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Polinuclear Metropolis And Competitiveness: Changes In Industrial Location And International Trade In Metropolitan Barcelona

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POLINUCLEAR METROPOLIS AND COMPETITIVINESS: CHANGES IN INDUSTRIAL LOCATION AND INTERNATIONAL TRADE IN METROPOLITAN BARCELONA

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Abstract

Economic literature on endogenous growth has tried to capture Marshallian externalities from the notion of homogenous region. However, some applied researches have argued recently against the usefulness of the homogenous regions as analytical units because the irruption of several localized densifications of productive activity of intrametropolitan nature. As a consequence, the metropolitan industry-mix could hide a high degree of specialization in several urban poles inside the metropolis.

This paper tries to identify agglomeration economies --both localization and urbanization-- from the recent economic literature on economic growth and cities. Moreover, it gives a particular emphasis to the contributions on the influence of specialization or diversification, urban structure and intrametropolitan sectoral localization. At the same time, this paper studies some consequences of globalization process on the conditions of productive specialization, firm size, technological intensity and industrial location inside the Metropolitan Region of Barcelona, from the statistical data of foreign trade (1988-1997), local employment (1991 and 1996) and number of firms. Information has been distributed in 26 manufactured activities and in a wide range of territorial areas that try to identify poles and corridors inside the metropolitan region.

The results show that in a metropolitan area as Barcelona there are several competitive systems with specialized companies, located in a polinucleated metropolitan space and with a flexible basis. Therefore, changes of regional foreign trade have been dramatic, with a growing share of medium-high technological intensity products. A diversified productive system, strong activity densifications in several urban cores and a small firm size are the main characteristic features of this area. In the same way, it's been identified an increasing role of corridors in location of productive activity and export performance, although concentration degree of several activities in the poles still remains high. So, the influence of urbanization economies in the evolution of medium-high industries seems to be progressively more significant.

1. From Prato to Barcelona: On the Analytical Unit and the Research Program.

Since the late seventies, with the reintroduction of the notion of industrial district from Professor Giacomo Becattini, a very interesting debate has emerged both in the field of the general economic analysis and in fields concerning more specifically with the territory. This debate is about the relevance of the spatial externalities as an explicative factor of the economic growth. In Becattini (1975) is outlined the existence of "a mechanism of creation and transmission of external economies to the firms but internal to the industry, which operates through the proliferation of small and medium firms specialized in different phases of a particular productive process". Later, on in his seminal work "Dal "settore" industriale al "distretto" industriale. Alcune considerazione sull'unità di indagine dell'economia industriale"(1979). Becattini generalizes this finding and proposes the "industrial district" meant as a city or urban area endowed with some specificities and becomes a research unit for the academics of industrial economy. The canonic city, or city of reference, for the study of the industrial districts is with no doubt Prato. Its characteristic sector is the textile, the size of its firms is small or medium, and the economic context is dominated by the internationalization of the economy after II WW.

Since the pioneering works of Becattini the economic analysis has had important contributors in the study of increasing returns, competitive equilibrium and industrial location such us Paul Romer, Robert Lucas and Paul Krugman[1]. It has been a collective work and has had as a result a rediscovery of the territory as a fundamental economic factor. The very recent study by Masahisa Fujita, Paul Krugman y Anthony J. Venables (1999) proposes a reconstruction of the spatial economy integrating the findings in these fields in the last twenty years. The externalities of an urban base are so important that they cannot be ignored in the study of the economy: the development process cannot be understood without the spatial frame.

However the transition from the industrial "district" to the "city" or "metropolis" as a research unit requires that the sort of agglomeration economies to be considered be extended. Indeed, together with the marshallian <u>economies of localization</u>, there appear a

set of economies of urbanization which are external to the firm but shared by all sectors or agents in the same urban space. Therefore the economies of localization represent only a part of the whole set of the economies of agglomeration studied in urban economic science[2]. Moreover we should consider the network economies, especially in the case of the metropolitan area of Barcelona [3].

The study of the external economies with a spatial base has focused especially on the so-called dynamic externalities which include both economies of localization of each sector in the city and economies of urbanization related with the urban size, (although always more from an industrial point of view rather than a territorial one). This is why externalities have been distinguished according to: Marshall, Arrow, Romer (MAR) externalities; Jacobs' externalities; and Porter' externalities. Among all these authors, the complexity of the city it is only present in Jacobs' studies [4].

As a matter of fact, in his Book IV of The Principles Marshall suggested the possibility that in some big cities there could exist a set of activities clustered together in different districts and that would present, at the same time, the advantages of the economies of localization specific to each sector as well as the economies of urbanization characteristic of a standard city. These advantages would derive from the bigger dimension of the urban market, which would make easier the response to unpredictable demands, and from the bigger complexity of the labor market, which would facilitate the access to an increasing specialization.

An outstanding part of the applied literature has tried to find evidence of the existence or importance of the economies of localization taking as a starting assumption the negligence of the set of economies of urbanization. Very often the target was the identification of industrial districts. Alternatively, the project "Barcelona as a Knowledge City" tries to explore the existence of conditions of productive specialization, firm size and location of the productive activity in a metropolis characterized by its traditional industrial export base.

In this report we only advance some results which allow to identify how in a metropolis such as Barcelona there can coexist competitive and specialized systems of small and

medium firms in a polinuclear metropolitan space and how they adjust to the new conditions of the globalization of the economy with a flexible base. Barcelona is a flexible city: diversified from the point of its export base, but with densifications of productive activity in the different urban centers or industrial districts.

The appropriate unit of analysis won't be the specialized intermediate city but the diversified metropolis. The economies of urbanization will compete with the economies of localization, driving a wide set of activities to a change of location. Therefore we must introduce to the analysis of urban form not only the distinction between central city and metropolitan rings but as well the distinction between suburban centers and suburban corridors. The location of new productive activities in the central city will denote the existence of new economies of localization related to the knowledge. Barcelona would tend to specialize in activities dense in knowledge, following the model Knowledge-based Economy studied as well by the OECD (1996).

2. **Barcelona, polinuclear metropolis. The Flexible City**.

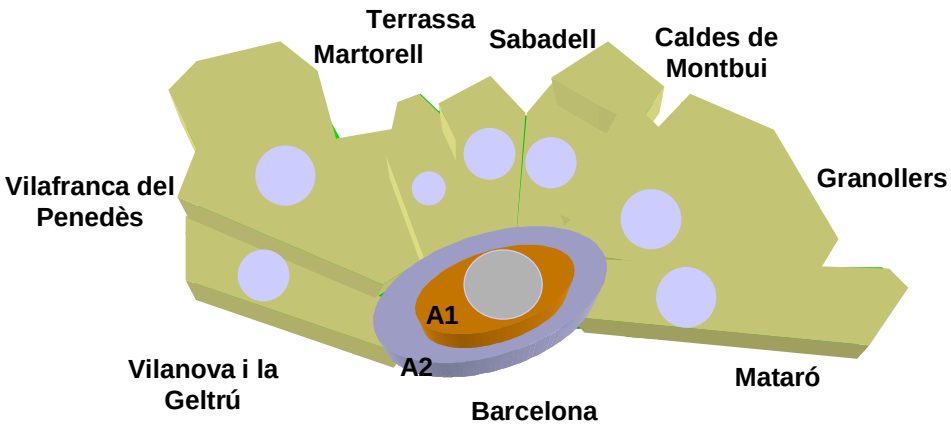
In this research we will identify some distinctive features of the economic globalization process, its compatibility with the decrease of the average size of the medium productive establishment and the relation between changes in the competitive position of each industrial sector and the concentration in the territory.

We will now follow with an analysis of the labor decentralization and the change of the economic base of the central city, as well as with the permanence of important polarizations of the economic activity in a relevant group of productive sectors that include the actual central city. In consequence in this epigraph evidence is provided of the compatibility of the process of opening up Barcelona's economy with the maintenance of important densifications in a wide group of industrial and tertiary sectors. Even with the existence of an important industrial decentralization process the totality of the Barcelona metropolis presents high concentration indexes in the suburban centers that compose it. This happens

both in industries with very segmented productive processes, such as the textile industry, as well as in more integrated industries, such as the automobile or motorcycle industry.

In the research we have worked with a cluster of cities in the agglomeration of Barcelona, which includes 26 poles and corridors. This grouping is based on the one used by the Metropolitan Transportation Authority (MTA) of Barcelona. It distinguishes eight metropolitan transportation corridors - Vilanova i la Geltrú, Vilafranca del Penedés, Martorell, Terrassa, Sabadell, Caldes de Montbui, Granollers and Mataró; four exterior areas, and the central agglomeration. In this way, we try to identify polarizations within each corridor, as well as to facilitate the study of industrial decentralization processes that affect not only the central agglomeration but also the totality of primary suburban centers. At this stage of the investigation the group of cities that present a high relationship with Barcelona (zones A1 and A2 of the MTA) were separated from the central agglomeration.

Figure 1.- Research geographical areas (Barcelona, A1, A2, 7 poles, 8 corridors)



The investigation is conditioned by the availability of the statistical data. Concerning foreign trade we have worked with a statistical series from 1988-1997 for the Province of Barcelona. The sectoral information comes from two basic sources: the census (1991 and 1996) and the social security (municipal series from 1991 to 1998). We also have available municipal data from the Economic Activity Tax (IAE) from 1993 and 1997. The

coefficients of localization have been calculated with the census data from cities with more than 10.000 total jobs and with more than 2.000 jobs in each sector. The classification that has been used is CNAE-93 with 31 sectors.

3. Globalization and flexibility

Concerning to foreign trade, in recent years Barcelona's economy has changed dramatically. A traditional industrial city, highly protected to foreign competition, has become a new economic reality integrated in the international markets. In this new context, the foreign trade has grown steadily. Thereby, in the case of manufacturing products, Barcelona's exports have grown at an annual average rate of 16,2% between 1988 and 1997, meanwhile it has grown a 10,9% by year in the case of imports. As a consequence, the export/import ratio has improved significantly, from 53% to 80% in the same period.

TABLE 1.- EXPORT STRUCTURE BY TECHNOLOGICAL CONTENT (MANUFACTURING)

Technological content	1988	1997	1988-92	1988-97
Exports				
HIGH	8,32%	10,50%	-0,17%	2,18%
MEDIUM-HIGH	50,91%	52,77%	3,85%	1,86%
MEDIUM-LOW	14,41%	14,09%	0,88%	-0,32%
LOW	26,36%	22,64%	-4,56%	-3,72%
Export/Import Ratio				
HIGH	29,32%	63,21%	3,72%	33,89%
MEDIUM-HIGH	50,56%	84,12%	8,31%	33,56%
MEDIUM-LOW	54,42%	72,83%	0,53%	18,41%
LOW	75,61%	85,41%	-20,78%	9,80%

An important transformation in the trade structure has been one of the main patterns in this evolution. Thereby, in the previous table we can see a growing role of products with high and medium-high technological content. They improve significantly their competitive position and also they increase their share in Barcelona's exports. In this way, it's revealed

that this group of industrial activities means as a whole more than 63% of manufacturing sales from Barcelona to foreign markets, a relative share that has grown in 4 points during the last ten years. At the same time, the four categories present a deficit in its trade balance. However, the export/import ratio has increased in 34 percentage points, far over the average growth in the whole manufacturing sector. In spite of this improvement, this ratio still remains below 65% in the case of products with the most advanced technology.

To identify more closely the strong and weak competitive points in Barcelona's trade relations, we try to isolate the influence of the overall trade evolution by means of a standardization procedure. Therefore, it has been computed the Standardized Revealed Comparative Advantage Coefficient (SRCAC) for two samples: a set of 26 representative industrial activities, and the OECD's rating (1999), according to its technological content.

That is $SRCAC_i = (A_i – B) \cdot S_i$, where X_i: exports of activity i; M_i: imports of activity I; X: exports of the whole industry; M: imports of the whole industry; A_i: $(X_i - M_i) / (X_i + M_i)$, B: $(X - M) / (X + M)$, S_i: $[100 / (1 - B)]$ if $A_i > B$ or $[100 / (1 + B)]$ if $A_i < B$. With this methodology the value $SRCAC_i$ could move between +100 and – 100, depending on a greater competitive advantage or disadvantage. In the next table SRAC value for each category of product is presented.

As a whole, Barcelona's economy shows a much better competitive position in 1997. Moreover, it is revealed:

- A set of industries with a strong competitive level, as printing and publishing, knitted or crocheted articles, transport equipment, beverage and automobile components.
- A group of industries with a significant improvement in their competitiveness, as electronics, motorcycle, food processing and chemicals.
- Some activities with competitive weakness, as precision instruments, basic chemical products, synthetic fibers, basic metals and pharmaceutical products.
- Several industries with a strong backward movement: clothing, textiles and tanning and dressing of leather.

TABLE 2.- STANDARIZED REVEALED ADVANTAGE COEFFICIENT

(MANUFACTURING, BARCELONA)

	1988	1997	1988-97
Industry:			
Food processing	-47,34	-16,30	31,03
Beverages	45,58	28,57	-17,01
Knitted or crocheted articles	42,72	45,62	2,90
Textiles	35,21	6,75	-28,47
Clothing	51,48	-10,41	-61,89
Tanning and dressing of leather	44,61	14,85	-29,76
Paper	-22,95	-14,58	8,37
Printing and publishing	37,09	52,28	15,19
Basic chemicals	-34,41	-36,90	-2,49
Chemical products	-26,82	-7,54	19,28
Pharmaceutical products	8,05	-24,73	-32,78
Wood and articles of wood	6,22	8,48	2,26
Synthetic fibers	4,69	-32,33	-37,01
Rubber and plastic products	14,31	4,92	-9,40
Non-metallic mineral products	12,82	11,64	-1,18
Basic metals	-48,42	-45,37	3,05
Metal products	19,93	6,89	-13,04
Machinery and mechanical appliances	-16,46	-9,40	7,06
Office equipment and computing	-34,74	-18,74	16,00
Electrical machinery	14,03	6,94	-7,09
Electronics	-64,35	-1,18	63,17
Medical and precision instruments	-63,01	-47,88	15,12
Transport equipment	35,40	43,16	7,76
Motorcycles	-20,52	15,29	35,81
Automobile components	17,72	24,20	6,49
Other manufacturing	5,49	-2,15	-7,64

Technological content:

HIGH	-34,15	-12,79	21,36
MEDIUM-HIGH	-2,48	2,31	4,79
MEDIUM-LOW	1,23	-5,11	-6,34
LOW	13,15	2,99	-10,16

On a technological basis, the results show that Barcelona's economy still has a significant negative trade balance in products with high technological content. Moreover, this group has reached the greater improvement in competitiveness during the period 1988-1997.

However, the research on industrial competitiveness should be made through the analysis of changes in specialization patterns. Therefore, we will try to identify the presence of structural changes by means of two simple dynamic and complementary tests on the manufacturing trade evolution for the different product categories, depending of their technological content: the terms of trade and the trade pattern. It has been computed the export and import unit values for a sample of more than 4.000 product categories. In the next table, we can find the comparison between both prices. When the export unit value is higher in more than 15%, we consider that in this product category there is *export price supremacy*. If not, when the import unit value is higher in more than 15%, then we consider that there is *import price supremacy*. And when the differences between both unit values are lower than 15% we consider that in this product category there is a *price similarity*.

TABLE 3.- SHARE IN FOREIGN TRADE (MANUFACTURING, BARCELONA)

1988	EXPORT PRICE SUPREMACY	IMPORT PRICE SUPREMACY	PRICE SIMILARITY
ALL PRODUCTS	32,65%	52,40%	14,96%
HIGH AND MEDIUM-HIGH	32,03%	52,60%	15,37%
LOW AND MEDIUM-LOW	33,14%	52,24%	14,62%

1997	EXPORT PRICE SUPREMACY	IMPORT PRICE SUPREMACY	PRICE SIMILARITY
ALL PRODUCTS	40,09%	43,30%	16,61%
HIGH AND MEDIUM-HIGH	38,19%	45,95%	15,86%
LOW AND MEDIUM-LOW	41,63%	41,15%	17,21%

1988-97	EXPORT PRICE SUPREMACY	IMPORT PRICE SUPREMACY	PRICE SIMILARITY
ALL PRODUCTS	7,44%	-9,10%	1,65%
HIGH AND MEDIUM-HIGH	6,16%	-6,65%	0,49%
LOW AND MEDIUM-LOW	8,49%	-11,09%	2,59%

Moreover, in the next table we present the terms of trade, both by means of the comparison between the average unit export and import prices (P_x/P_m) and by means of the comparison between the average export and import quantities (Q_x/Q_m). Of course, the computation of $[(P_x \cdot Q_x)/(P_m \cdot Q_m)]$ give us the value of the export/import ratio.

TABLE 4.- TERMS OF TRADE (MANUFACTURING, BARCELONA)

1988	IN PRICES (Px/Pm)	IN QUANTITIES (Qx/Qm)	EXPORT/IMPORT RATIO
ALL PRODUCTS	0,787	0,667	0,525
HIGH AND MEDIUM-HIGH	0,596	0,819	0,488
LOW AND MEDIUM-LOW	1,010	0,588	0,593

1997	IN PRICES (Px/Pm)	IN QUANTITIES (Qx/Qm)	EXPORT/IMPORT RATIO
ALL PRODUCTS	1,022	0,781	0,799
HIGH AND MEDIUM-HIGH	0,910	0,908	0,827
LOW AND MEDIUM-LOW	1,043	0,724	0,755

1988-97	IN PRICES (Px/Pm)	IN QUANTITIES (Qx/Qm)	EXPORT/IMPORT RATIO
ALL PRODUCTS	0,235	0,114	0,274
HIGH AND MEDIUM-HIGH	0,315	0,089	0,339
LOW AND MEDIUM-LOW	0,033	0,137	0,162

We can see how the improvement in the trade balance is a consequence of the growth in the terms of trade, both in prices and in quantities. This fact drives to a significant advance in the relative weight of the product categories with export price supremacy. However, the positions with import price supremacy still are predominant. This is the consequence of a deficit in the trade balance with high technological content. But an outstanding result is that this technological gap seems to be very narrowed during the recent years.

We will try to get more information on the competitiveness dynamics using other methodology. So, we have identified each product category depending on its dominant competitiveness strategy. It has been separated those products in which trade depends

mainly on the price competitiveness from those products in which competitiveness depends on quality, as in Aiginger's research (1997). That is, we identify four possible markets:

- *Market with competitive advantage in prices*: if unit export value is lower than the unit import value and the export quantity is higher than the import quantity.
- *Market with competitive disadvantage in prices*: if unit export value is higher than the unit import value and the export quantity is lower than the import quantity.
- *Market with competitive advantage in quality*: if export quantity is higher than the import quantity, in spite of a higher unit export value.
- *Market with competitive disadvantage in quality*: if export quantity is lower than the import quantity, in spite of a higher unit import value.

TABLE 5.- EXPORT/IMPORT RATIO DISCRIMINATED BY TRADE PATTERN (MANUFACTURING, BARCELONA)

1988	ALL MARKETS	PRICE MARKETS	QUALITY MARKETS
ALL PRODUCTS	0,525	0,636	0,330
HIGH AND MEDIUM-HIGH	0,488	0,512	0,311
LOW AND MEDIUM-LOW	0,593	0,834	0,380

1997	ALL MARKETS	PRICE MARKETS	QUALITY MARKETS
ALL PRODUCTS	0,799	0,950	0,771
HIGH AND MEDIUM-HIGH	0,827	1,183	0,802
LOW AND MEDIUM-LOW	0,755	0,664	0,721

1988-97	ALL MARKETS	PRICE MARKETS	QUALITY MARKETS
ALL PRODUCTS	0,274	0,314	0,441
HIGH AND MEDIUM-HIGH	0,339	0,671	0,492
LOW AND MEDIUM-LOW	0,162	-0,170	0,341

If both the difference between unit values and the difference between export and quantities show the same sign, it is a market with a trade pattern based on quality or product differentiation. Otherwise, the trade pattern would be based on price differences –of course, it is assumed that unit values reflect costs and also product homogeneity. With this methodology, it is possible to infer the export/import ratio, discriminating between markets.

In spite of the significant improvement in competitiveness, in both trade patterns Barcelona's trade balance still remains with a negative sign. However, the advance of technology-intensive products is outstanding, as far as in this group it is identified a positive balance in those relations in which competitiveness would depend on price differences. On one hand, a more favorable evolution in the peseta exchange rate since 1992 and the strong inflow of foreign direct investment in the recent years could probably explain this behavior, mainly in the case of the transport equipment and electronics industries. On the other hand, it is very significant the loss in cost competitiveness in those markets with low technological content, mainly in front of the competition in international and domestic market from no-EU countries. Textiles, clothing and leather would be the most damaged productions.

The positive evolution of Barcelona's exports is compatible with the presence of a small firm size. In the next table, there is a comparison with other metropolis from Japan, USA and Europe. The dominant trend is to decrease the average size. However, it is possible to identify two different patterns: on the one hand, USA and Great Britain; on the other hand, Japan and rest of Europe (Trullén, 1997). Barcelona shows similar results to Japan, with an average size of 10 employees by industrial firm. To sum up, Barcelona's economy seems to follow a guideline of growing competitiveness, fully compatible with the presence of a productive system very segmented. That is, it emerges as a diversified metropolis with an outstanding productive flexibility.

TABLE 6.- AVERAGE SIZE OF FIRMS IN DIFFERENT METROPOLITAN AREAS

(Number of employees per firm)

	TOTAL			MANUFACTURING		
	1970	1980	1990	1970	1980	1990
USA						
Chicago	26,4	25,2	19,8	72,3	70,3	54,6
New York	15,2	12,7	18,0	29,4	26,3	25,7
Philadelphia		27,9	28,1		56,3	48,2
JAPAN						
Kobe	9,9	8,6	9,0	24,0	18,1	16,5
Tokyo	10,8	9,8	11,5	14,6	12,0	12,6
Kyoto	7,4	7,3	8,1	10,2	9,1	10,1
Osaka	10,9	9,0	10,0	16,1	11,2	12,0
Yokohama	10,4	9,2	10,7	31,7	22,7	20,3
EUROPE						
Paris		7,4	7,4			
London	22,2	20,7		43,9	29,4	
Milan	8,0	7,6		13,1	12,4	
Barcelona		9,5	9,3			12,7

4. Polinucleation vs. decentralization.

In this section we will study the employment territorial dynamics in the metropolis of Barcelona. Two different forces exist: the centrifugal one, which encourages economies of urbanization motivated by the land abundance and the land cost, and the centripetal one, with localization economies like “industrial districts” and with the urbanization economies related the accessibility or the proximity to the market.

First of all, the growing decentralization process of the industrial employment from Barcelona to the metropolitan region is apparent. There is no available data on industrial relocation. Looking at the employment data we see an increasing tertiarization of the employment in the central city and an attraction of industrial labor to the metropolitan suburbs. But if we examine the employment statistics in Barcelona city we can clearly identify the intensity of the business cycle, especially in the tertiary sector. Consequently,

we must make a distinction between trend and cycle. The deindustralization of the metropolitan center is a trend, clearly towards tertiarization. Barcelona city is therefore the central provider of the totality of the Barcelona Metropolitan Region. Moreover, there is a higher intensity of the business cycle in the central city than in the first and second metropolitan ring. The trend towards the tertiarization and deindustrialization of the activities of Barcelona city is reflected as well in the land consumption, according to the data available on taxable surface of the IAE. Between 1995 and 1999, in tertiary activities the demand for taxable surface has increased annually in more than 500.000 m2.

To which point the tertiarization and deindustrialization process that affects the city of Barcelona has caused a decrease in the polarization of the productive activity in the city? The next table shows the coefficients of employment localization found in cities with most labor dimension. We find a high permanence in the higher coefficients of localization, despite the intensity of employment loss in the period 1991/1996. Thus, high condensations of industrial district activity remain in cities such as Mataró, Terrassa and Sabadell (textiles), Granollers (food processing), Rubí and Barberà (metallurgy and construction of metallic products). We can also detect the appearance of a very high coefficient of localization in transport equipment in Martorell, as a consequence of the new SEAT plant.

TABLE 7.- MAIN ECONOMIC ACTIVITY DENSIFICATIONS

City	Sector	Employment 1991	Employment 1996	Localization Coefficient 1991	Localization Coefficient 1996
BARCELONA	Real state and services to firms	85.346	91.357	1,37	1,35
BARCELONA	Public Administration	43.620	48.265	1,30	1,24
BARCELONA	Education	34.709	40.382	1,13	1,22
BARCELONA	Health and social services	38.822	40.013	1,29	1,27
BARCELONA	Financial services	39.390	33.252	1,47	1,46
SABADELL	Textiles and clothing	9.999	7.593	2,48	2,55
MATARÓ	Textiles and clothing	10.963	7.341	4,84	4,72
MARTORELL	Transport equipment	1.391	6.891	3,73	10,46
TERRASSA	Textiles and clothing	9.136	6.773	2,73	2,62

Additionally we must emphasize the intensity and even growth of the coefficients of localization of the tertiary sectors in the city of Barcelona, thus constituting clusters or "tertiary districts" in activities such as financial services, real state and business, education and sanitary services.

In consequence, with the following model we will try to explain the evolution of industrial employment in the period 1991-1996 from a set of independent variables that explain the incidence in the decentralization process from the central agglomeration of the city, the effect of the degree of concentration of each industry in the territory, the effect of the average dimension of the firms and the influence of the behavior of the sectoral demand.

The following model has been specified:

$$VL_i^{9691} = \alpha + \beta_1 DES_i + \beta_2 CON_i + \beta_3 DIM_i + \beta_4 DEM_i,$$

where the coefficient *i* represents each of the defined industrial clusters, while the dependent variable VL_i^{9691} is the logarithmic expression of the variation in the levels of employment in each sector during the period 1991-1996. The independent variable $DES_{i,}$ on the other hand, reflects the employment variation in each sector that is directly attributable to the activity relocation from central city[5], while the variable CON_i indicates the degree of geographic concentration of activity at the beginning of the period. DIM_i tells us of the effect of the average size of the firms in each different type of activity *i*. Finally DEM_i attempts to bring together the effect of the evolution of demand on the behavior of employment, from the available data on foreign trade flows[6].

The results obtained, presented in the next table, allow us to infer some interesting conclusions:

- First, once the evolution of the industrial employment by the existing differences in demand behavior is corrected, the transcendence of the geographical decentralization

process from the central agglomeration of the metropolis to the suburban centers and metropolitan axes is confirmed.

- Second, it is also manifest that the activities that presented a higher level of concentration, in general, have seen their level of employment decrease with higher intensity.
- Third, the activities that present a higher average dimension of the firms would show a better evolution in their employment. This could be associated to their higher relation capital-labor and, in consequence, the better utilization of economies of internal scale.

MODEL 1

Dependent Variable: VL_i^{9691}

Variable	Coefficient
α	0,110
	(2,61)
DES	0,819
	(20,15)
CON	-0,208
	(-2,76)
DIM	0,002
	(5,42)
DEM	0,157
	(2,12)
R^{2-}Adj.	0,950
F-statistic	120,4
Prob (F)	(0,0000)
SSR	0,25
Observations	26

(In parenthesis are presented the t statistics)

As a conclusion of this section we highlight the detection of an intense process of industrial decentralization and also the permanence of productive activity densifications in cities with

a long industrial tradition such as Mataró, Sabadell and Terrassa. We remark also the permanence of an elevated concentration of tertiary activities in the city of Barcelona.

5. Influence of agglomeration economies

This industrial location model does not incorporate the influence of externalities on employment evolution. Therefore, we need another specification to deduce the effects of industrial agglomeration on firm competitiveness, because localization could be determining in the export propensity of firms (Bagella et al, 1998). So, it is estimated an econometric model that identifies the explanatory factors of the employment level in the year 1996 (L_{ij}^{96}), in each industry (*i*) located in every geographical area (*j*). The model presents the current level of the local employment in an industrial sector as a function of some variables: (i) the dimension of its own sector in the past L_{ij}^{91} (and, therefore, the importance of historical conditions); (ii) the local specialization index[7] of this area in that sector (e_{ij}^{91}) at the beginning of the period; (iii) a global specialization index[8] of each area (E_j^{91}) at the beginning of the period; and (iv) the average size of firms in this sector and located in that area (D_{ij}^{96}). The model is estimated for two kinds of industries: high and medium-high technological content (model 2A) and low and medium-low technological content (model 2B).

Therefore, the model to estimate is the following[9]:

$$L_{ij}^{96} = \alpha + \beta 1\ L_{ij}^{91} + \beta 2\ e_{ij}^{91} + \beta 3\ E_j^{91} + \beta 4\ D_{ij}^{96},$$

So, we try to infer both the influence of those scale economies that are internal to firms – through the average firm size— and the influence of external economies, in this case through the variables e_{ij}^{91} and E_j^{91}. To sum up, it will be tested whether the local specialization, the local productive diversity or the firm size are the main determining factors in the evolution of industrial employment. Moreover, the model tries to explain the influence of knowledge flows between firms: meanwhile the variable representative of the diversity level of local environment will try to identify externalities of inter-industrial type,

the local specialization variable as well as the dimension of the sector in the past will try to capture externalities of intra-industrial pattern.

MODEL 2A

Dependent Variable: L_{ij}^{96}

Variable	Coefficient	Coefficient
α	1,281	1,243
	(5,22)	(5,05)
L_{ij}^{91}	0,804	0,808
	(30,46)	(30,49)
e^{91}	6,041	4,717
	(2,47)	(2,01)
E^{91}	-0,522	-0,453
	(-2,12)	(-1,84)
D_{ij}^{96}	0,00007	-0,000007
	(0,67)	(-0,86)
TRANSP		1,424
		(4,48)
R^{2-} Adj.	0,889	0,891
F-statistic	593,1	484,2
Prob (F)	(0,0000)	(0,0000)
SSR	112,1	109,8
Observations	296	296

(t-Student between brackets - Heteroscedasticity adjusted with White-test)

The results show a greater influence of external economies on industries with higher technological-intensity, in which firm size seems to be less significant. That is, production with greater technological knowledge-intensity probably would be more benefited from agglomeration economies. The inclusion of a dummy variable (TRANSP) to identify the displacement effect of the transport equipment industry from Barcelona to Martorell confirms that both the local specialization level and the availability of a diversified environment stimulate the localization of advanced knowledge-intensive industries. Probably, the presence of small and medium enterprises that are very dynamic in their innovative activity explains the employment evolution in these industries. Prevezer (1997)

has noted that the significance of knowledge spillovers is bigger in the early stages of product life-cycle. As a consequence, agglomeration economies could be more decisive in industries with higher technological content or higher density in new knowledge.

MODEL 2B

Dependent variable: L_{ij}^{96}

Variable	Coefficient
α	0,783
	(5,04)
L_{ij}^{91}	0,878
	(37,61)
e^{91}	-4,828
	(-2,81)
E^{91}	6,132
	(1,81)
D_{ij}^{96}	0,0006
	(2,89)
R^{2-} Adj.	0,822
F-statistic	418,4
Prob (F)	(0,0000)
SSR	166,9
Observations	363

(t-Student between brackets - Heteroscedasticity adjusted with White-test)

In the case of industries with lower technological content, it is detected a larger geographical dispersion of employment. That is, a tendency to displacement of production from areas with high local specialization level. As a consequence, in these industries the geographical concentration level is decreasing. However, the positive employment evolution of those firms located in few diversified environments could suggest that the local agglomeration level still remains as one of the main determining factors and therefore that the influence of localization economies is significant. In any way, large firms have shown more favorable records in their employment level, probably due to their higher ability to introduce the necessary product and process innovations to face a growing foreign

competence from products with low cost and scarce differentiation[10]. In any way, it is necessary a deeper analysis to detect with higher precision the influence of the different kind of external economies on the industries located in the metropolitan agglomeration.

6. Conclusions

Barcelona presents several competitive systems with specialized firms, located in a polinucleated metropolitan space and with a flexible basis. In recent years, changes of regional foreign trade have been dramatic, with a growing share of medium-high technological intensity products. The positive evolution of Barcelona's exports is compatible with a diversified productive system, strong activity densifications in several urban cores and a small firm size.

Although the concentration of several economic activities in the poles still remains at a high level and therefore the localization economies seem to be outstanding, the influence of urbanization economies in the evolution of medium-high industries could be significant.

Finally, it seems necessary to focus the Marshallian externalities research on a polinuclear metropolis basis --that is specialized in its poles but diversified as a whole-- instead of limiting the analysis to some highly-specialized cities --like the canonical industrial district case.

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[1] A study about the origins of this debate can be found in Joan Trullén (1991); a study about its development can be found in Ivan Muñiz (1998).

[2] See Roberto Camagni, Economia urbana, Chapter I, La nuova Italia Scientifica, Roma, 1993.

[3] These economies had been analyzed following the methodology of Dematteis and Camagni for the case of Barcelona, in another research work. See G. Dematteis and Roberto Camagni.

[4] Jane Jacobs (1969), The economy of cities.

[5] That is, the sectoral employment variation in the city of Barcelona.

[6] With this end, DEM_i has been calculated from the growth in exports in the period 1992-1997, expressed in deviation over the mean. To isolate the different incidence on the demand appears to be especially relevant when the analyzed period is very short since the presence of asymmetric cyclical behavior could somewhat distort the comparison between the sectoral evolution of employment.

[7] Computed as $e_{ij} = \left| (L_{ij}/L_j) - (L_i/L) \right|$.

[8] Computed as $E_j^{91} = \Sigma_i \left| (L_{ij}/L_j) - (L_i/L) \right.$. Therefore, it captures if local environment is formed by other different industries.

[9] It is based on Callejón and Costa (1995).

[10] Probably, that is the case of textiles, clothing and leather industries.