that all the parameters associated with the price of complements have the expected sign (negative), the same that happens with the price of substitutes having parameter estimates with positive sign, except in the case of Food, beverages and tobacco. As for the regional income elasticity, the majority of goods are normal (the sign of the parameter is positive) but in four sectors (Ferrous and non ferrous ores and metals; Non metallic minerals and mineral products; Transport material and Food, beverages and tobacco) the signs are negative, indicating that in these cases goods are inferior. Nevertheless, the parameters estimated in these last three cases are not statistically significant. In the case of average EU income elasticity, the only sectors that present negative parameter estimates are Ferrous and non ferrous ores and metals and Textiles and clothing, leather and footwear.

As for conjectural variations, these are presented in figure 1. The figure shows the degree of competition perceived by the different manufacturing sectors. The horizontal axis measures the conjectural variation with respect to local competition whereas in the vertical axis the expected reactions regarding external competition (i.e. from firms located outside the region) are shown. The negative relationship found for all sectors means that when local competition is stronger, industries try to exploit market power in distant markets, maybe through cooperative agreements or by collusive behaviour. Those regions that have a high degree of local competition (when the parameter of the conjectural variation referred to the local competition is close to or greater than -1), present conjectural variations in relation to external competition close to zero,

indicating that the local industry perceives that the neighbouring competitors won't react to their strategic movements.

Table 1. Estimation results

	S1	S2	S3	S4	S5	S6	S7	S8	S9
I. Price cost margin equation									
α_{11}	-0,0642	0,1914	0,1216	0,1348	0,1479	-0,0037	0,1853	0,0606	-0,0025
	(-9.178)	(1.354)	(1.653)	(5.903)	(3.459)	(-0.181)	(4.632)	(1.949)	(-0.042)
α_{22}	-0,0624	0,1138	0,0280	0,0376	0,0585	-0,0318	0,0647	0,0089	-0,1351
	(-7.673)	(0.855)	(0.422)	(3.218)	(2.208)	(-1.324)	(1.944)	(1.716)	(-2.762)
α_{12}	-0,0288	-0,3902	-0,2832	-0,2845	-0,3801	-0,0094	-0,3627	-0,1729	0,0289
	(-2.688)	(-1.439)	(-2.011)	(-6.884)	(-5.299)	(-0.230)	(-4.769)	(-3.980)	(0.273)
β_1	-0,0168	0,0004	0,0004	-0,0007	-0,0004	-0,0028	-0,0053	0,0047	-0,0001
	(-6.834)	(0.100)	(0.671)	(-0.674)	(-1.012)	(-3.194)	(-4.973)	(3.232)	(-0.214)
β_2	-0,0184	0,0003	0,0007	-0,0013	-0,0017	-0,0016	-0,0015	-0,0034	0,0001
	(-5.567)	(0.147)	(1.713)	(-2.620)	(-3.642)	(-1.196)	(-0.886)	(-1.598)	(0.332)
μ	0,2986	0,2283	0,2800	0,2776	0,2464	0,2272	0,2672	0,2160	0,2983
	(54.633)	(34.941)	(38.999)	(17.608)	(21.031)	(34.940)	(37.993)	(33.921)	(53.348)
Θ	-0,998	-0,998	-0,997	-1,001	-1,024	-1,001	-1,001	-0,999	-0,967
	(-6.273)	(-0.359)	(-2.441)	(-3.233)	(-2.708)	(-1.385)	(-3.637)	(-1.871)	(-1.749)
II. Demand function									
η_0	21,866	5,213	6,903	8,877	5,831	6,602	11,482	5,275	9,194
	(38.312)	(20.277)	(22.002)	(54.557)	(22.361)	(85.788)	(54.093)	(43.882)	(49.501)
η_1	-8,375	-4,471	-4,471	-3,453	-6,231	-0,200	-3,324	-2,552	-5,911
	(-26.202)	(-27.741)	(-28.791)	(-25.029)	(-29.631)	(-3.432)	(-22.840)	(-26.371)	(-63.068)
η_2	10,754	3,222	3,378	2,391	4,978	-0,747	2,344	1,102	5,449
	(29.188)	(17.187)	(17.441)	(15.998)	(21.047)	(-13.495)	(14.466)	(9.335)	(49.861)
η_3	-0,018	-0,0004	0,006	0,013	-0,005	-0,00002	0,003	0,010	0,002
	(-2.085)	(-0.088)	(1.657)	(3.322)	(-0.846)	(-0.012)	(0.795)	(3.821)	(0.729)
η_4	-1,213	0,591	0,472	0,368	0,575	0,525	-0,032	0,602	0,214
	(-19.604)	(20.628)	(13.893)	(19.765)	(19.569)	(61.286)	(-1.341)	(43.603)	(10.516)

t-statistics in parenthesis.
Source: Own elaboration

The opposite situation is also present, in which local industries are less competitive but they perceive that they face a stronger competition coming from contiguous or neighbouring regions. From the figure we observe that, in general terms, competition perceived in the local markets is more intense than

that coming from external markets. As for local competition, most of the estimated conjectures are concentrated around -1 or inferior values, which means that the intensity of the competition in the territory is high. This represents that, in aggregate terms, firms expect that their strategic movements don't have consequences on prices, so it is not possible to exploit market power. On the other hand, perceived competition regarding external markets is more volatile. Thus, there are sectors that perceive that the firms located in other regions will act in a cooperative way, adapting their supply in face of the decisions adopted by the firm located in the reference region. There are regional industries as well that estimate that their strategic movements don't induce their rivals to respond (Cournot) and even those sectors in certain regions that also perceive greater competition in external markets and act as price takers.

In the figure we can also observe the relationship between competition perceived in the local market and in the external markets. In all the sectors it is depicted an inverse relationship between local and external competition. This means that the stronger is the competition perceived in the local market, higher is the market power in the external markets that the industries think they can take advantage of, acting collusively in price or quantity setting. The inverse relationship between local competition and external competition points out that there is at least one source of market power for the regional industries. When it is not possible to obtain supranormal profits in the local market given the intensity of competition in the region, it is possible to obtain them exploiting market power in other regions that form the rest of the partially integrated market.

Figure 1. Local and external conjectural variations by region and sector

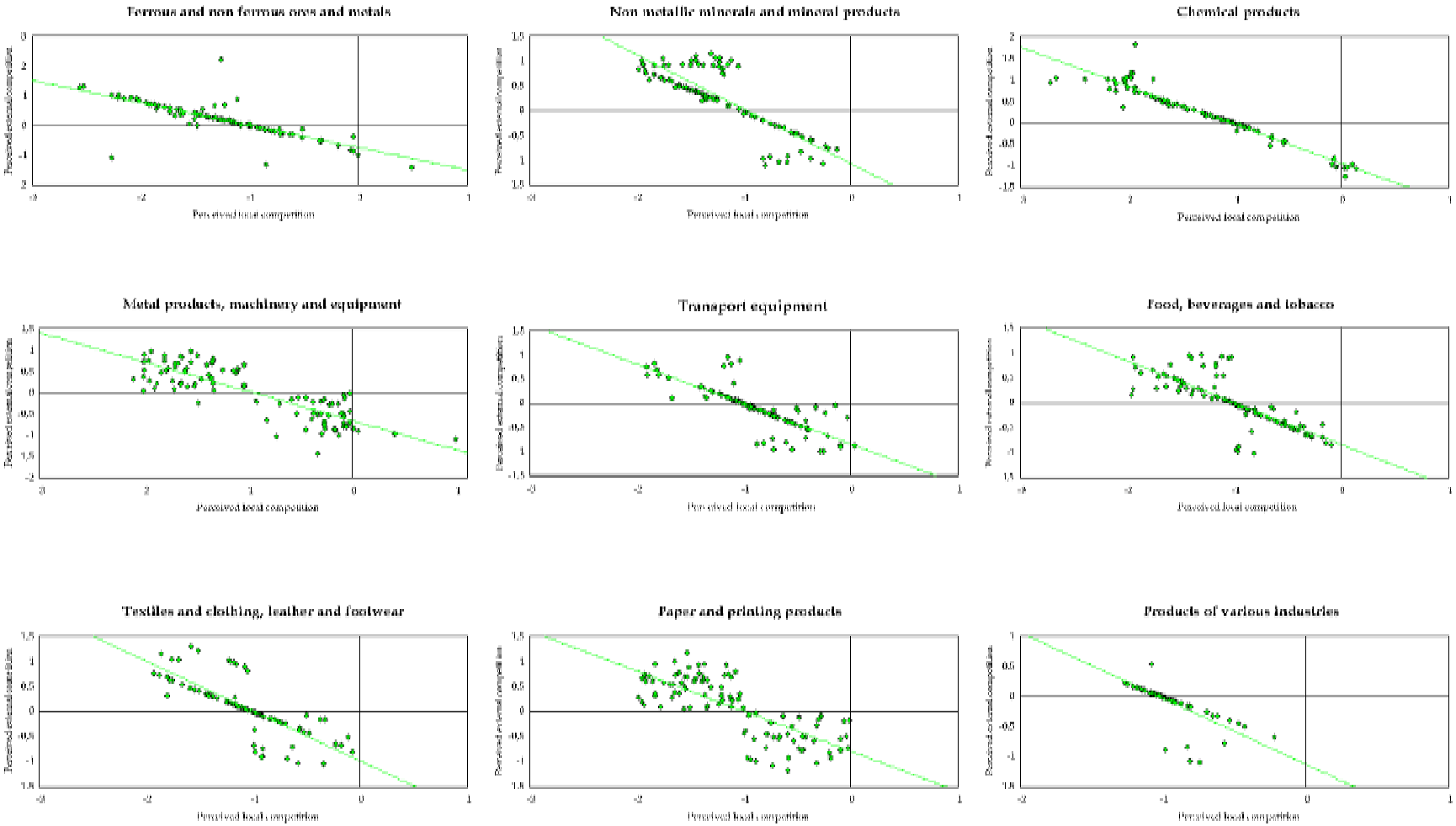


Table 2 relates the estimated conjectural variations with the observed changes in geographical concentration of the European industry in the period 1985-1995. From the table it should be highlighted that, on average, conjectural variations with respect to local competition are around -1, indicating a price taking behaviour in most of the local industrial markets. On the other hand, perceived conjectural variations on competition coming from external markets are all near 0, what would suggest that on average the regional industries expect that firms located in other territories, collectively, won't respond to strategic movements. In a way this result would be indicating a high degree of market segmentation in regional industrial markets, since strategic actions undertaken by an industry in a region would not be compensated by strategic movements on the part of firms located in other regions. Finally, given the homogeneity of local and external conjectural variations parameter estimates there is not evidence of a relationship between the degree of competition and the changes in the geographical concentration of the industry.

Table 2. Changes in geographical concentration and conjectural variations

	Geographic Concentration*	**Conjectural Variations**	
		Local	**External**
Ferrous and non ferrous ores and metals	**-0,076**	-1,259	0,219
Non-metallic minerals and mineral products	0,005	-1,195	0,256
Chemical products	**-0,007**	-1,275	0,218
Metal products, machinery and equipment	**-0,010**	-0,945	0,005
Transport equipment	**-0,016**	-0,886	-0,102
Food, beverages and tobacco	**-0,017**	-1,008	0,024
Textiles and clothing, leather and footwear	**-0,050**	-1,047	0,065
Paper and printing products	0,036	-1,082	0,082
Products of various industries	0,009	-0,975	-0,054
Total	**-0,015**	-1,075	0,079

* Calculated with an entropy index, so a negative number indicates an increase in spatial concentration.

Source: Own elaboration.

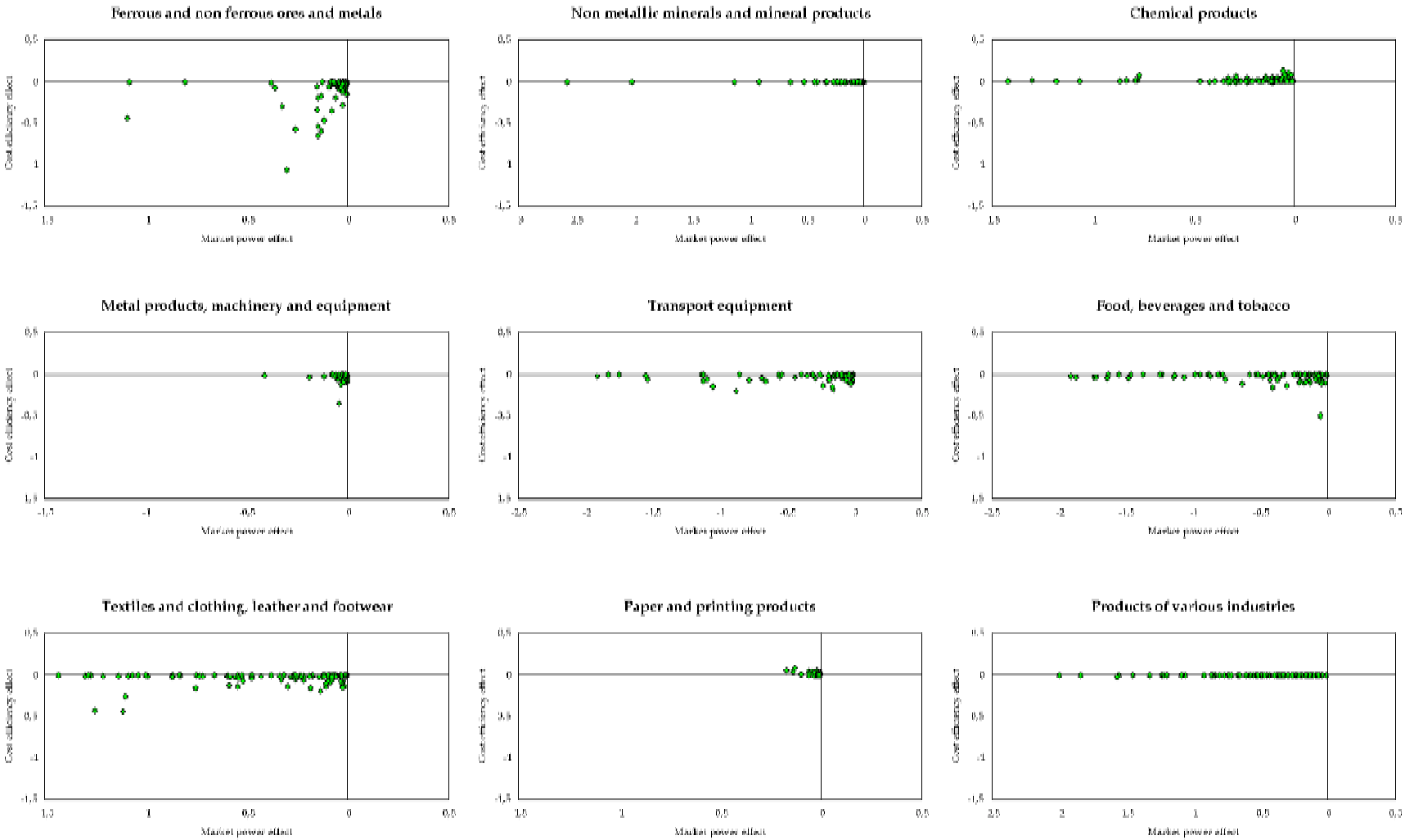
Finally, the effects of a greater geographical concentration on market power in final and intermediate markets as well as the effects on intermediate goods production costs are analyzed. As we have already seen, table 1 indicates that the conjectural variations parameter in the intermediate goods market is statistically equal to -1 in six of the nine sectors, so for these industries the effect is null while for the three remaining sectors it is not possible to discard final firms behaving oligopsonistically in the intermediate goods market. To simplify, it is assumed that this distortion is null in all sectors. Thus, we compare two effects that impact directly in the firms' location decisions. The results are shown in the figure 2.

The first thing that is worthwhile to highlight from the different panels of figure 2 is that the market power effect is always negative, as suggested by theory. In other words, an increase of geographic concentration of production reduces the market power of the firms located in the more agglomerated region since it intensifies competition among them. Nevertheless, this effect is composed by local market power and market power exercised in external markets. Although these results are not explained here, theory suggests that local market power will decrease because of the increase in the intensity of competition in the agglomerated region while at the same time its market power increases in external markets, since in these markets the intensity of competition tends to diminish. The results obtained here show that the first effect dominates over the second and that, on aggregate, a greater geographical concentration tends to moderate the market power of the located firms. On the other hand, the effect of a higher spatial industrial concentration on the intermediate costs of production is less clear and presents less dispersion than the previous one. We observe sectors where the effect is null or almost null as well as others where one there is a relatively important impact. Different sectors with different technologies and different intermediate input intensity have different effects on intermediate efficiency.

From figure 2 it is possible to distinguish three groups of activities. In the first place, those in which the majority of the regions have negative market power and cost efficiency effects, this is both market power and costs are reduced (Ferrous and non ferrous ores and metals; Metal products, machinery and equipment and Paper and printing products). A second group of activities would be defined by a greater variability of the market power effect but a null or almost null effect on intermediate production costs. Here we would include the sectors Non metallic minerals and mineral products, Chemical products and Products of various industries. Finally, the third group would be composed by those activities that observe a stronger impact on intermediate production costs, usually a negative impact, while the market power effect observes higher dispersion. This last group is composed by the following sectors: Transport equipment, Food, beverages and tobacco and Textiles and clothing, leather and footwear.

The total effect, calculated as the sum of the market power and the cost efficiency effects is always negative, indicating that a greater geographical concentration of production partially reduces the distortion caused by final firms' market power by intensifying competition in this stage of the productive process provoking at the same time an increase in the efficiency with which intermediate goods are produced. The source of these efficiency gains reside in that, associated to the geographical concentration of the final production, there is also a process of geographical concentration in the production of intermediate goods. The cost complementarities of the agglomerated production of final and intermediate goods are noticeable by means of the savings in the costs of transporting the intermediate goods and from the creation and consolidation of external economies in the territory.

Figure 2. Market power and cost efficiency effects by region and sector



To analyze if this it is the case, table 3 relates the changes in geographical concentration of the different manufacturing activities with (weighted) average market power and cost efficiency effects for each industry. The table indicates that the cost efficiency effect means that a higher geographical concentration of production increases productive efficiency because of the reduction of the costs of manufacturing intermediate goods. This efficiency necessarily moves to the final stage, since we have supposed that final firms are price takers.

In five out of the nine industries considered an increase in the geographic concentration is observed between 1985 and 1995 along with an increase in the intermediate goods productive efficiency. These industries are Ferrous and non ferrous ores and metals; Metal products, machinery and equipment; Transport equipment; Food, beverages and tobacco and Textiles and clothing, leather and footwear. Of the rest of industries it is interesting to highlight Chemical products, in which a greater geographical concentration, actually observed in the period 1985-1995, tends to increase the costs of production.

Table 3. The effects of geographic concentration on market power and cost efficiency

	Geographic Concentration*	**Effects**	
		Market power	**Cost efficiency**
Ferrous and non ferrous ores and metals	**-0,076**	-0,0786	**-0,0798**
Non-metallic minerals and mineral products	0,005	-0,1401	0,0000
Chemical products	**-0,007**	-0,1944	0,0189
Metal products, machinery and equipment	**-0,010**	-0,0161	**-0,0228**
Transport equipment	**-0,016**	-0,2644	**-0,0273**
Food, beverages and tobacco	**-0,017**	-0,4179	**-0,0305**
Textiles and clothing, leather and footwear	**-0,050**	-0,4080	**-0,0420**
Paper and printing products	0,036	-0,0139	0,0093
Products of various industries	0,009	-0,5437	**-0,0005**
Total	**-0,015**	-0,2308	**-0,0194**

* Calculated with an entropy index, so a negative number indicates an increase in spatial concentration.
Source: Own elaboration.

7 Conclusions

In this work a structural model is developed and estimated to analyze the vertical organization of firms in space, as well as its effects on the degree of competition and the phenomena of agglomeration. The model is applied to the specific case of nine industries and 104 regions of the EU using the REGIO database. The estimations are carried out for each manufacturing sector using panel data techniques with fixed effects to capture the differences among regions.

The estimated model is based on a theoretical model proposed in Duch (2004) and in the literature on empirical industrial organization. The system of equations allows analyzing diverse characteristics of industrial relationships in the different European regions considered. Of particular relevance are the estimated conjectural variations reflecting the degree of average industry's perceived competition, both in local as well as in external markets. It is also possible to analyze the effects that a greater geographical concentration has on the market power of firms and on production costs.

The results point out that, in general, intermediate firms apply price-cost margins between 20 and 30%. Also, it is confirmed that in most sectors final firms are price takers in the intermediate goods market, as it was supposed in the theoretical model developed in Duch (2004). All the parameters associated to the price of complements have the expected sign (negative) and almost the same thing happens with the price of substitutes, being their estimated coefficients positive. The regional per capita income elasticity indicates that goods are normal except in the case of four sectors in which they turn out to be inferior.

The estimated conjectural variations present heterogeneous results, from which it is complicated to highlight clear patterns between the different regions and the different sectors. However, when the different perceived competition degrees are related for the different manufacturing sectors, both local and external, we observe that, in general terms, perceived competition in local markets is more intense than that coming from external markets. Also, an inverse relationship is observed between local and external competition in all sectors, indicating that the greater the perceived competition in the local market, higher is the market power that the industries feel they can take advantage of in external markets. Thus, this would point out that firms always exploit some source of market power, because when it is not possible to gain supranormal profits in the local markets given the intensity of competition in the region, it is possible to obtain them exploiting market power in the rest of regions.

The relationship between the estimated conjectural variations and the changes in geographical concentration of the European industry in the period 1985-1995 point out that, on average, conjectural variations with respect to local competition are close to -1, indicating a price taking behaviour in most of local industrial markets. On the other hand, conjectural variations on external competition are in the vicinity of 0 suggesting that, on average, regional industries expect that the firms located in other territories won't respond collectively to strategic movements. This result indicates an important degree of segmentation in the European markets. However, there is not evidence of a close relationship between the degree of competition and the changes in the geographical concentration of industry.

The effects associated to geographical concentration on market power and intermediate goods' cost efficiency point out that the former is always negative, as the theory suggests. This indicates that an increase of the share of production of a given region in a specific sector reduces the market power of the firms

located there because in this region competition among them is intensified. On the other hand, the effect of a greater spatial concentration on the intermediate goods costs of production doesn't present a clear pattern and shows less dispersion. We observe sectors where the effect is null or almost null, as well as others where there is a relatively important impact. The total effect, calculated as the sum of both, is always negative indicating that the geographical concentration of the industry mitigates the distortion derived from final firms' market power by increasing the degree of local competition and allowing efficiency increases in the production of the intermediate goods. One of the possible sources of these earnings is based on the decisions of co-location of final and intermediate production, allowing that the cost complementarities of the specialized and located production arise.

Finally, it is worth to mention that from the results obtained in this work it seems clear that there is a good margin for the spatial (as well as functional) reorganization of European industry, in order to maintain and to increase its competitiveness. It is to be expected that in the next years we continue to observe important changes in the pattern of location, as well as the presence of flexible specialization strategies in many regions and in many industries.

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Appendix

Table A.1 Regions included

Germany (NUTS 1)		Belgium (NUTS 2)	
Baden-	Niedersachsen	Région Bruxelles	Brabant Wallon
Bayern	Nordrhein-	Antwerpen	Hainaut
Berlin	Rheinland-Pfalz	Limburg	Liège
Bremen	Saarland	Oost-Vlaanderen	Luxembourg-B
Hamburg	Schleswig-Holstein	Vlaams Brabant	Namur
Hessen		West-Vlaanderen	
Spain (NUTS 2)		**France (NUTS 2)**	
Galicia	Castilla-la Mancha	Ile de France	Pays de la Loire
Asturias	Extremadura	Champagne-Ardenne	Bretagne
Cantabria	Cataluña	Picardie	Poitou-Charentes
Pais Vasco	C. Valenciana	Haute-Normandie	Aquitaine
Navarra	Baleares	Centre	Midi-Pyrénées
La Rioja	Andalucia	Basse-Normandie	Limousin
Aragón	Murcia	Bourgogne	Rhône-Alpes
C. de Madrid	Canarias	Nord - Pas-de-Calais	Auvergne
Castilla y León		Lorraine	Languedoc-
Italy (NUTS 2)		Alsace	Provence-Alpes-
Piemonte	Marche	Franche-Comté	Corse
Valle d`Aosta	Lazio		
Liguria	Abruzzo	North East	West Midlands
Lombardia	Molise	Yorkshire and	North West
Trentino-Alto	Campania	East Midlands	Wales
Veneto	Puglia	East Anglia	Scotland
Friuli-Venezia	Basilicata	South East	Northern Ireland
Emilia-Romagna	Calabria	South West	
Toscana	Sicilia		
Umbria	Sardegna	Noord-Nederland	West-Nederland
Portugal (NUTS 2)		Oost-Nederland	Zuid-Nederland
Norte	Alentejo		
Centro	Algarve		
Lisboa e Vale do			

Source: Eurostat.

Table A.2 NACE RR-17 classification. Industry

Code	Sector
S1	Ferrous and non ferrous ores and metals
S2	Non-metallic minerals and mineral products
S3	Chemical products
S4	Metal products, machinery and equipment
S5	Transport equipment
S6	Food, beverages and tobacco
S7	Textiles and clothing, leather and footwear
S8	Paper and printing products
S9	Products of various industries

Source: Eurostat.