DOCUMENTS DE TREBALL
DE LA DIVISIÓ DE CIÈNCIES JURÍDIQUES,
ECONÒMIQUES I SOCIALS

Col·lecció d'Economia

Regional integration and specialisation patterns in Spain*

Elisenda Paluzie[1]
Jordi Pons[2]
Daniel A. Tirado[3]

Adreça correspondència:

[1]Departament de Teoria Econòmica
Universitat de Barcelona
Av. Diagonal 690
08034 Barcelona, Catalonia (Spain)
paluzie@eco.ub.es

[2]Departament d Econometria, Estadística i Economia Espanyola
Universitat de Barcelona

[3]Departament d Història i Institucions Econòmiques
Universitat de Barcelona

Recepció document: Novembre 1999

* The authors gratefully acknowledge CICYT financial support through research projects SEC99-0432 and PB98-1187, as well as the comments of an anonymous referee. Daniel Tirado has contributed to this paper while visiting the *European University Institute* in Florence. A scholarship given by the *Ministerio de Educación y Cultura*, Program SM1999-004, has made possible his research stay.

Abstract

The aim of this paper is to analyse how economic integration in Europe has affected industrial geographical concentration in Spain and explain what the driving forces behind industry location are. Firstly, we construct regional specialisation and geographical concentration indices for Spanish 50 provinces and 30 industrial sectors in 1979, 1986 and 1992. Secondly, we carry out an econometric analysis of the determinants of geographical concentration of industries. Our main conclusion is that there is no evidence of increasing specialisation in Spain between 1979 and 1992 and that the most important determinant of Spain's economic geography is scale economies. Furthermore, traditional trade theory has no effects in explaining the pattern of industrial concentration.

Resum

L'objectiu d'aquest treball és analitzar com la integració econòmica a Europa ha afectat a la concentració geogràfica de les indústries a Espanya i explicar quines són les forces determinants de la localització industrial. En primer lloc, construïm índexs d'especialització regional i de concentració geogràfica per a les 50 províncies espanyoles i per 30 sectors industrials el 1979, 1986 i 1992. En segon lloc, realitzem una anàlisi economètrica dels determinants de la concentració geogràfica de les indústries. Les nostres conclusions més importants són que no existeix evidència d'un augment en l'especialització a Espanya entre 1979 i 1992 i que el determinant més important de la geografia econòmica espanyola són les economies d'escala. A més a més, la teoria tradicional del comerç no explica el patró de concentració industrial.

KEY WORDS: geographical concentration, industrial specialisation, economic integration

JEL Classification: F15, R12

1. Introduction

The phenomenon of industrial agglomeration has generated in the last decade a renewed interest among economists. This interest arises in part from the regional integration processes that have been undertaken in several areas of the world in the second half of the 20th century. These processes are causing a blurring of the lines between international and interregional trade and have been the inspiration of a new strand of literature called "new economic geography" that combines international trade theory with insights from industrial organisation and regional economics[1]. In FUJITA *et al*., 1999, the main models of this new field are synthesised.

One of the theoretical predictions of this literature is the possible increase in the geographical concentration of industries as a result of trade liberalisation. This prediction has been tested for US regions and European countries by a relatively young empirical literature (KIM, 1995; BRÜLHART and TORSTENSSON, 1996; BRÜLHART, 1996; AMITI, 1997; HAALAND *et al.*, 1999).

Following this line of work, the aim of this paper is to analyse how economic integration in Europe has affected the geographical concentration of industry in Spain and explain what the driving forces behind industry location are. First, we construct regional specialisation indices and geographical concentration indices for Spanish 50 provinces and 30 industrial sectors in 1979, 1986 and 1992. Second, we carry out an econometric analysis of the determinants of geographical concentration of industries.

The Spanish case should be an interesting case study of the effects of economic integration in the pattern of industrial location. A majority of

empirical studies have focused on an analysis at the national level. The forces at work might be the same at the international and the regional level but the greater degree of factor mobility across regions within a country tends to strengthen the cumulative causation mechanisms that may lead to industrial agglomerations. The analysis that we have performed for Spanish regions might help us to identify these effects. In addition, the fact that Spain is a late joiner to the EU (1986) and therefore has experienced a more sudden dismantling of trade barriers, could give to this case study and additional interest.

The remaining of the paper is organised as follows: the second section considers the relationship between industrial location and economic integration in the light of both the theoretical and the empirical "new economic geography" literature. The third section defines the empirical variables used to analyse industrial patterns. In the fourth section, the empirical analysis is performed and finally the last section presents the main conclusions of the study.

2. Economic integration and industrial location

The existence of industrial agglomerations that create huge differences among whole regions has traditionally been analysed by location theory and regional economics. But these two fields have not succeed in incorporating the space variable into mainstream economic models. On the one hand, location theory tradition that begins with Von Thünen's Isolated State and continues with Weber, Lösch, Christaller and Isard, tries to be a microeconomic analysis of the optimal location of economic activities. Its methodological drawbacks have prevented her from becoming one of the main fields of economic theory: the agent's decision process is often confusing or even absent, market structure is not well defined.

On the other hand, regional development theory, furnishes the intuitive idea that explains geographical economic inequalities. The most important

characteristic of space is its heterogeneity. So, very small areas concentrate the majority of economic activities and wealth while others stagnate in a marginal role. The mechanisms responsible for this unbalance would be Myrdal's backwash effects and Hirschman's polarisation effects. Perroux's economic growth poles and Hirschman's forward and backward linkages also explain, although in a more positive and less deterministic way, the existence of agglomerations that concentrate industrial activity. The problem of all these theories is their lackness of formalisation into models that could be of general acceptance by economic theory.

In what concerns classical international trade theory, space has played a secondary role in spite of Bertil Ohlin's aim to integrate international trade theory in a more general location theory. Trade between countries or regions is explained by differences in their underlying characteristics (factor endowments in the Heckscher-Ohlin model, technology in the ricardian model). It is therefore, space itself which is unequal and makes some areas produce some goods and other areas other goods, but economic activity by itself does not generate any geographical inequality.

But inequalities in resource distribution are not enough to explain the magnitude of economic geographical concentration that exists in the real world. The existence of scale economies is essential to explain the geographical distribution of economic activities. New trade theory of the 80's offers a new explanation for the existence of trade and gains from trade. Scale economies give countries an incentive to specialise and trade even in absence of differences in their technology or factor endowments. Equilibrium in these models is affected by market size: a larger market would allow the survival of more firms than a smaller market. These models have therefore a locational implication derived from this home market effect, that is the tendency to concentrate production near larger markets.

The problem of new trade theory models is that they assume since the beginning the existence of large markets and small markets but don't explain this initial division. The evolution of these models towards a formalisation of the cumulative causation mechanism that explains the existence of agglomerations has given rise to a new field: the "new economic geography", leaded by Paul Krugman and Anthony J. Venables. This field has connections both with new trade and new growth theories and with industrial organisation and regional economics. [2]

In “new economic geography” models, trade costs and increasing returns interact in a monopolistic competition framework to explain the settlement of industrial agglomerations. The mechanisms that give rise to the endogenous formation of centre-periphery structures are the centripetal forces, the forward and backward linkages that reinforce an industrial agglomeration once in place. These models also pose in a direct way the question of the possible effects of economic integration on industrial location.

The first formal model is KRUGMAN, 1991b. It's a regional model, that is a model that explains the settlement of a centre-periphery structure within a country or any other kind of borders that allow labour mobility. Krugman shows that the interaction between labour mobility, increasing returns and trade costs creates a tendency for firms and workers to concentrate. Trade liberalisation associated with the process of economic integration brings about the settlement of centre-periphery patterns with all industry concentrated in one region. Labour mobility acts as the destabilising force that generates the linkages causing the cumulative causation process. KRUGMAN and LIVAS, 1996, develop a modified version of this model that explains the existence of giant Third World metropolis as a consequence of the strong forward and backward linkages that arise when manufacturing tries to serve a small domestic market. When the economy opens up to international trade these linkages are largely weakened and a process of dispersion of economic activity takes place.

In an international context, barriers to labour mobility might limit the role of migration as the centripetal force that favours agglomeration. International models (KRUGMAN and VENABLES, 1995; VENABLES, 1996) don't allow for labour mobility between countries and it's the existence of input-output linkages between firms that creates the tendency for manufacturing agglomeration. In this kind of models, the integration process would have two different stages: an early stage of growing world inequality with a core-periphery pattern that spontaneously forms, and a second stage of convergence in real incomes, where continuing reductions in trade costs, eventually, lead to a reindustrialisation of the low-wage region. Labour immobility and therefore the possibility of wage differentials between regions is the key to this non-monotonic process.[3]

All these models pose grand issues like the division of the world into industrialised and deindustrialised areas but economic geography has traditionally been worried about problems more modest like the concentration of firms belonging to the same sector in an industrial district. In this respect, KRUGMAN and VENABLES, 1996, set up a model with two industrial sectors to explain industrial specialisation. In this model, input-output linkages between firms in the same sector are stronger than between firms in different sectors. Integration leads each country to specialise in the production of one sector.

The predictions of these models have important policy implications, especially for the European Union. Thus, the main prediction is the increase in regional inequalities. Yet, this prediction depends crucially on the labour mobility assumption. The absence of labour mobility weakens agglomeration in a process of regional integration. In the case of the EU, in principle, free movement of workers is allowed but cultural and linguistic differences act as a restraint and therefore weaken the agglomeration forces. In addition, if migration does not eliminate wage differentials, the last act as a dispersion force in favour of regional convergence. The prediction of an increase in industrial

specialisation seems more feasible in the short term because it only requires intersectoral mobility within countries.

Therefore, the majority of empirical tests that have been performed are centred in the analysis of industrial specialisation and geographical concentration of industries. Thus, a line of work followed by KIM, 1995, BRÜLHART, 1996, BRÜLHART and TORSTENSSON, 1996, AMITI, 1997 and HAALAND *et al.*, 1999, uses summary measures (concentration indices) to describe the evolution of industrial specialisation and geographical concentration of industries across European countries or U.S regions. The majority of these studies examines also the forces that produce the trends in specialisation and location. The possible sources of regional specialisation are different according to different trade theories. Thus, these studies represent also an indirect way to test the main trade theories.

KIM, 1995, analyses long-run trends (1860-1987) in regional specialisation in the US. He shows that the increase in industrial regional specialisation occurred before the First World War while the US were becoming an integrated national economy. Since the 30's, regional specialisation has been falling. Scale economies and the intensity in the use of resources in a Heckscher-Ohlin model are the sources of regional specialisation consistent with these trends while external economies are inconsistent with the trends observed. BRÜLHART, 1996, BRÜLHART and TORSTENSSON, 1996, AMITI, 1997 and HAALAND *et al.*, 1999, work on European national data.

BRÜLHART, 1996, finds that between 1980 and 1990, fourteen out of eighteen industries considered have become more geographically concentrated. Sectors characterised by scale economies show the most important increases in concentration.

BRÜLHART and TORSTENSSON, 1996, find some support for the existence of a U-shaped relationship between the degree of regional concentration and spatial agglomeration predicted by the models when labour

mobility is low. So the activities with strong scale economies were more concentrated in regions close to the centre of the EU during the first stages of European integration, while concentration in the centre has decreased during the 80's.

AMITI, 1997, shows that industrial specialisation has increased in all European countries, except Spain and the UK, during the period 1968-1980. Thirty industries show an increase in their geographical concentration between 1976 and 1989 while fourteen show a decrease and twenty-three remained unchanged. She also regresses the geographical concentration indices on three variables to proxy three strands of trade theories: scale economies (new trade), deviation of factor intensities from the mean (Heckscher-Ohlin) and share of intermediates in production (new economic geography). Both scale economies and intensity on the use of intermediates have a positive and significant effect in geographical concentration. But the factor intensity variable has no effect on geographical concentration. This is due to the similarity in terms of relative factor endowments of the five countries in the sample.

HAALAND *et al.*, 1999, performs an analysis similar to that of AMITI, 1997, but they consider whether the single market has had an influence on factors determining location by comparing impact over time. Therefore, their empirical analysis is cross-sectional, centred in the comparison between two points of time: 1985 and 1992. They also distinguish between absolute and relative concentration. They find that expenditure is the most important determinant of the economic geography of Europe although Heckscher-Ohlin and Ricardo's theories are still important. Intraindustry linkages also play a major role in determining the absolute concentration of industries. Their most controversial result is the negative and significant impact they find for scale economies in 1992.

This empirical literature has made an important effort to test some of the predictions of the new trade and the new economic geography. The problem

with this line of work is that it doesn't allow us to distinguish unambiguously between the theories. A different line of work has been followed by DAVIS and WEINSTEIN, 1996, 1998, 1999. These authors use a framework that nests an increasing returns model of economic geography featuring home market effects with that of Heckscher-Ohlin. So their empirical specification is articulated from a general equilibrium perspective and they are able to identify precise null and alternative hypotheses. The basis is the KRUGMAN, 1980, increasing returns model with costs of trade and the test is the existence of home market effects of demand on production. In DAVIS and WEINSTEIN, 1996, they apply this framework to analyse the structure of OECD production and they find scant significance of economic geography effects. In DAVIS and WEINSTEIN, 1999, the same framework is used to explain the structure of regional production in Japan. The results are in this case different and economic geography effects appear to be economically very significant. In DAVIS and WEINSTEIN, 1998, the model is paired with a richer geography structure and they find evidence of the importance of increasing returns, in combination with comparative advantage, in affecting OECD manufacturing production structure.

In the case of Spain, the empirical analysis of the location of manufacturing activities has focused on the role of external economies in the line opened by GLAESER *et al.*, 1992, and HENDERSON *et al.*, 1995. This approach, applied to the Spanish case by FLUVIÀ and GUAL, 1994, GOICOLEA *et al.*, 1995, CALLEJÓN and COSTA, 1996, DE LUCIO *et al.*, 1998 and VILADECANS, 1999, is different both theoretically and empirically from the above. Anyhow the measures of industrial specialisation and geographical concentration used are the same. FLUVIÀ and GUAL, 1994, found that Spanish regions (autonomous communities) didn't increase their specialisation during the period 1980-1989 in a trend opposed to the one observed at the European level.

3. Specialisation and industry characteristics: measures

To see whether specialisation has increased in Spain, we construct regional specialisation indices for each province and geographical concentration indices for each industrial sector. The regional specialisation indices are a measure of the degree of industrial diversification (or specialisation) of a region. Movements in these indices indicate changes in the industrial structure of the region. The geographical concentration indices indicate which industries are the most concentrated. Movements in these indices indicate changes in the spatial distribution of the industries.

Several indices of regional specialisation and geographical concentration have been used by the literature. We have chosen to use the Gini coefficients. We calculated other indices like the Hirschman-Herfindhal index or the relative concentration index, but the evidence found, in the case of the Spanish industry for the period 1979-1992, was very similar. On the other hand, ELLISON and GLAESER, 1997, and MAUREL and SÉDILLOT, 1999, have noted recently that the size of firms is extremely relevant to explain the territorial concentration of activity. Nevertheless, in our work we haven't calculated the index suggested by these authors because the data concerning the size of each firm considered in the analysis is not available and it hasn't been possible to proxy it. An application of these indices to the Spanish economy that proxies this variable can be found in CALLEJÓN, 1997, for Spanish provinces, and VILADECANS, 1999, for Spanish municipalities. Considering both the difficulties involved in proxying this variable and the fact that the results obtained by these authors are not very different from ours, we chose not to use this index.

To measure regional specialisation, we construct a Gini index for each region. This index ranges from 0 to 1. The higher the index, the more specialised

is the region. Also, to measure geographical concentration we construct a Gini index for each industry. This index ranges from 0 to 1. The higher the index, the greatest the geographic concentration of the industry.

To explain the pattern of geographical concentration of industries, we construct explanatory variables that proxy for industry characteristics that according to trade theories might influence concentration. All trade theories predict that a reduction in trade barriers leads to an increase in specialisation but the source of specialisation is different in each of these theories. According to traditional trade theory, differences in the underlying characteristics of regions or countries give rise to comparative advantage in the production of some goods and hence favour industrial specialisation.

In the ricardian model, comparative advantage arises from differences in relative technology between countries. Following HAALAND *et al.*, 1999, we proxy differences in technology by differences in labour productivity, defined as value added per employee. We define the index $TECDIF_i$:

$$TECDIF_i = \sqrt{\frac{1}{n}\sum_j \left(\frac{\frac{VA_{ij}}{E_{ij}}}{\sum_j \frac{VA_{ij}}{E_{ij}}} - \frac{\sum_i \frac{VA_{ij}}{E_{ij}}}{\frac{1}{c}\sum_j \sum_i \frac{VA_{ij}}{E_{ij}}} \right)^2}$$

where VA depicts value added, E depicts employment and n is the number of regions. The subindex i corresponds to the industry and the subindex j to the region. $TECDIF_i$ will be higher, the more significant the cross region differences in labour productivity. The first term within the brackets measures labour productivity in industry i in region j relative to the average labour productivity in this industry across regions, while the second term measures the average labour productivity in region j relative to the other regions. According to ricardian theory the more important relative productivity differences are, the

higher will the degree of regional specialisation be and the more geographically concentrated should the industry be.

In the Heckscher-Ohlin model, countries or regions specialise in industries which are intensive in the factors in which they are relatively abundant. To capture Heckscher-Ohlin effects, we will focus on the labour factor, using an index that measures deviation of labour intensities from the mean that was proposed by AMITI, 1997. The index HO_i is defined as:

$$HO_i = \left| \frac{\sum_j LC_{ij}}{\sum_j VA_{ij}} - \frac{\sum_j \sum_i LC_{ij}}{\sum_j \sum_i VA_{ij}} \right|^2$$

where *LC* depicts labour costs and *VA* depicts value added. So *HO* is defined as labour costs divided by value added, at factor cost, less the mean of total labour costs as a proportion of the mean of the value added at factor cost. A high value signals that the industry in question differs from the average industry in terms of labour use. We will expect that those industries that differ a lot from the mean should be the most geographically concentrated.

New trade theory predicts that a demand bias in favour of a particular good creates a large home market for this good, and the interaction of economies of scale and trade costs typically lead to net export. Therefore, differences in expenditure structure might determine industry location as well as differences across industries in scale economies. To capture new trade theory effects we are limited to focus on scale economies as does AMITI, 1997. We are not able to construct a variable that proxies concentration of expenditure in the line followed by DAVIS and WEINSTEIN, 1996, 1998, 1999, and HAALAND *et al.*, 1999, due to our data base limitations. We will use the variable $SCALE_i$ to proxy scale economies:

$$SCALE_i = \frac{\sum_j E_{ij}}{\sum_j NF_{ij}}$$

where *E* depicts employment and *NF* depicts number of firms. *SCALE* is defined as employment divided by the number of firms and therefore measures average firm size. We expect industries subject to high scale economies to be more geographically concentrated.

The new economic geography literature emphasises the importance of home market effects and scale economies in determining the location of industries. This literature has also noted the importance of vertical linkages between firms in encouraging agglomeration (KRUGMAN and VENABLES, 1995; VENABLES, 1996). A large number of downstream firms attracts a large number of upstream firms due to demand or backward linkages while a large number of upstream firms reduces the price of intermediate inputs for downstream firms thus constituting a forward or cost linkage. These linkages will be stronger the higher the proportion of intermediate goods in the production of final goods. We construct the *EG1* index to measure intermediate goods intensity:

$$EG1_i = \frac{\sum_j (X_{ij} - VA_{ij})}{\sum_j X_{ij}}$$

where *X* is production and *VA* value added. So *EG1 is* defined as production less value added (intermediate consumption) divided by production, at market prices. We expect that the higher *EG1* the higher will be the geographical concentration of industries.

In industrial specialisation models (KRUGMAN and VENABLES, 1996), input-output linkages between firms in the same sector are stronger than

between firms in different sectors. We construct the index *EG*2 to measure these intra-industry linkages.

$$EG2_i = \frac{\sum_j IOI_{ij}}{\sum_j X_{ij}}$$

where *X* is production and *IOI* is input from own industry. We expect that the more of its own production an industry uses as intermediates, the more concentrated it will be.

4. Empirics

4.1 Data sources and descriptive analysis

The data set we use is the *Encuesta Industrial* (Industrial Survey) provided by the *Instituto Nacional de Estadística* (INE, Spanish Statistical Office). It includes data for 50 Spanish provinces (all of them except Ceuta and Melilla) and 30 manufacturing sectors. The time period we use, 1979-1992 is the longest period available with homogeneous industrial groupings.[4] We will use the following information from the data set: number of firms, employment, labour costs, production and deflated gross value added. To construct the *IOI* variable, we use the input-output tables of the Spanish economy, provided also by the INE, in every year considered.

The information contained in the *Encuesta Industrial* is subject to the statistical secrecy and, consequently, data for sectors with less than 6 firms in a province is not available. In 1992, the omitted information represented the 3.1% of total employment and the 4.8% of gross value added. This might cause a slight bias in favour of agglomeration when calculating the GINI indices.

Table 1 presents the Gini indices of regional specialisation for 1979, 1986 and 1992. Only 16 among the 50 provinces show an increase in specialisation. The magnitude of this increase is very small. The Gini index increased only by approximately 10 % in the provinces where it increased the most (Madrid, Lugo, Sevilla and La Rioja). These provinces were at the beginning of the period less specialised than average. The rest of provinces show a decrease in specialisation that is also very moderate. In the province where the Gini decreases the most (León), a very specialised province, the Gini decreases by only 13.1%. The average Gini index shows a moderate decrease in specialisation (11.7%) and this reduction takes place before 1986, the year of Spain's entry in the EC, after 1986 it remains stable.

Table 2 presents the Gini indices of geographical concentration of industries for 1979, 1986 and 1992. The table also shows the ranking of industrial sectors in terms of geographical concentration. Only 13 among the 30 sectors considered show an increase in their geographical concentration. This increase is also very moderate. Only 7 sectors changed their ranking and the sector for which the change was more important, chemicals and oil products, only increased three places in the rank (from being the 7th more concentrated in 1979 to the 4th in 1992). The rest of sectors show a moderate decrease in geographical concentration. On average, the Gini concentration index decreased by 0.01% during this period, which is equivalent to say that it remained stable.

These results are somehow surprising. We find two possible explanations for them. First, Spanish regions show a very high degree of specialisation in comparison to the average European region.[5] The geographical concentration of industries in Spain seems to be high (an average Gini of 0.67). Hence the room to increase furthermore specialisation and geographical concentration in Spain is limited. Second, our analysis stops in 1992 so the effects of what has been called the "1992 package" are not yet observable. It is possible that the main effects

that we expect from European integration are still to come and hence need a longer period of analysis.

4.2 Results

A systematic test of the relationship between industry characteristics and geographical concentration of industries is performed. We carry out an econometric analysis of the determinants of geographical concentration of industries. Hence, we estimate the following equation, where the endogenous variable is the Gini index of geographical concentration of industries (presented in table 1) and the exogenous variables are the explanatory variables that proxy for industry characteristics:

$$GINIP_i = b_1 + b_2 SCALE_i + b_3 HO_i + b_4 LEG_i + b_5 TECDIF_i + u_i \qquad (1)$$

Equation 1 is estimated individually for the years 1979, 1986 and 1992 and the results of estimation are shown in Table 3. The variable *LEG* is alternatively *LEG1* or *LEG2*, although in our final specification we opted for *LEG1* for reasons explained later in the text. We use log transformations of the equation. Since we have detected problems of heteroscedasticity, we use OLS but we estimate standard errors by WHITE's (1980) heteroscedasticity consistent method.

The reason we work with cross section data is to be able to interpret the results in terms of the possible changes that European integration has brought to geographical concentration of industries in Spain. We want to analyse whether the relative importance of the forces driving concentration of industries has changed through the integration process. As pooling of data might entail loss of valuable information, we estimate the equation three times (in 1979, 1986 and 1992) instead of performing a panel data estimation.

Another problem that we might encounter in the econometric estimation is endogeneity. In "new economic geography" models, the interaction between trade costs and increasing returns gives rise to industrial agglomerations through a cumulative causation process. Industries where scale economies are important will concentrate in a few locations. This will enable the firms to set lower delivered prices to its customers. These may stimulate more demand and raise output levels further to approach the minimum efficient scale. Internal scale economies will develop as output rises. Cumulative, self-multiplying forces are at work in the impact of scale economies on economic development in space implying that scale economies may not only be decisive for industrial concentration but also viceversa.

To test for endogeneity, we use a HAUSMAN, 1978, specification test that allows us to choose between the OLS estimation and an alternative estimation using instrumental variables (the method is explained in DAVIDSON and MACKINNON, 1993). The HAUSMAN, 1978, test is based in the idea that the covariance of an efficient estimator and its difference with respect to an inefficient estimator is zero. Formally we have:

$$q = (\hat{b}_{OLS} - \hat{b}_{IV})' \cdot \left[Var(\hat{b}_{IV}) - Var(\hat{b}_{OLS}) \right]^{-1} \cdot (\hat{b}_{OLS} - \hat{b}_{IV}) \sim \chi_e^2$$

where the subindices OLS and IV represent, respectively, OLS estimation and instrumental variables estimation, 2SLS (two stage least squares). To perform the instrumental variables estimation we used the first lag in the scale economies variable. The q statistic, under the null hypothesis of endogeneity of the regressors, is asymptotically distributed as a χ^2 with as many degrees of freedom (*e*) as non-exogenous regressors are present in the specification.

The test indicates that endogeneity is a problem in 1992 and a less severe problem in 1979 and 1986. We therefore deal with the endogeneity problem by

performing a 2SLS estimation using as instrument variables lagged measures of scale economies. In table 3, we present for each year the OLS and 2SLS estimations. We choose the 2SLS estimation for the year 1992. For the years 1979 and 1986, it is more difficult to choose between the two options. Nevertheless, the conclusions derived from the analysis for these two years are the same using any of the two estimation methods.

Our results indicate that the scale economies variable has a positive and significant effect in the geographical concentration of industries regardless of the year considered. This is in accordance with our a priori expectations. Furthermore, in 1992 the degree of scale economies appears to matter more for concentration than it did in 1979. The impact of scale economies on geographical concentration should be interpreted as support for the new trade and new economic geography theories.

The estimated equation indicates that the intermediate goods intensity variable that proxies for inter-industry linkages has a negative and significant effect on concentration for the years 1986 and 1992. This result is quite surprising and represents evidence against the new economic geography. However, the theoretical models emphasise the importance of input-output linkages in promoting agglomerations but they also note (KRUGMAN and LIVAS, 1996) that these linkages might be weakened by the opening of a closed economy to free trade. In an inward-looking economy, industrial centres are the places where firms have the best access both to domestically produced inputs and to the domestic market. Once the economy has turned outward these linkages become less important. In the case of Spain some sectors characterised by a high intermediates use, like the production and first transformation of metals or chemicals and oil products, could have been in the past concentrated in a few locations to be close to suppliers. However, the opening of the economy by allowing the firms to receive most of its intermediate inputs from abroad weakens the linkage advantages of core locations.

We also estimated the equation including the variable that proxies for intra-industry linkages (*EG2*). The variable was not significant in any of the periods analysed. We therefore removed it from the final equation estimated and chose to include only the inter-industry linkages variable (*EG1*).

The factor intensity variable has no effect on geographical concentration in 1979, 1986 and 1992. The Heckscher-Ohlin theory requires the existence of differences in relative factor endowments for trade and specialisation to take place. Regions within a country are more similar in terms of their endowments than countries and hence it is not surprising that we don't find Heckscher-Ohlin effects as determinants of geographical concentration of industries across Spanish provinces.

The variable that proxies for technological differences is not significant in 1979, 1986 and 1992. Ricardian comparative advantage seems to be working against agglomeration of activities.

5. Conclusions

This paper has shown that there is no evidence of increasing specialisation in Spanish provinces between 1979 and 1992. The fall in trade costs that represented the entry of Spain in the EC doesn't appear to have affected the geographical concentration of industries in Spain. The fact that the economic geography of Spain was already highly concentrated could be a possible explanation. We also should wait till we could analyse the effects of the 1992 package to reach a more definite conclusion.

Our results indicate also that the most important determinant of the economic geography of Spain is scale economies. Its impact on industrial concentration is always positive and significant and seems to have gained importance during the integration process.

Traditional trade theory (Heckscher-Ohlin and Ricardo) has no effects in explaining the pattern of industrial concentration. In a regional context, with a very high mobility of factors and very few differences in the relative factor endowments, this result is not surprising.

Finally, input-output linkages don't seem to play a role in determining location. In this case our hypothesis is that the opening up of the Spanish economy might have weakened the importance of being close to suppliers.

Notes

[1] "New economic geography" is the name that has been given to a specific class of increasing returns models by KRUGMAN, 1991a. We will use it in the remaining of the paper with this meaning although economic geography refers to a more general field.

[2] In FUJITA *et al.*, 1999, the main models of the "new economic geography" literature are summarised formally. Also, an excellent survey of the new economic geography can be found in OTTAVIANO and PUGA, 1998.

[3] PUGA, 1999, develops a theoretical model that unifies in the same framework regional models like KRUGMAN, 1991b, and international models like KRUGMAN and VENABLES, 1995. He considers both interregional migration and input-output linkages as forces in favour of agglomeration. PUGA's model allows us to analyse the differences and similarities between international and interregional agglomeration.

[4]There is data available up to 1996 but its non homogeneity makes impossible to work with the same data set.

[5] FLUVIÀ and GUAL, 1994, analyse specialisation in European regions defined as NUTS2, a geographical unit larger than the unit used here. In their study, European regions have in average a Gini index of specialisation that equals 0.22 in 1989 while Spanish regions have an average Gini of 0.28.

References

AMITI M. (1997) Specialisation patterns in Europe, Discussion Paper No. 363, Centre for Economic Performance, LSE, London.

BRÜLHART M. (1996) Commerce et spécialisation géographique dans l'Union Européenne, *Economie Internationale* **65**, 169-202.

BRÜLHART M. and TORSTENSSON J. (1996) Regional integration, scale economies and industry location, Discussion Paper No. 1435, Centre for Economic Policy Research, London.

CALLEJÓN M. (1997) Concentración geográfica de la industria y economías de aglomeración, *Economía Industrial*, **317**, 61-68.

CALLEJÓN M. and COSTA M. T. (1996) Economías externas y localización, *Economía Industrial* **305**, 75-86.

DAVIDSON R. and MACKINNON J.G. (1993) *Estimation and inference in Econometrics*. Oxford University Press, Oxford

DAVIS D. R. and WEINSTEIN D. E. (1996) Does economic geography matters for international specialisation, Working paper No. 5706, NBER, Cambridge, MA.

DAVIS D. R. and WEINSTEIN D. E. (1998) Market access, economic geography, and comparative advantage: an empirical assessment, Working paper No. 6787, NBER, Cambridge, MA.

DAVIS D. R. and WEINSTEIN D. E. (1999) Economic geography and regional production structure: An empirical investigation, *European Economic Review* **43**, 379-407.

DE LUCIO J. J., HERCE J. A. and GOICOLEA A (1998) The effects of externalities on Value Added and Productivity Growth in Spanish Industry, Documento de Trabajo 98-05, FEDEA.

ELLISON G. and GLAESER E.L. (1997) Geographic concentration in US manufacturing industries: A dartboard approach, *Journal of Political Economy* **105**, 889-927.

FLUVIÀ M. and GUAL J. (1994) Comercio internacional y desarrollo regional en el marco de la integración europea, in ESTEBAN, J. M. and VIVES, X. (Eds), *Crecimiento y convergencia regional en España y en la Unión Europea*, Institut d'Anàlisi Econòmica, Barcelona.

FUJITA M., KRUGMAN P. and VENABLES A. J. (1999) *The Spatial Economy: Cities, Regions and International Trade*. The MIT Press, Cambridge.

GLAESER E., KALLAL H., SCHEINKMAN J.A and SHLEIFER A. (1992) Growth in Cities, *Journal of Political Economy* **100**, 1126-1152.

GOICOLEA A, HERCE J. A. and DE LUCIO J. J. (1995) Patrones territoriales de crecimiento industrial en España, Documento de Trabajo 95-14, FEDEA.

HAALAND J. I., KIND H., KNARVIK K. and TORSTENSSON J. (1999) What determines the economic geography of Europe?, Discussion Paper No. 2072, Centre for Economic Policy Research, London.

HAUSMAN J.A. (1978) Specification tests in econometrics, *Econometrica* **46**, 1251-1272.

HENDERSON V., KUNCORO A and TURNER M. (1995) Industrial Development in Cities, *Journal of Political Economy* **103**, 1067-1090.

KIM S. (1995) Expansion of markets and the geographic distribution of economic activities: the trends in U.S regional manufacturing structure, 1860-1987, *Quarterly Journal of Economics* **110**, 881-908.

KRUGMAN P. (1980) Scale economies, product differentiation and the pattern of trade, *American Economic Review* **70**, 950-959.

KRUGMAN P. (1991a) *Geography and Trade*. The MIT Press, Cambridge.

KRUGMAN P. (1991b) Increasing returns and economic geography, *Journal of Political Economy* **99**, 484-499.

KRUGMAN P. and LIVAS R. (1996) Trade Policy and the Third World Metropolis, *Journal of Development Economics* **49**, 137-150.

KRUGMAN P. and VENABLES A. J. (1995) Globalization and the inequality of nations, *Quarterly Journal of Economics* **110**, 857-880.

KRUGMAN P. and VENABLES A. J. (1996) Integration, specialization and adjustment, *European Economic Review* **40**, 959-967.

MAUREL F. and SÉDILLOT B. (1999) A measure of the geographic concentration in French manufacturing industries, *Regional Science and Urban Economics* **29**, 575-604.

OTTAVIANO G. and PUGA D. (1998) Agglomeration in the global economy: a survey of the new economic geography, *The World Economy* **21**, 707-731.

PUGA D. (1999) The rise and fall of regional inequalities, *European Economic Review* **43**, 303-334.

VENABLES A. J. (1996) Equilibrium locations of vertically linked industries, *International Economic Review* **37**, 341-359.

VILADECANS E. (1999) *El papel de las economías de aglomeración en la localización de las actividades industriales. El caso español*, PhD dissertation, Universitat de Barcelona.

WHITE H. (1980) A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity, *Econometrica* **48**, 818-838.

Appendix

Table 1. Gini indices of regional specialisation

	1979	1986	1992
Alava	0.7679	0.7488	0.7405
Albacete	0.7357	0.7503	0.6809
Alicante	0.7213	0.7139	0.6497
Almería	0.8191	0.8746	0.8232
Asturias	0.8706	0.8420	0.8085
Ávila	0.8465	0.8325	0.8402
Badajoz	0.7391	0.7582	0.7716
Baleares	0.7553	0.7479	0.6816
Barcelona	0.4988	0.4587	0.4454
Burgos	0.7238	0.7330	0.7327
Cáceres	0.8444	0.8139	0.8352
Cádiz	0.8057	0.8455	0.7678
Cantabria	0.7052	0.6702	0.6813
Castellón	0.7725	0.7890	0.8046
Ciudad Real	0.8251	0.7533	0.7846
Córdoba	0.6516	0.6640	0.5957
Cuenca	0.8417	0.8178	0.8205
Girona	0.6747	0.6467	0.5961
Granada	0.7676	0.7549	0.7164
Guadalajara	0.8568	0.9150	0.8547
Guipúzcoa	0.7046	0.6848	0.6780
Huelva	0.8889	0.9469	0.9068
Huesca	0.8713	0.8594	0.7972
Jaén	0.7619	0.8363	0.7112
La Coruña	0.6419	0.6817	0.6289
La Rioja	0.6718	0.7424	0.7085
Las Palmas	0.6715	0.6857	0.7013
León	0.8542	0.8539	0.7418
Lleida	0.6987	0.7555	0.6866
Lugo	0.7546	0.7964	0.8387
Madrid	0.4954	0.4977	0.5613
Málaga	0.7839	0.7873	0.7468
Murcia	0.6188	0.6106	0.6045
Navarra	0.6490	0.6260	0.6120
Orense	0.8291	0.8090	0.7922
Palencia	0.8987	0.9149	0.8979
Pontevedra	0.7388	0.6972	0.7232
Salamanca	0.7398	0.8423	0.7766
Segovia	0.7849	0.8275	0.7821
Sevilla	0.5985	0.6058	0.6416
Soria	0.8227	0.8550	0.8737
Tenerife	0.8143	0.8464	0.8318
Tarragona	0.6449	0.7209	0.6689
Teruel	0.8382	0.8670	0.8601
Toledo	0.7205	0.7257	0.6596
Valencia	0.5186	0.4810	0.4322
Valladolid	0.7288	0.7213	0.7254
Vizcaya	0.7250	0.7072	0.6517
Zamora	0.9539	0.9481	0.9061
Zaragoza	0.5807	0.5455	0.5850
Global	0.3863	0.3490	0.3408

Table 2. Gini indices of geographical concentration of industries

SECTORS	1979	Rank	1986	Rank	1992	Rank
Water	0.6094	27	0.6034	27	0.6056	27
Prod.&1rst Transf. of metals	0.8740	9	0.8706	10	0.8745	9
Mat. for build&const.&non metallic minerals	0.4958	29	0.4871	29	0.4833	30
Glass products and ceramics	0.8297	17	0.8392	15	0.8315	15
Petrochemistry, org.&nonorganic chemistry	0.9228	7	0.9556	4	0.9550	4
Plastics &synthetic fibres	0.9518	4	0.9610	3	0.9805	1
Fertilisers&paintings	0.8618	12	0.7900	19	0.8475	12
Other industrial chemical products	0.9060	8	0.9059	8	0.9070	8
Pharmaceutical products	0.9778	2	0.9757	2	0.9753	3
Other final consumption chemical products	0.9386	6	0.9420	6	0.9184	7
Melting, foundry and iron works	0.8592	13	0.8615	12	0.8293	16
Metallic goods and service stations	0.6965	25	0.6886	25	0.6774	26
Agric. & ind. machinery&eq.	0.7969	21	0.8095	16	0.7984	18
Office equipment	1.0000*	1	0.9921	1	0.9797	2
Electric machinery and materials	0.8654	11	0.8789	9	0.8201	17
Electronic materials. precision &optics	0.9396	5	0.9513	5	0.9411	6
Vegetables &fish preserves	0.7998	19	0.7915	18	0.7870	20
Flour mills, bread &pastries	0.4112	30	0.4763	30	0.4980	29
Food products&tobacco	0.7297	22	0.7562	22	0.7562	22
Alcohol&drinks	0.7099	24	0.7283	23	0.7053	24
Textiles	0.8675	10	0.8660	11	0.8726	10
Leather&shoes	0.8551	14	0.8397	14	0.8422	13
Apparel	0.7169	23	0.7212	24	0.7232	23
Wood, cork &derivatives	0.5812	28	0.5850	28	0.5486	28
Furniture	0.6626	26	0.6633	26	0.6797	25
Paper&derivatives	0.8173	18	0.7817	21	0.7961	19
Printing&Publishing	0.7995	20	0.7964	17	0.8372	14
Plastic derivatives	0.8423	16	0.7891	20	0.7642	21
Toys	0.9581	3	0.9406	7	0.9444	5
Other manufactures	0.8520	15	0.8611	13	0.8513	11
Global	0.6780		0.6719		0.6700	

* In this sector, the Gini index of 1 does not mean that all the sector is concentrated in one province. It is a consequence of the problem of statistical secrecy, explained in section 4.1 (when a province has less than 6 firms in a sector, the data is not available).

Table 3. Estimates of the determinants of geographical concentration of industries

	1979		1986		1992	
	OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
Constant	0.291[c]	0.292[c]	0.322	0.325	0.066	0.070
	(0.169)	(0.170)	(0.224)	(0.226)	(0.181)	(0.184)
LSCALE	0.143[a]	0.144[a]	0.167[a]	0.169[a]	0.153[a]	0.157[a]
	(0.043)	(0.044)	(0.027)	(0.028)	(0.035)	(0.035)
LHO	0.013	0.013	0.011	0.011	0.016	0.015
	(0.015)	(0.016)	(0.022)	(0.022)	(0.012)	(0.012)
LEG	-0.188	-0.192	-0.494[b]	-0.503[b]	-0.448[c]	-0.470[c]
	(0.232)	(0.231)	(0.227)	(0.223)	(0.254)	(0.256)
LTECDIF	-0.008	-0.007	-0.018	-0.018	0.020	0.020
	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Adjusted R^2	0.519	0.519	0.608	0.607	0.578	0.576
HAUSMAN test	3.299[c]	----	3.360[c]	----	6.670[a]	----
n. obs.	30	30	30	30	30	30

Notes: Heteroscedasticity consistent standard errors in parentheses.
([a]) significance level 1%, ([b]) significance level 5%, ([c]) significance level 10%.
The SCALE variable was divided by 10^3
Estimation methods: (OLS): Ordinary least squares; (2SLS): Two-Stage least squares

1

2

3

4

5