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## Conference Paper

# Creative and knowledge economies and their linkages with other economic sectors: analysis for the Catalonia Region

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# **Creative and knowledge economies and their linkages with other economic sectors. Analysis of the Catalonia region**

**Eduardo Chica Mejía & Carlos Marmolejo Duarte**

## **Abstract**

The increase in the last decades of the weight of the knowledge-economies in the economies of metropolitan areas is transforming the dynamics of urban development, for access of these sectors to agglomeration economies, such as skilled labor and good communication infrastructures. Polycentrism is helping in such a process. In this paper the interactions of these economies with other economic sectors are analyzed in order to know the relationship between levels of economic dependence of economic sectors and their spatial patterns. In doing so, the input-output matrix of Catalonia is analyzed by means of multidimensional scaling techniques and compared to the geographical distance among sectors. Results suggest a little correlation between economic dependence and geographic distance from the different economic sectors, and a high correlation factor was found when considered in isolation of the knowledge economies. This phenomenon could be the result of great economic dependence of all economic sectors to these sectors, which are located mostly in the center of all relations of the region's economy. Consequently, knowledge economies are localized geographically around the whole territory, although, more concentrated than others sectors.

## **Keywords**

Knowledge economies, regional development, MDS analysis

## **Introduction**

The increase in the last decades of the weight of the creative and knowledge economies; high technology industries (hereafter HTI) and knowledge intensive services (hereafter KIS) in productive activities in metropolitan region, is changing its dynamics of development of these activities access to agglomeration economies, such as: market skilled labor, good communications infrastructure and diversified economic production. Polycentric metropolitan processes contribute to the expansion of these economic sectors across the territory, by encouraging the emergence and consolidation of local labor markets specialized.

This communication comes from the doctoral thesis which objective is to study the impact of the KIS-HTI sectors in the urban development of metropolitan areas and in particular the metropolitan region of Barcelona (hereafter MRB). The study is approached from the analysis of functional relationships established by these sectors with other sectors of the economy and their effects on various explanatory variables in urban development.

In this paper we present the results of the analysis of the interactions of the KIS-HTI sectors with other economic sectors in Catalonia, in order to understand the relationships between levels of economic dependency and patterns of location in the territory. It analyzes the Input-output matrix of Catalonia (2001) and one matrix of geographical distances of the different economic sectors, built with data on locally based workplaces (hereafter LBW) and interdistances cities for the same year. Dates are analyzed by means of multidimensional scaling technique Proxcal. The results indicate a low correlation between levels of economic dependency and the geographical distance of the different economic sectors and a high correlation when considering in isolation the relationship of KIS-HTI. This phenomenon may be the result of greater economic dependence of all sectors in the KIS-HTI sectors, which are located in the center of all economic relations in the region, more concentrated than other sectors.

This document is structured as follows: in section 1 it is introduced the definition of creative and knowledge economies and their impact on regional and metropolitan development, section 2 describes the methodology used in the analysis of the input- product and geographic distance matrix, section 3 presents the case study, section 4 presents the results of previous tests on the performance of KIS-HTI sectors in the labor market area of study, section 5 presents the main findings and conclusions of the analysis Proxcal of Inter-industry transactions matrix and Distance matrix, and finally, section 6 presents the conclusions of the study.

## **1. Creative and knowledge economies and their impact on regional and metropolitan development**

The KIS-HTI sectors correspond to all economic sectors that have greater expertise in employment and management of knowledge-based processes. In the classification which the

Organization for Economic Cooperation and Development (OECD) of all economic sectors, knowledge economies are defined as high-tech industries and services with high knowledge <sup>1</sup>

Since mid 1990's, the interest on the economies of knowledge and its implementation on the territory has grown significantly. The innovative environment posed by Camagni (1991) as a reinterpretation and development of innovative processes derived from the industrial district concept, highlighted the potential of the environment to facilitate innovation through a balance between business, local roots and the relationship between financial institutions research centers and universities. The concept of industrial district in the local development level had been raised previously by Becattini (1979) from his study of Italian models of industrial districts.

Simmie & Lever (2002) more recently pointed out as factors in the economies of knowledge, the presence of infrastructure to support scientific and technological production, as well as to the existence of urban communities with visions organized on its scientific, technological, artistic and business practice.

The relationship between proximity, knowledge and spatial concentration is a reason that supports the alternative view to the dispersion of the city in the territory. Access to the most qualified and scientific knowledge and tacit<sup>2</sup>, require physical proximity (Storper & Venables, 2004). Hence, despite the decentralization of the economy by the processes of globalization and the new organization of economic activity, which has helped the IT revolution, the centers of cities and metropolitan areas remain the places which generate the scientific and

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<sup>1</sup> These economic sectors corresponding to the areas defined by Chica & Marmolejo (2011) as SIC sectors and them are the result of applying a methodology, which is initially the result of the selection of sectors defined by the OECD as high knowledge and high technology and information on the level of training of each of the occupations for the total economic sectors, to find by statistical techniques of principal components analysis and hierarchical cluster analysis, the LBW with higher qualifications for each of the economic activities and their homogeneous grouping sets. Factor analysis, resulting better qualified occupations correspond to those defined in the National Classification of Occupations (NCO-1994) with the following categories: 1) leadership, 2) scientists, professionals and intellectuals, 3) technical support and 4) administrative. Also were selected, 14 economic sectors of the 60 sectors of the National Classification of Economic Activities (NACE-1993), built in 6 groups. These are: high technology industries, including manufacturing equipment and medical surgical precision, optical and clocks, manufacture of office machinery and computers and electronic, radio, television and communication, financial services, including financial intermediation services and auxiliary activities, insurance and pension plans and real estate, R & D and education as computer and telecommunications and business services professionals, including legal and accounting activities, market research and public relations, consulting on business management and various professional services (hereafter SE), health, veterinary and social and the creative industries and cultural services including activities such as production and distribution of video, radio and television, literary and artistic creation, libraries, archives, museums, sports and recreational activities.

<sup>2</sup> It is understood as the kind of knowledge that is part of the "know how" of a social group or community from various organizational routines.

innovation processes (Marmolejo & Roca, 2006). That is why decentralization and relocation of the knowledge economies in metropolitan areas constitute an element of particular interest in the discussion of growth patterns in metropolitan areas, apparently contributing to a polycentric growth thereof, by the necessary presence agglomeration economies for its development.

Although the works mentioned have linked the presence of economies of knowledge with some peculiarities inherent to the territory, few studies have linked the intra-metropolitan location of these activities with the structuring of a polycentric space. Muniz and Garcia-Lopez (2009) highlight the work related to the study of edge cities<sup>3</sup>, Garreau (1991), as the only ones who have advanced in this aspect, especially for the study of localization patterns of specialized services like the financial services. The spatial concentration of these sectors, are explained as a response to the synergies (knowledge externalities) between companies, the need for frequent face-to-face and the choice of a location accessible to customers. The same authors in the study of these economies in the MRB (Muñiz & García-López, *op.cit.*)<sup>4</sup> have been concluded among other aspects, that although these economic sectors appear more concentrated than the rest, they offer greater resistance the effects of decentralized and trends of all economic activity.

## **2. Methodology and data**

For this analysis, the departure point is the information of the matrix of technical coefficients of domestic consumption of Input-output matrix of Catalonia of 2001 and a geographic distance matrix of the different economic sectors. This matrix is built on information for every municipality about of LBW and distance intercity by road. Both matrices are analyzed using a multidimensional scaling analysis (Proxcal) with three main objectives: 1) spatially represent economic and geographic proximity between all the KIS-HTI sectors and other economic sectors, 2) verify whether a correlation exists between matrices, and 3) determine whether there is a relationship of interdependence between the location of KIS-HTI sectors and other economic sectors.

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<sup>3</sup> These urban agglomerations are characterized by a high concentration of work places in a space occupied by offices and housing (Muñiz & Garcia Lopez,2009).

<sup>4</sup> These authors have identified subcenters of knowledge economies, grouping these activities into four major groups: FIRE, which including financial intermediation services and real estate; PS, which including activities related to business services, technical services for architects and engineers and business; KIS, which include computer activities, health, education, research and development, post and telecommunications, and, finally, HTI sectors, which including manufacturing of office machinery,computer, electronic, radio, tv, medical equipment surgical precision and optics, pharmaceuticals and aerospace construction.

The analysis was done initially for 59 economic sectors according to the National Classification of Economic Activities (NACE-1993) and subsequently for 43 sectors corresponding to the set of preferred consumer sectors of industries and enterprises<sup>5</sup>. This classification is the result of an analysis cluster of all economic sectors from the information on the distribution of uses of the economy (IDESCAT, 2001). This analysis yielded four clusters differentiated by type of end user consumption. These are: 1) personal consumption sectors (11); 2) government consumption sectors (5); 3) consumption to those companies and export sectors (28) and 4) aimed at consumer and retail companies (15) as export sectors. HTI sectors, financial services (excluding real estate and insurance), business related services, post and telecommunications services and R&D are in the main consumption clusters of enterprises, especially those that export; while, healthy services and education are in the cluster of government consumption; and finally cultural sectors, real estate and insurance are in the cluster of personal consumption. Table 1 shows the respective sectors grouped in clusters are highlighted in color KIS-HTI sectors.

#### *Matrices regional input-output*

This technique<sup>6</sup> allows to describe and investigate the fundamental processes that connect the regions of a system and all the separate aspects of their economies (Isard, W., 1960). As a descriptive tool, this technique collects information about the interrelationships of the various economic sectors of an economy. This matrix expresses the functional relationships between different sectors of an economy, through the matrix of technical coefficients interior, which contains information about all transactions interindustrials. It is established by a flow of each of the sectors producing each of the consumption items. The rows describe the distribution of a sector throughout the economy, while the columns show the inputs required by a particular industry in its production. Express the distribution of inputs per unit of production in each sector. In addition to this information, the input-output matrix provides information on final demand component, consisting of sales of production of each sector to final market, expressed in household consumption, government consumption, companies consumption and exports, and information on value added, which includes data on other types of inputs, including: workers' wages and imports of inputs. For this analysis, it is taken information from the matrix of technical coefficients inside the Input-output of Catalonia, 2001 (IDESCAT, 2001).

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<sup>5</sup> To carry out this selection has been made K-Means cluster analysis of data on use of the economy contained in the input-output matrix of Catalonia, 2001.

<sup>6</sup> Its development is due to W. Leontief (1936)

**Table 1. Classification economic sectors by type of end user consumption**

sector code	code NACE	sector name
<b>Cluster 1</b>		
<b>Household consumption sectors</b>		
12	18	Industries clothing and fur
3	5	Fishery products, aquaculture and related services
33	41	Furniture collection, purification and distribution of water
35	50	Services trade and repair of motor vehicles
37	52	Services of retail trade (except motor vehicles) and repair
38	55	Hospitality
45	66	Insurance and pension plans (except compulsory social security)
47	70	Real estate
57	92	Recreational, cultural and sporting
58	93	Other personal services
59	95	Services of households employing domestic staff
<b>Cluster 2</b>		
<b>Government consumption sectors</b>		
53	80	Education services
54	85	Veterinary and health services and social services
55	90	Public health services
52	75	Services Administration, defense and compulsory social security
56	91	Services provided by associations
<b>Cluster 3</b>		
<b>Companies consumption and high exports</b>		
20	26	Manufacture of other non-metallic mineral products
11	17	Textiles
13	19	Leather, leather products and footwear
16	22	Products of the edition, printed and recorded material products
17	23	Coke, refined petroleum products and nuclear fuel
18	24	Chemicals
19	25	Rubber and plastic products
22	28	Metal products (except machinery and equipment)
23	29	Machinery and mechanical equipment
24	30	Office machinery and computers
25	31	Machinery and equipment
26	32	Electronic materials, equipment and radios, television and communications
27	33	Equipment and surgical instruments, precision optics and watches
28	34	Motor vehicles, trailers and semitrailers
29	35	Other transport
30	36	Furniture and other manufacturing
32	40	Furniture production and distribution of electricity, manufactured gas
36	51	Services and wholesale trade intermediaries (except motor vehicles)
39	60	Transport services by rail and other land transport
40	51	Maritime transport services, coastal roads and interior
41	62	Air and space transport services
42	63	Services related to transport and services of travel agencies and tour operators
44	65	Financial intermediation services (except insurance and pension plans)
46	67	Services auxiliary to financial intermediation
49	72	Computer services
50	73	Services Research and Development
9_10	15-16	Industries food products, beverages and tobacco
<b>Cluster 4</b>		
<b>Companies consumption and low exports</b>		
1	1	Products of agriculture and animal husbandry and related services
14	20	Wood, cork and wood products and cork (except furniture); articles straw and plaiting
15	21	Pulp, paper and paperboard and articles of paper and cardboard
2	2	Products of forestry, logging and related services
21	27	Products of metallurgy
31	37	Recycling Services
34	45	Construction work
4_5_6	10_11_12	Energy Products
43	64	Postal and telecommunications
48	71	Hire of machinery, personal effects and household goods
51	74	Other business services
7_8	13_14	Other minerals (excluding energy products)

source: NACE-93 and own elaboration

### *Distance matrix between economic sectors*

This matrix is constructed with data on municipal LBW and physical distance intercity road. It seeks to identify the geographical distance between the different economic sectors, to relate the mass of existing workers for each economic sector intercity road distances. It is calculated for a total of 946 municipalities and 59 economic sectors of the NACE classification (broken down to two digits) as shown in Equation 1. Where:  $Dg_{ij}$  is the geographic distance between sectors  $i$  and  $j$ ;  $P_{ix}$  is the total of LBW of sector  $i$  in the municipality  $x$ ;  $P_{jy}$  is the total of LBW of sector  $j$  in the municipality  $y$ , and  $d_{xy}$  is the distance between municipalities  $x, y$ .

$$Dg_{ij} = \frac{\sum_{x=1, y=1}^{946} P_{ix} * P_{jy} * d_{xy}}{\sum_{x=1, y=1}^{946} P_{ix} * P_{jy}} \quad (1)$$

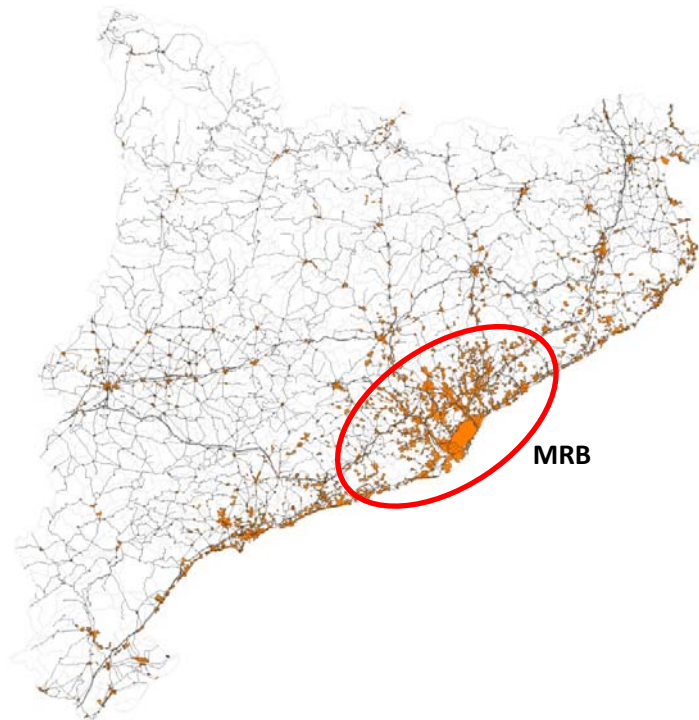
### **3. Case Study**

Administratively Catalonia is one of the 17 Spanish autonomous communities. Corresponds to a NUTS-2 units in the nomenclature of European Union statistics. It consists of 946 municipalities 7, which is administratively grouped into 4 provinces. In 2001, 6.343.110 people lived and had 2.793.971 LBW (INE, 2001). The largest urban agglomerations are located in MRB, where is located the city of Barcelona and a set of small and medium-sized cities in which live about 60% of the population of Catalonia and where it generates approximately 70% of its total GDP (INE, 2001). Other major cities in size, located outside of the MRB are Girona, Tarragona and Lleida, all functions of the provincial capital.

Artificialised soil throughout the region for 2000 was approximately 1.543 km<sup>2</sup> (INE, 2001). The MRB occupied 709 km<sup>2</sup>, or 46% of the total artificialised area of Catalonia (Corine Land Cover, 2000), although the total area represented only 10% of the total area of Catalonia. Figure 1 shows the ground artificialised the entire study area is highlighted approximate level of the MRB.



Figure 1. Artificialized area of Catalonia, 2000



Source: Corine Land Cover, 2000

#### 4. The KIS-HTI sectors and their labor market

##### 4.1. Analysis of density and percentage of LBW by grouping of KIS-HTI sectors

In 2001, Catalonia was 2,615,490 LBW, of which 75% were located in the MRB (INE, 2001). The global representation of the KIS-HTI sectors was first, in-depth knowledge services from 27.3% in Catalonia and 30% for the MRB, which accounted for 82.4% of all LBW dedicated to these activities in Catalonia; and on the other hand, high-tech industries, from 0.5% of LBW for Catalonia and 0.6% for the MRB, which accounted for 92.6% of the LBW dedicated to these activities in Catalonia. The reason for this greater representation of this sectors in the labor market of the MRB is justified by its greater economic and population weight, the rest of the territory.

The analysis of the density of KIS-HTI sectors in 2001, shows that it is mainly in Barcelona (3.721 LBW/km<sup>2</sup>) where the highest densities. With equally high values, but below are 7 central area: Badalona, Santa Coloma de Gramenet, L'Hospitalet de Llobregat, Sant Just Desvern. Sant Joan Despi, Cornellà de Llobregat and Esplugues de Llobregat, with an average density of 1.268 LBW/km<sup>2</sup>. Other municipalities located outside the central metropolitan area with the highest densities are: Sabadell, Granollers, Mataró, Callella, Premià de Mar,

Vilafranca del Penedès, Vilasar de Mar, Cerdanyola del Vallès, Terrassa with an average density of 1.037 LWB/km<sup>2</sup>. Most of these municipalities correspond to historical cities that have vertebrate endogenous growth territory's economic growth peripheral to the Barcelona and central conurbation; Cerdanyola is an exceptional case, because the greater specialization of labor market has been the result of economic decentralization process from Barcelona. Other cities featured on the outside of the MRB are Girona, Lleida, Manresa, Igualada, Vic, with an average density of 998 LBW/km<sup>2</sup>, but Girona has a value similar to those found in the central conurbation.

#### 4.2 *Distribution spatial KIS-HTI workers by place of work and residence*

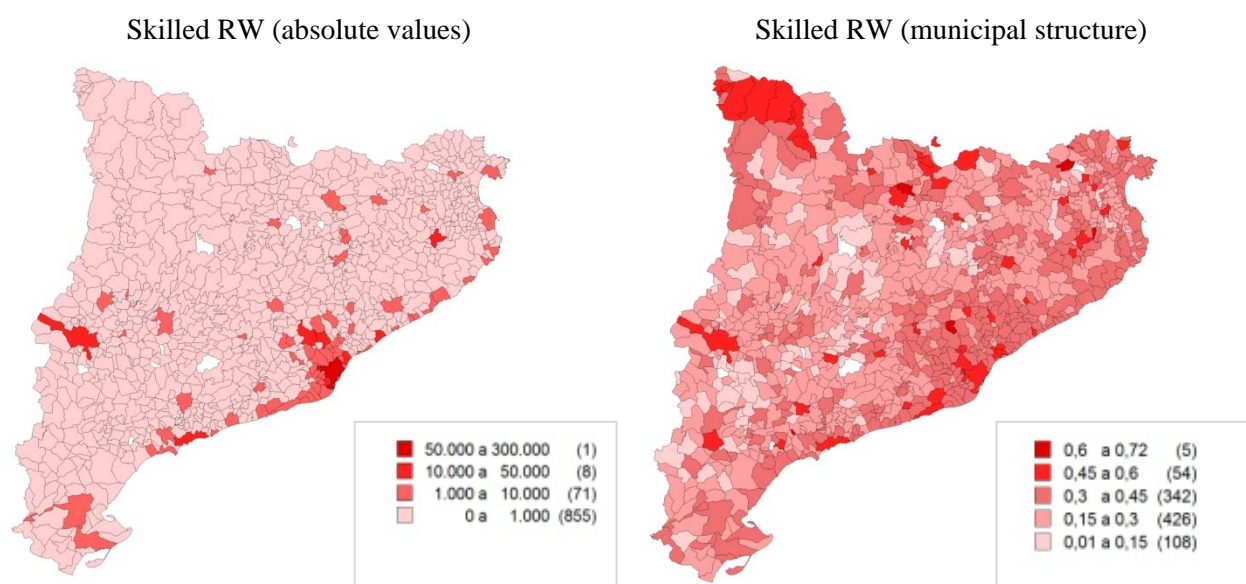
The analysis of territorial distribution of workers by place of residence and work shows the skill, which correspond to the main mass of workers employed in these sectors of the economy (75% of the total mass of workers are skilled occupations)<sup>7</sup> are located mainly in the cities of Badalona, Barcelona and L'Hospitalet de Llobregat in the central area, accounting for 47.2% of all skilled workers; too in the cities of Sabadell, Terrassa and Mataró of the MRB, accounting for 7.3% of all skilled workers and in the cities of Tarragona, Girona and Lleida, which are provincial capitals, with 7.3% of the total. There is also a significant concentration in the remaining central conurbation and in most municipalities in the MRB located between it and the urban system Sabadell-Terrassa, as well as the municipalities of the MRB located towards the coast.

The structure of this distribution at the municipal level shows that in the range of percentages of skilled workers on total employees, the highest values (between 45% and 72%) are in some municipalities of the MRB (include Barcelona and Sant Cugat del Vallès, which have also a high number of skilled workers) and in provincial capitals. Also in some municipalities in the districts of the Pyrenees and other inland areas observed high percentages, explained by a low and diverse mass of workers. Figure 2 shows the distribution of total LBW of qualified residents-workers (RW), firstly because of its size on the scope of study and secondly, by its representative at the municipal level, the firsts are expressed in absolute values and the latest one in percentage values.

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<sup>7</sup> Clasificación of Chica & Marmolejo (2011) from National Ocupacional Clasificación, 1994.

Figure 2. **Skilled workers, who live and work in the same municipality (RW)**



Source: INE, 2001 and own elaboration

#### 4.3 Production in euros of KIS-HTI sectors

The productivity<sup>8</sup> of knowledge economies is generally higher than other economic sectors, except for HTI sectors and some KIS sectors. Real estate, financial services, postal services and telecommunications are the sectors of the economy with higher productivity (10 times the overall productivity of Catalonia in the real estate case and twice in the other cases). Except for KIS-HTI sectors, energy and transport sectors are the most productive (6 times the overall productivity of Catalonia in the first case and twice in the second case) (IDESCAT, Input-output matrix of Catalonia, 2001).

The greater productivity of KIS-HTI sectors is the reason of their high production values (33,1% of total production of Catalonia in 2001), even though these sectors account for only 28,2% of LBW. KIS sectors represent 33,1% of production and 27,7% of LBW. On the other hand, HTI sectors represent 0,9% of production and 0,5% of LBW. Table 2 shows the production in millions of euros of KIS-HTI sectors for 2001.

Table 2. **Production in euros of KIS-HTI sectors**

	millions of euros	% of total
all sectors	123.843	100%
KIS sectors	41.037	33,1%
HTI sectors	1.162	0,9%

Source: VAB 2001-IDESCAT, 2001

<sup>8</sup> The productivity of workers in every economic sector is calculated from of gross value added (GVA) produced by every sector in one year and it divided by the number of workers of this sector.

In the structure of internal production of KIS-HTI sectors, real estate, business services and financial services are ranked to provide the greatest amount of their total production. These sectors accumulate 57% of total production. On contrary, R & D services, industries and computer activities are ranked in the lowest values. Table 3 shows the production in millions of Euros of KIS-HTI sectors by groups and the percentage of production that every sector gains of total production.

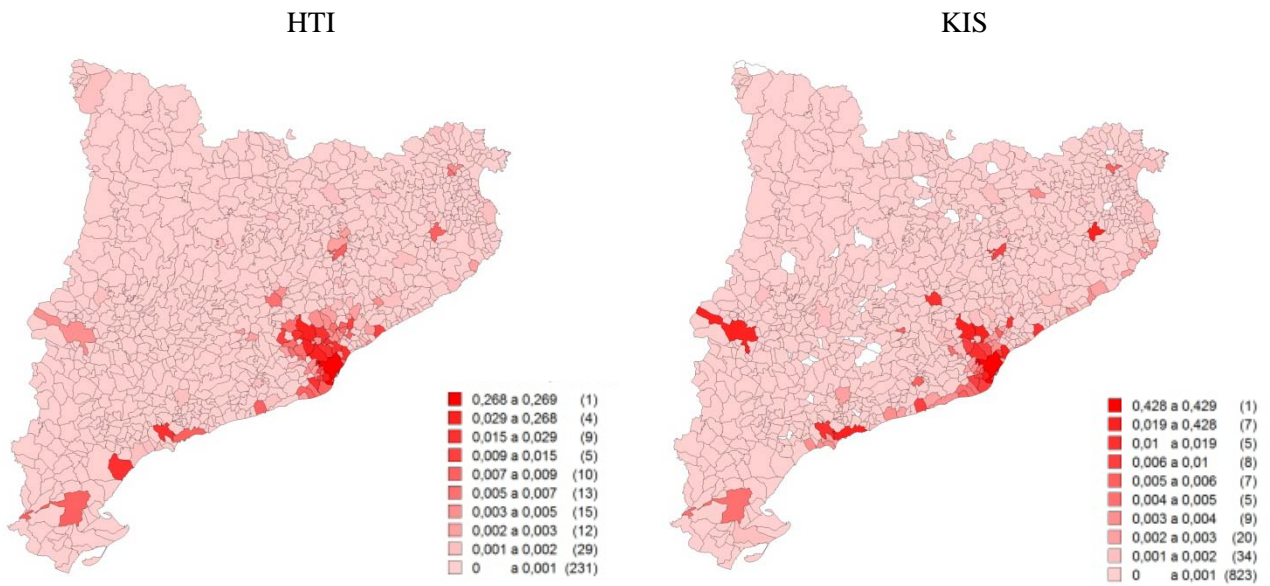
**Table 3. Production in euros of each KIS-HTI sectors**

		millions of euros	% of total
HTI		1.162	2,8%
	Postal and telecommunications	2.805	6,6%
	Financial services	6.010	14,2%
	Real estate	9.898	23,5%
	Computer services	1.364	3,2%
KIS	R&D	79	0,2%
	Business related services	8.167	19,4%
	Education	4.407	10,4%
	Health and social services	5.623	13,3%
	Recreational, cultural and sporting	2.684	6,4%
		42.199	100%

Source: VAB 2001-IDESCAT, 2001

Spatial distribution from municipal level of production on KIS-HTI sectors (considering their size) shows in percentage terms that it is higher in the central metropolitan area and some MRB employment sub-centers, as well as provincial capitals. For disaggregation in industries and services sectors, this distribution shows some differences. In HTI, the highest values are concentrated in the CBD (27% of total production) and some MRB employment subcenters, as Sabadell, Terrassa, Sant Cugat del Vallès and Cerdanyola del Valles, in addition to other municipalities, as Vandellòs, where there is a nuclear energy station. In KIS sectors, the highest values are in the CBD (43% of total production) and some cities of central conurbation, as Badalona and L'Hospitalet de Llobregat. In addition to some MRB employment subcenters, as Sabadell, Terrassa, Mataró, Granollers and Vilanova i la Geltrú; the provincial capitals and other major cities, as Manresa, Vic and Reus. Figure 3 shows the distribution of total production in percentage values for KIS-HTI sectors.

Figure 3. **Production in euros of each KIS-HTI sectors (size of municipal-level production)**



Source: INE, 2001 and own elaboration

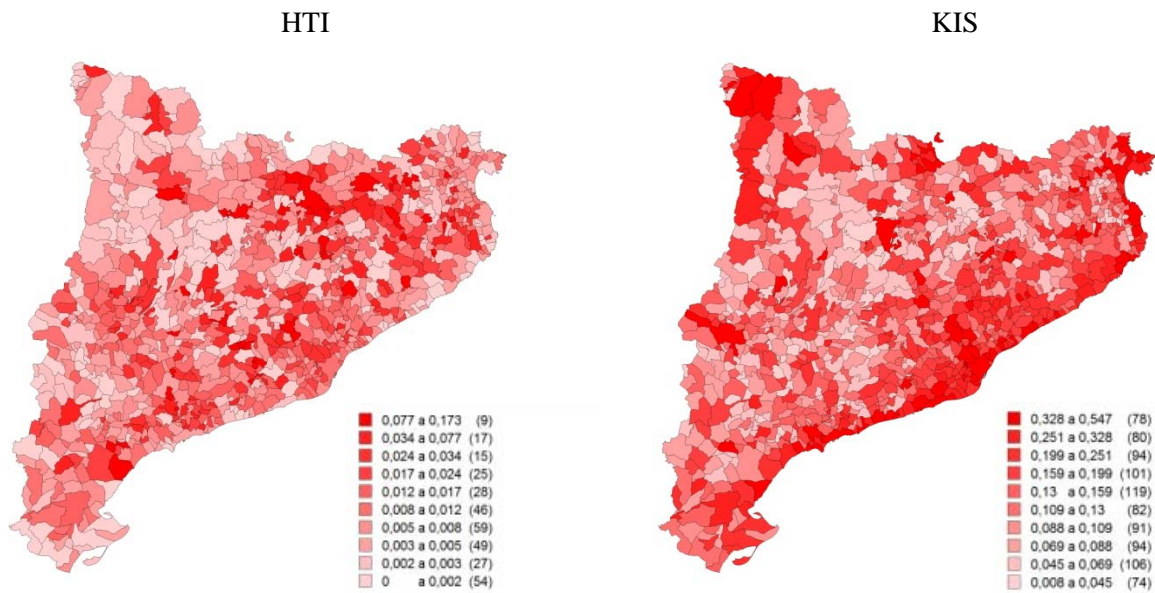
The KIS-HTI structure on municipal-level production evidences high value of services in total production over industries. In HTI sectors the most representative range of local production is between 8% and 17% and it is mainly located in the cities of inland areas, peripheral to the MRB and urban systems of the provincial capitals. In KIS sectors the most representative range of local production is between 33% and 55% and it is mainly located in the CBD and its central conurbation, the provincial capitals, some coastal cities and other cities located at MRB with a high population. Figure 4 shows the municipal structure of the production of KIS-HTI sectors in percentage values in relation to total production.

## 5. Results of Proxcal multidimensional scaling analysis

The Proxcal analysis is a method, which tries to find the structure of a set of distance measures between objects or cases from assignment to specific positions in a conceptual space, therefore distances between points are according a maxim proximity measures (similarities or dissimilarities) similar to Euclidean distances, for its representation in a multidimensional space of low dimension. In the space multidimensional scaling objects take the form of points and the proximity between them reflects the analogy of cases. (Pérez, 2005).



Figure 4. **Production in euros of each KIS-HTI sectors (production structure at the municipal level)**



Source: INE, 2001 and own elaboration

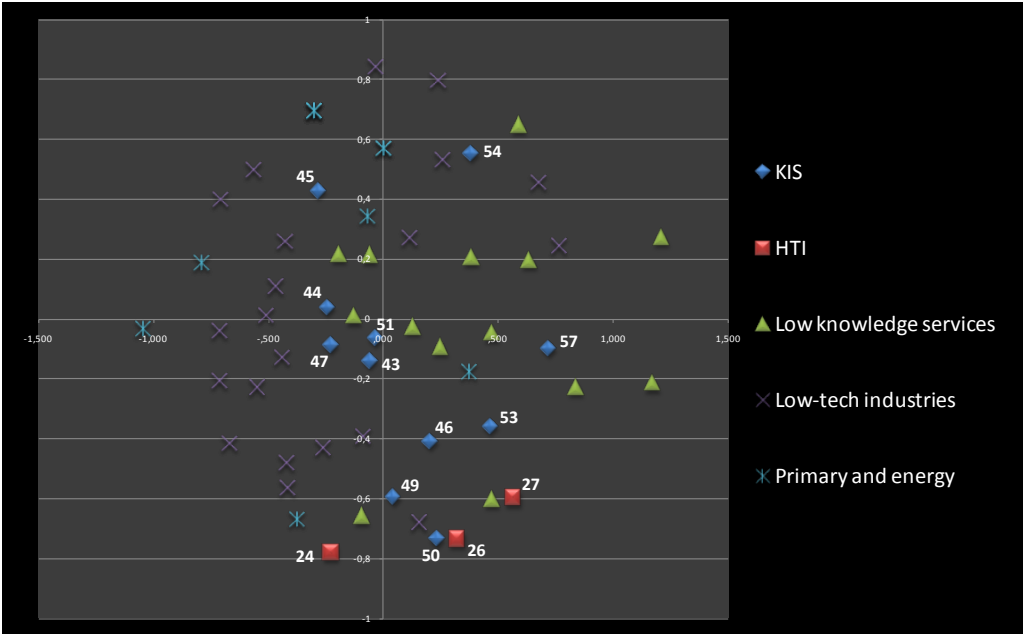
In this paper the use of this tool has three objectives 1) the spatial representation of proximity between KIS-HTI sectors and other economic sectors 2) investigation about correlation between products and services intersectional demand and their geographical location, 3) analyze if there is a interdependence between location of KIS-HTI sectors and other economic sectors. For this purpose the Inter-industry transactions matrix of Input-output matrix of Catalonia 2001 is used, and other matrix, which is constructed from municipal LBW data disaggregated for economic sectors according to NACE classification (by two-digit) and intercity road distances, which we denominate as Distances matrix.

### 5.1 *Multidimensional scaling analysis of the Inter-industry transactions matrix of Input-output matrix of Catalonia, 2001*

The analysis shows that at the heart of the functional relationships of all Inter-industry transactions, are some KIS sectors (financial and business related services, real estate, post services and telecommunications) and other not KIS sectors (transport, rental of machinery and trade). These sectors have a high internal demand. On contrary, primary sectors and some industries are on the periphery of these functional relationships; this means that these sectors have a lower internal demand from other economic sectors. This group also includes HTI sectors and some KIS sectors, as computer services, education, insurance and health, cultural and social services. This phenomenon may be related, in the case of the

sectors targeted to companies, with a great export activity to the rest of the Spanish state and other countries. Figure 5 shows the distribution of all sectors in the map of functional relationships, resulting from the Proxcal analysis (sectors are grouped according to the activity).

Figure 5. PROXSCAL analysis results matrix of inter-industry transactions)



Source: own elaboration

The analysis about the distance between each object (it represent every sector) Proxcal space and the center of all relationships (coordinate (0.0) Proxcal space) shows in a first quartile of distances, the location of sectors with increased demand from other sectors economic. There are five KIS sectors in this quartile: financial and business related services (codes 44, 46 and 51), post services and telecommunications (code 43) and real estate (code 47). Table 4 shows the distribution of all sectors in quartiles of distance to centroid.

Table 4. Centroid distance (quartiles) matrix of inter-industrial transactions

Q1	centroid distance	Q2	centroid distance	Q3	centroid distance	Q4	centroid distance
sector code		sector code		sector code		sector code	
s51 (KIS)	0,07	s18	0,46	s56	0,67	s26 (HTI)	0,80
s36	0,13	s37	0,47	s54 (KIS)	0,67	s29	0,80
s48	0,13	s23	0,48	s25	0,70	s24 (HTI)	0,81
s43(KIS)	0,15	s22	0,50	s10	0,70	s17	0,81
s35	0,22	s16	0,50	s13	0,71	s3	0,81
s47 (KIS)	0,24	s19	0,51	s57 (KIS)	0,73	s31	0,81
s44 (KIS)	0,25	s45 (KIS)	0,51	s11	0,74	s27 (HTI)	0,82
s42	0,27	s7	0,57	s14	0,75	s28	0,83
s39	0,29	s8	0,57	s4	0,76	s21	0,84
s34	0,29	s53 (KIS)	0,59	s5	0,76	s58	0,87
s32	0,35	s20	0,59	s6	0,76	s55	0,88
s30	0,40	s15	0,59	s40	0,76	s2	1,04
s33	0,42	s49 (KIS)	0,60	s1	0,77	s52	1,19
s38	0,44	s9	0,64	s50 (KIS)	0,77	s59	1,24
s46 (KIS)	0,46	s41	0,67	s12	0,78		

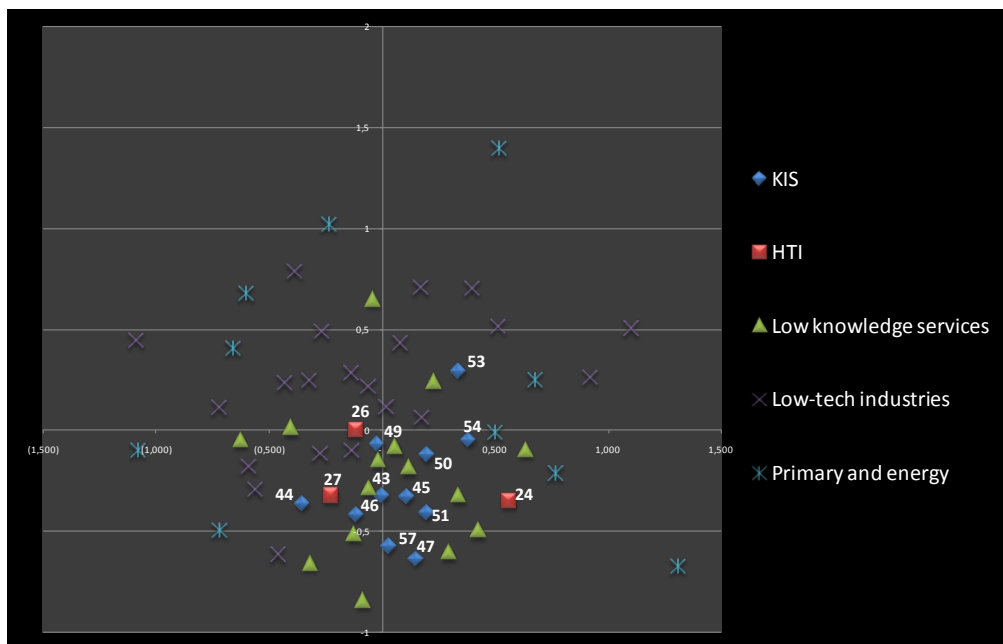
Q = quartile

Source: own elaboration

5.2. *Multidimensional scaling analysis of the Distance matrix of economic sectors of Catalonia, 2001*

The analysis shows that at the heart of the functional relationships of Distance matrix some KIS sectors are: computing activities, post and telecommunications services, insurance and R&D and electronics manufacturing and other not KIS sectors as: transport and some industries with low and medium level technology, as: editing, printing and reproduction, the chemical and motor vehicle manufacturing. It means these sectors are more concentrated than other sectors around the territory. On contrary, primary sectors and some services sectors are located on the periphery considering these relations of distance. It means these sectors are more scattered around the territory. Figure 6 shows distribution of all sectors (sectors are grouped according to the activity).

Figure 6. **Proxcal analysis of Distance matrix**



Source: own elaboration

The analysis about the distance between each object (representing a sector) Proxcal space and the center of all relationships (coordinate (0.0) of Proxcal space) shows in a first quartile of distances that sector are more concentrated around the territory. In this quartile there are four KIS sectors: computing activities (code 49), R &D (code 50), post services and telecommunication (code 43) and insurance (code 45). Also, there is one HTI sector: manufacture of electronic, radio, television and telecommunications (code 26). Three of these sectors are part of the cluster directed primarily for the consumption of companies and export,



except for the sectors with codes 43 and 45. Other sectors contained in this quartile are demanded principally by companies. This feature proves that the space center Proxcal are referring to the location of Barcelona and its metropolitan region, where are located the main airport and port of Catalonia and the larger labor market of this region. In addition to the analysis of the specialization of economical activity explains that the municipalities are located close to Barcelona have a greater expertise in these sectors.

Table 5 shows the distribution of all sectors in quartiles of distance to the centroid of all relations of Proxcal space. Appendix 1 shows the municipalities with a greater specialization in economic sectors, which also have a set of LBW representative (minimum 1% of LBW of the sector of reference).

Table 5. Centroid distance (quartiles) matrix of distances

Q1 sector code	centroid distance	Q2 sector code	centroid distance	Q3 sector code	centroid distance	Q4 sector code	centroid distance
s49 (KIS)	0,07	s54 (KIS)	0,38	s12	0,61	s29	0,77
s41	0,10	s27 (HTI)	0,39	s58	0,63	s7	0,78
s28	0,11	s19	0,40	s11	0,63	s32	0,80
s26 (HTI)	0,12	s36	0,40	s52	0,64	s15	0,81
s16	0,17	s46 (KIS)	0,43	s35	0,65	s38	0,85
s18	0,19	s25	0,44	s56	0,65	s6	0,87
s40	0,22	s53 (KIS)	0,45	s47 (KIS)	0,65	s9	0,88
s31	0,22	s51 (KIS)	0,45	s24 (HTI)	0,66	s4	0,90
s50 (KIS)	0,23	s48	0,46	s55	0,67	s10	0,96
s42	0,29	s22	0,49	s5	0,72	s8	1,05
s23	0,30	s33	0,50	s20	0,72	s2	1,08
s21	0,31	s44 (KIS)	0,51	s34	0,72	s14	1,18
s43 (KIS)	0,32	s59	0,53	s30	0,73	s17	1,21
s39	0,33	s13	0,55	s37	0,73	s3	1,47
s45 (KIS)	0,35	s57 (KIS)	0,58			s1	1,49

Q = quartile

Source: own elaboration

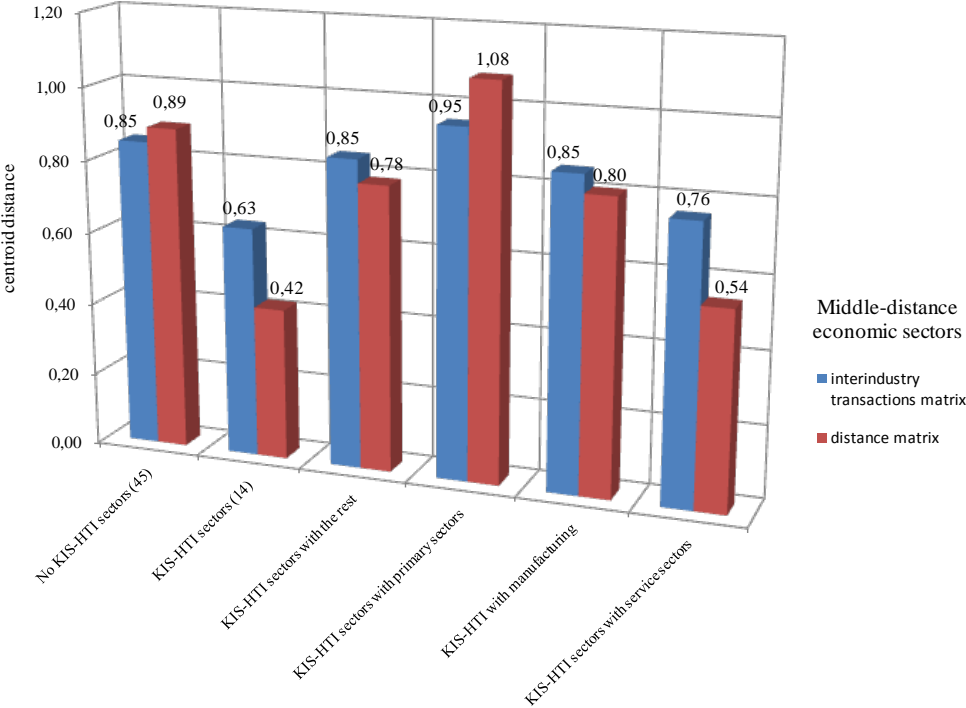
### 5.3 Analysis of correlation between economic and geographical dependence of the economic sectors

The analysis of *Pearson* correlation coefficients between Proxcal analysis of Inter-industry transactions matrix and Distances matrix of the economic sectors shows a low correlation considering all economic sectors (**r=0.17**). This correlation improves if considered in isolation KIS-HTI sectors (**r=0.26**). Taking into account only 43 sectors, which are defined as consumption of the companies, the correlation coefficients show a tendency to a positive increase (**r=0.26**). It is more important when considered in isolation KIS-HTI sectors (**r=0.54**). This improvement in correlation coefficients, although it is not entirely indicative of a logical relationship between functional dependence and the geographic location of economic activities; however, shows a clear trend to this phenomenon in the case of KIS-HTI sectors.

5.4 Interdependencies between the location of KIS-HTI sectors and other economic sectors

Analysis of the space Proxcal distances of both matrices, as KIS-HTI sectors considered in isolation, which has an average distance of less than other sectors, more evident in the analysis of the Distance matrix than Inter-industry transactions matrix. If it is considered the distance between these sectors and the others economic sectors, it will increase and it will be a little lower in the distance matrix. If it is considered the distance from primary sectors, industries and services; the distance is high with primary sectors and low with service sectors. This trend is the same for both matrices; but distances of Inter-industry transactions matrix are greater than the distances of Distances matrix with industrial and services sectors and lower with primary sectors. Figure7 show these values

Figure 7. Proxcal analysis distances



Source: own elaboration

The analysis of Proxcal distances of both matrices, between total economic sectors with KIS-HTI sectors, grouped into quartiles, allows us to conclude that the first quartile, including economical sectors with a greater economic dependence from these, in the case of Inter-industry matrix, or sectors closer to its labor market, in the case of Distances matrix. In the first case, this sectors correspond mainly to services (7) (trade, transportation of all types and rental of machinery); although there are some industries (4) (publishing, printing and

reproduction; furniture, electrical machinery manufacturing and construction) and one primary sector, which corresponds to the collection, purification and distribution of water. In the second case, the first quartile sectors maintained a similar distribution: services (7), but only agree with 4 of the services of previous matrix (transport of all types and rental machinery); the other services (3) correspond to health services, associate activities and domestic service. Off all the industries (4), only one match with the another matrix (publishing, printing and reproduction). Other industries are: chemical industries, manufacturing of machinery and manufacturing of cars. In the remaining quartiles of the distribution of sectors are more diverse, only in the fourth quartile in both matrices there is obvious predominance of the primary sectors.

This analysis provides information about of the tendency to the location of certain economic activities, which are attracted to places, where KIS-HTI sectors are located. However, it is necessary to do a more detailed analysis by the aim of if this phenomenon actually occurs. Table 6 presents detailed the composition of the quartiles of distances for both matrices.

**Table 6. Economic sectors by quartiles (Q) according to the distance Proxcal space to sectors KIS-HTI**

**Distances Proxcal analysis of the Inter-industry transactions matrix**

Q1		Q2		Q3		Q4	
sector code	a-d	sector code	a-d	sector code	a-d	sector code	a-d
s30	0,52	s39	0,70	s58	0,82	s55	1,09
s42	0,53	s38	0,70	s22	0,84	s3	1,09
s48	0,53	s18	0,72	s20	0,89	s4	1,09
s33	0,54	s9	0,74	s7	0,92	s5	1,09
s36	0,56	s32	0,75	s8	0,92	s6	1,09
s25	0,57	s10	0,76	s29	0,92	s28	1,12
s40	0,61	s1	0,77	s12	0,92	s52	1,12
s41	0,61	s19	0,80	s11	0,94	s17	1,12
s16	0,62	s23	0,80	s13	0,96	s21	1,16
s37	0,62	s15	0,80	s31	0,99	s2	1,26
s35	0,66	s56	0,81	s14	1,08	s59	1,27
s34	0,69						

**Distances Proxcal analysis of the Distance matrix**

Q1		Q2		Q3		Q4	
sector code	a-d	sector code	a-d	sector code	a-d	sector code	a-d
s42	0,32	s31	0,57	s32	0,73	s10	1,02
s40	0,32	s39	0,58	s25	0,74	s7	1,03
s41	0,35	s37	0,61	s22	0,76	s15	1,04
s16	0,39	s36	0,62	s58	0,78	s9	1,18
s48	0,40	s52	0,63	s5	0,82	s4	1,19
s59	0,41	s38	0,65	s6	0,86	s2	1,19
s18	0,44	s21	0,65	s13	0,87	s17	1,29
s23	0,47	s11	0,68	s34	0,91	s3	1,32
s28	0,48	s29	0,68	s30	0,92	s8	1,34
s55	0,49	s19	0,70	s35	0,95	s14	1,39
s56	0,50	s12	0,71	s20	1,00	s1	1,73
s33	0,55						

a-d = average distance KIS-HTI sectors  
 primary-energy sectors  
 manufacturing  
 services sectors

Source: own elaboration

## 5. Conclusions

Of all KIS-HTI sectors, financial and business related services are more centrally in the Inter-industry transaction matrix; it main that these sectors offer and consume more units of production than other economic sectors. In contrast, HTI sectors have a less economic dependence from others sectors. In turn, the Distance matrix evidences that these economic sectors: computer activities, R &D and some HTI sectors are more centralized than the rest of economic sectors. In contrast, real estate, education, cultural and sports activities are scattered around the territory.

Proxcal analysis of the Inter-industry transactions matrix, which explains the level of intersectoral economic dependence, allow us to conclude that there is a greater economic dependence of all economic sectors with some KIS sectors, as: financial and business related services, real estate, telecommunications and postal services and other sectors not KIS, as trade and rental of machinery. The sectors with a lower economic dependence are the HTI sectors, primary sectors and some low-tech industries. In contrast, Proxcal analysis of the Distance matrix allow us to conclude that the services, specially the KIS sectors are more concentrated around the territory, whereas primary sectors and low technology industries sectors are more remote scattered around the territory. Of the KIS sectors, which located more concentrate are the R & D, computer activities and manufacturing of electronic, radio, television and communication. Observing the location on the territory of the economical activities, in special of activities of consumption of companies and activities that export products and services, we can conclude that the center of Proxcal space match with the location of Barcelona and its metropolitan region. It is according to the location of more quantity qualified workers and the specialization of these region towards knowledge economies.

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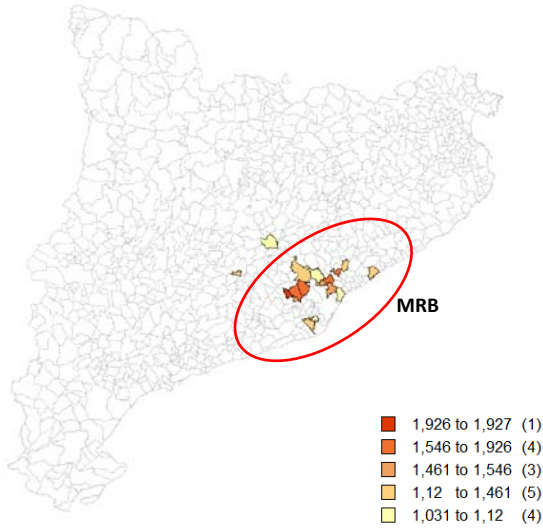
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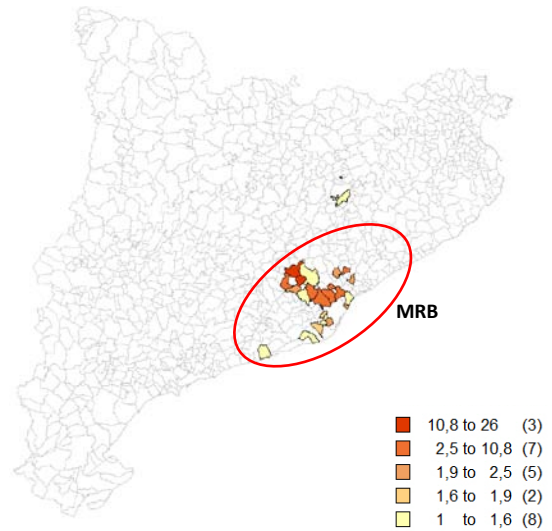
Appendix 1

**Map 1. Coefficients of specialization of manufacturing, services, KIS and HTI sectors**

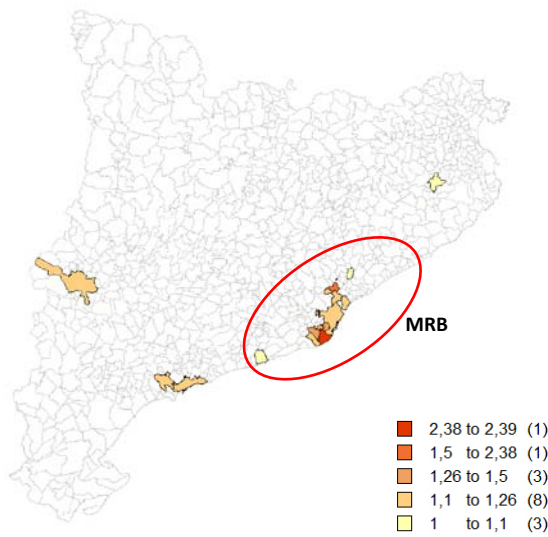
mainly exported industries (than 1% of LBW)



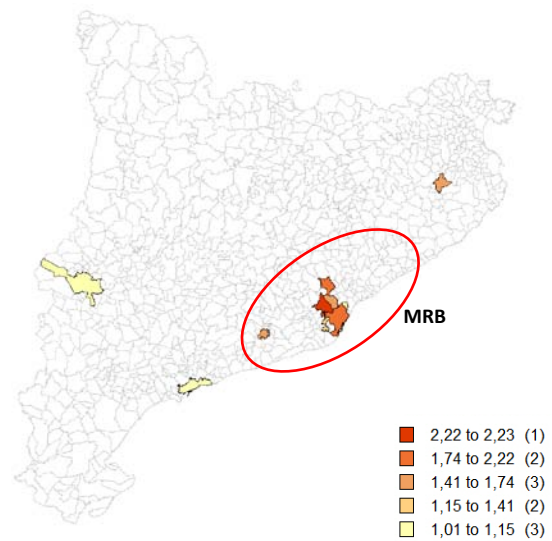
mainly exported HTI(than 1% of LBW)



mainly exported services(than 1% of LBW)



mainly exported KIS(than 1% of LBW)



Source: own elaboration