Universidade de Aveiro Departamento de Economia, Gestão e Engenharia Industrial
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Análise Exploratória Espacial das Atividades Económicas em Portugal

Exploratory Spatial Analysis of the Economic Activities in Portugal

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Economia, realizada sob a orientação científica do Doutor Miguel Lopes Batista Viegas, Professor Auxiliar Convidado do Departamento de Economia, Gestão e Engenharia Industrial da Universidade de Aveiro

Dedico este trabalho aos meus adorados pais, irmão, avós e à Carolina pelo apoio incondicional.
Ao Tio Silvestre, pela mais genuína e sentida transmissão de valores e ideais.

o júri

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agradecimentos

Gostaria de agradecer sentidamente aos professores que me acompanharam e marcaram ao longo destes anos no meu trajeto académico e que por serem alguns, felizmente, não os enumero. Contudo não poderia, de maneira alguma, deixar de destacar a importância que o professor Miguel Viegas teve para mim. Não só pela maneira como me foi cativando enquanto aluno e pela sempre disponibilidade na partilha de conhecimento e contribuição para este trabalho, mas também pela inspirativa e contagiante vontade em aprender e fazer sempre mais.

palavras-chave

Aglomeração, Análise Espacial de Dados Exploratória, Coeficiente de Gini Locacional, Municípios Portugueses

resumo

As atividades económicas não se distribuem uniformemente em todo o território. Como tal, a concentração geográfica das atividades económicas tem despertado um grande interesse na comunidade científica, na sequência de exemplos famosos como o Silicon Valley (Califórnia), Route 128 (Boston), Cambridge (Reino Unido), o estado federal de Baden Wurttemberg (Alemanha).

Dada a importância desta matéria, geralmente aceite como uma prioridade no quadro das diversas políticas de desenvolvimento económico, o objetivo deste trabalho é medir e descrever o padrão de distribuição espacial dos principais sectores da atividade económica em Portugal. Para isso, seguimos a metodologia de R. Guillain and J. Le Gallo (2010), combinando o coeficiente de Gini locacional com uma Análise Espacial de Dados Exploratória, aplicada aos dados do emprego por sector e por municípios em 2009 e 2010. Esta abordagem tem a vantagem de introduzir uma dimensão espacial nas medidas habituais de concentração, procurando assim determinar o padrão de localização de cada sector de atividade e medir a correlação espacial.

keywords

Agglomeration, Exploratory Spatial Data Analysis, Locational Gini Coefficient, Portuguese Municipalities

abstract

Economic activities are not evenly distributed throughout the territory. As such, the geographical concentration of economic activities has aroused a great interest in the academic community, following such famous examples as Silicon Valley (California), Route 128 (Boston), Cambridge (UK), the federal state of Baden Wurttemberg (Germany).

Given the importance of this matter, regarded as a priority in terms of economic development policies, the aim of this paper is to measure and describe the spatial distribution pattern of the main sectors of economic activity in Portugal. For this we follow the methodology of R. Guillain and J. Le Gallo (2010), combining the locational Gini coefficient with an Exploratory Spatial Data Analysis, applied to the employment data by sector and by municipalities in 2009 and 2010. This approach has the advantage of introducing a spatial dimension to the usual measures of concentration, thus seeking to determine the location pattern of each sector of activity and to measure spatial correlation.

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1. INTRODUCTION

Economic activities are not evenly distributed throughout the territory. Be that at regional, national or intercontinental level, the history of human civilizations shows that communities, through extensive migrations have concentrated increasingly on certain areas which currently represent a small proportion of the total surface of the planet. According to Eurostat data and the latest survey LUCAS (Land Use Cover Area frame Survey, March 2011), the areas designated for residential, commercial and industrial purposes, including infrastructures, occupy only 11% of the total area of Europe at 27 (except Bulgaria, Cyprus, Malta and Romania). As it can be seen in Figure 1, these occupancy rates vary considerably from region to region (NUTS II). The soil, with its environmental, productive and supportive functions, assumes a central role in ecosystems and biodiversity conservation and is a fundamental resource for economic activities. The distribution of different land uses is influenced by numerous biological, geographical and socioeconomic factors and largely determines their occupation through a constant and mutual interaction.

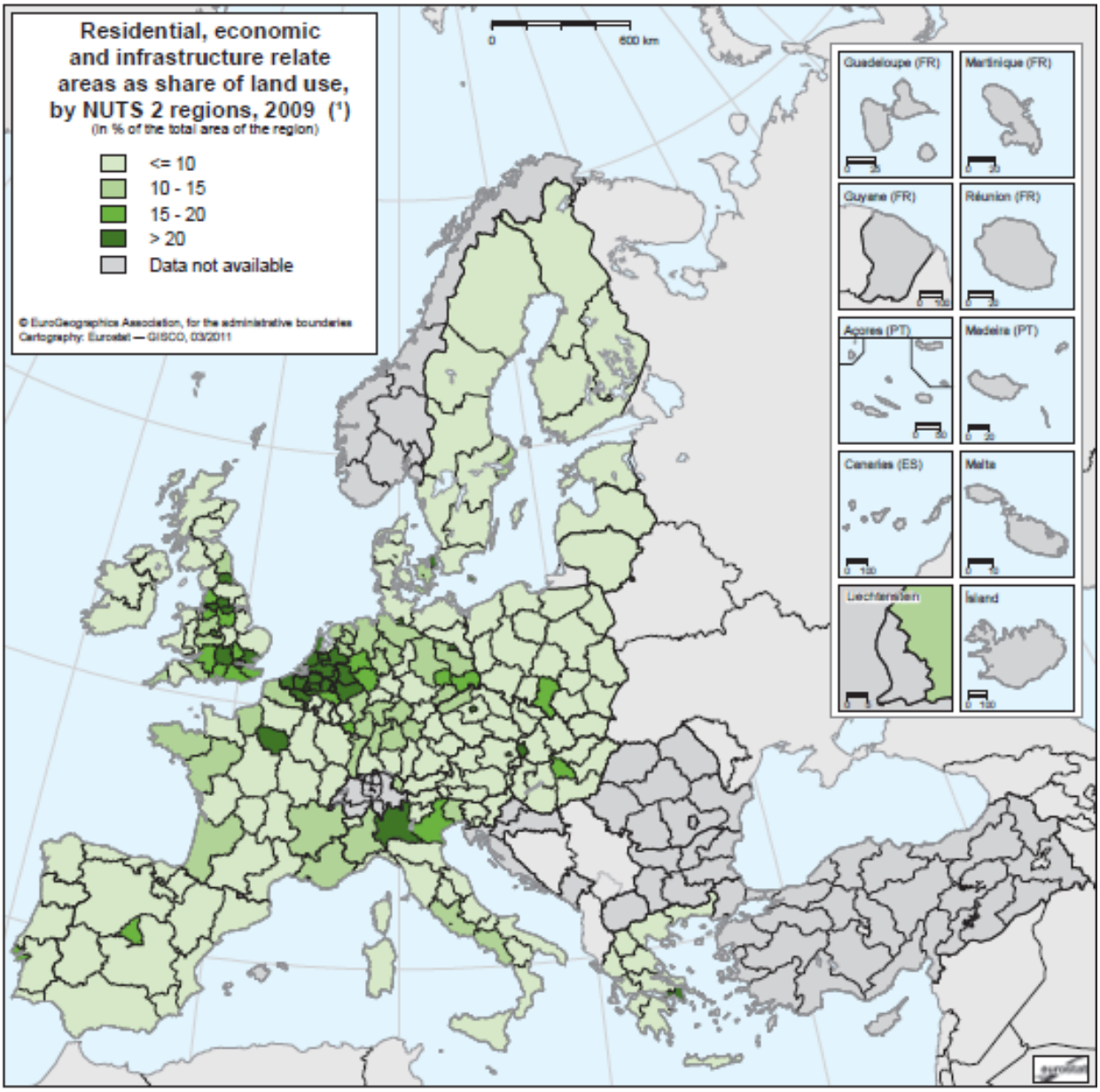
The geographical concentration of economic activities has aroused a great interest in the academic community, following many famous examples like Silicon Valley (California), Route 128 (Boston), Cambridge (UK) and the federal state of Baden Wurttemberg (Germany). Since the early contributions about the location of agricultural activities around the preindustrial city, many authors have sought to describe the factors that determine the distribution of economic activities across the territory. Alfred Marshall opposing the Fordism production model describes an alternative model called the industrial district. The industrial district is defined as a production system, geographically limited, and based on an intense division of labor between small and medium sized enterprises within the same industrial sector (Alfred Marshall, 1919). According to Paul Krugman, considered the father of the New Economic Geography, agglomeration of firms in a restricted area of the territory arises from the interaction between economies of scale, transport costs and the difference in labor costs between sectors ("Home Market Effect") in a circular process with positive feedback effects (P. Krugman (1980), Paul Krugman (1991b)). The cluster concept, another expression for economic agglomeration popularized by the work of Michael Porter, can be defined as a network of interdependent companies

and institutions, geographically close to each other and linked together through trades, technologies and common know-how (M.E. Porter, 1998).

In the early 90s, Michael Porter carried out on behalf of the Portuguese government, a study on the Portuguese economy which identified seven priority industry clusters in traditional sectors: wine, tourism, automobile, footwear, textiles, wood and cork (M. Porter, 1994). In 2001, the thematic of clusters was recalled, through the governmental initiative PROINOV - Integrated Program to Support Innovation, designed to support the development of innovation clusters in key areas (Joana Choringas, 2009). In this context, the program identified seven mega clusters: food, habitat, fashion, leisure, mobility, health and personal services, and information and entertainment, and three clusters: footwear, automobile and Software (Joana Choringas, 2009). Like the Porter report, PROINOV was also abandoned prematurely. Currently, the program COMPETE - Operational Program Thematic Factors of Competitiveness (2007-2013) mentions within its Collective Efficiency Strategy the existence of "poles of competitiveness and technology" and "other clusters" such as energy, health or agro industrial (Compete, 2009).

Given the importance of this matter, regarded as a priority in terms of economic development policies, the aim of this dissertation is to measure and describe the spatial distribution pattern of the main sectors of economic activity in Portugal. For this we follow the methodology of R. Guillain and J. Le Gallo (2010), combining the locational Gini coefficient with an Exploratory Spatial Data Analysis, applied to the employment data by sector and by municipalities in 2009 and 2010. This approach has the advantage of introducing a spatial dimension to the usual measures of concentration, thus seeking to determine the location pattern of each sector of activity and to measure spatial correlation (R. Guillain and J. Le Gallo, 2010).

The dissertation is divided as follows: in the next section we review some important literature on the matter. In section 3 we describe the data and methodology used to estimate the pattern of concentration and location of different sectors of economic activity. The main results are presented in the fourth section and section 5 concludes with some final comments.



(1) Bulgaria, Cyprus, Malta and Romania were not included in the LUCAS 2009 survey.

Source: Eurostat (online data code: lan_lu_ovw)

Source: Eurostat

Figure 1

2. LITERATURE REVIEW

J.H. Von Thünen (1826) aimed to explain the pattern of agricultural activities around cities in preindustrial Germany. There are several factors that characterize and influence the price of land and its use such as soil conditions, topography, geographical location, etc… But the most important feature Thünen considered was the transport-cost differential in space, that is, transportation costs by one more unit of distance.

Thus, J.H. Von Thünen (1826) assumes land is homogeneous to all aspects and that there is a town center, whose location is given, exogenously, and it is there that are made all the transactions related to agricultural goods. Agents are price takers and there is free entry of producers. It is known that by allocating a portion of land to a given agricultural activity production costs of all other activities are indirectly affected, as these will have to be implemented farther away, which leads to higher transportation costs. As it can be seen, the land in this context consists of both a commodity, with a perfectly competitive market, since a small portion in a continuous space is something highly replaceable; and as a substrate to perform activities. Thus the problem arises concerning about which agricultural activities must be implemented and where.

Given the above, Thünen proposes that each farmer makes an offer based on the surplus that he can obtain from the use of one more unit of acquired land - concept of bid rent function, which describes the maximum price that an agent is willing to pay in order to occupy certain location (J.F. Thisse, 2011). This implies that any land is allocated to an agricultural activity in accordance with the bidding process in which the producer that offers the highest bid is the one who gets the corresponding lot. In turn, the producer's bid depends on the transportability of its production (embodied in transportation costs) and on the amount of land needed to produce one unit of its agricultural goods. With the allocation of each plot of land to the highest bid, agricultural activities will be distributed according to the pattern of concentric rings and the epicentre will be the market town. Each ring is specialized in a particular agricultural activity. Due to all above, the land rent decreases as the distance to the market town increases, from ring to ring, since the transport cost raises.

The model generated four concentric rings of agricultural activity. Dairying and intensive farming lies closest to the city. Since vegetables, fruit, milk and other dairy products must get to market quickly they would be produced close to the city.

Timber and firewood would be produced for fuel and building materials in the second ring. Wood was a very important fuel for heating and cooking and is very heavy and difficult to transport so it is located closer to the city.

The third zone consists of extensive fields crops such as grain. Since grains last longer than dairy products and are much lighter than fuel, reducing transport costs, they can be located further from the city.

Ranching is located in the final ring. Animals can be raised far from the city because they are self-transporting. Animals can walk to the central city for sale or for butchering.

Beyond the fourth ring lies the wilderness, which is too great a distance from the central city for any type of agricultural product.

Von Thünen's rings proved especially useful to economic history, such as Fernand Braudel's *Civilization and Capitalism,* untangling the economic history of Europe and European colonialism before the Industrial Revolution blurred the patterns on the ground.

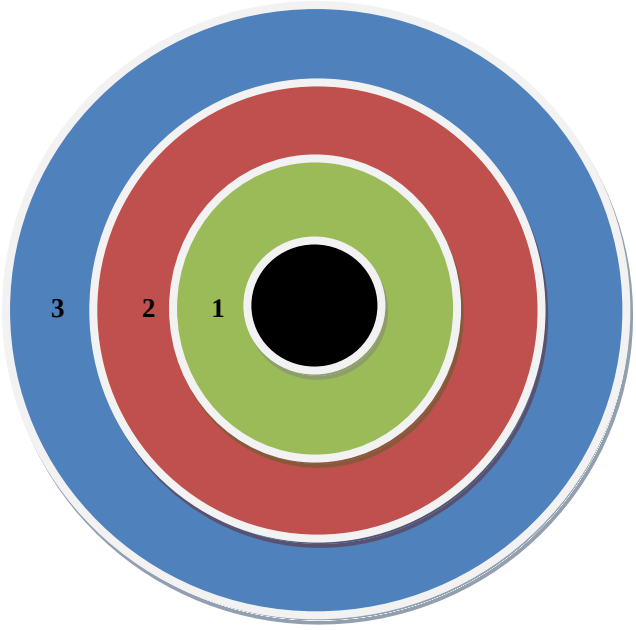


Figure 2: Thünen’s concentric rings

Alfred Marshall suggested that the industrial district, which is defined as a production system composed by a geographically limited set of small and medium companies of the same industry has advantages over Fordism, which, as opposed to,

defending the existence of large enterprises fully vertically integrated, that is, produce everything necessary for the granting of the final product. These advantages are presented by Marshall (Paul Krugman, 1991b), namely:

- Geographic agglomerations of a certain industrial sector leads to a concentration of labor with specific qualifications in the same industrial sector, ensuring no unemployment or labor shortage;
- Can promote the creation of companies specialized in non-tradable inputs of that sector;
- There may be sharing of knowledge and experiences among companies that enhance the production function. This does not happen if only there was a single producer.

Edgar M. Hoover (1948) also mentions that geographical concentrations of industries, such as may be the case of industrial districts, foster the development of the productivity of the labor force in industry. An important characteristic that influences production costs, regardless of individual capabilities, is the labor market size within the range likely to employ someone because the more skilled workers are, the greater is the flexibility of labor and thus more effectively one can input the production costs (Edgar M. Hoover, 1948). The author also states that in many localities where there is high expertise in a particular industry all institutions tend to be able to support this type of industry and the population, which in most cases depends on the employment associated with that industrial branch, such as schools that can open more vocational courses linked to that kind of local predominant industry. Hence, the effect of geographical concentrations of industries is to strengthen and perpetuate the concentration of companies of those kinds of industries that use similar qualifications. However, Hoover warns that these advantages are achievable only through the existence of other labor market characteristics such as organization and attitude.

Scholars in economics tend to explain the world according to the forces they know how to model, in particular tending to eliminate mathematical resistances. In terms of the international economy, until the 80's, this meant that there was an almost exclusive emphasis on the comparative advantage of David Ricardo, assuming perfect competition

and constant returns to scale, instead of assuming increasing returns to scale and imperfect competition in explaining trade, which were then ignored (Paul Krugman, 1991a).

However, the importance of increasing returns is unquestionable, as evidenced by the existence of numerous clusters of high concentration in several economic activities existing all over the world and within each country. Therefore, Krugman believes that the existence of increasing returns influence the location of economic activities (Paul Krugman, 1991a).

Paul Krugman (1991b) tries to answer the question why the industry tends to focus in one or a few geographical points of a country while the remaining peripheral regions become mere agricultural suppliers to the industrial centers, modelling ideas of earlier literature.

Paul Krugman (1991b) assumes the hypothesis that the externalities associated with either supply or demand are important to explain the problem, since in the presence of imperfect competition and increasing returns to scale if a company acts in order to affect the demand for goods from another company it may lead to externalities that are much more tangible than any spillover effects, for example. Imagine a country in which there are only two types of production, agriculture and manufacturing. Agricultural production is characterized by constant returns to scale and is land intensive; manufactures is characterized by increasing returns to scale and requires a reduced amount of land to be implemented. Where will manufactures production be implemented? *Cæteris paribus,* industry will tend to be located close to where the demand is higher, since this will provide reduced transportation costs. But it raises a new question: Where will the demand be higher? Part of the demand comes from the agricultural sector, but another important part comes from the manufactures production itself. This relationship has a "snow ball" effect ("circular causation"). In short, the manufacturing production in order to realize economies of scale while at the same time reducing the transportation costs tend to be located at or near the region with the highest demand. But demand also depends on the manufactures' distribution / location, or, in other words, the agglomeration effect is not a stable equilibrium, generating a "snow ball" effect. Thus, agglomeration generates more agglomeration and in its surroundings brings depression, causing regional divergence.

Krugman points out that there are two forces that oppose each other indirectly. On one hand, contributing to the regional divergence the "home market effect" tells us that, all

else constant, wages tend to be higher in larger markets and, on the other hand, contributing to regional convergence, the extension of competition that makes the industrial workers of the region with the smallest fraction of the workforce in the industry to have less competition than the workers in the region with a higher workforce percentage in industry, and thus able to receive higher wages leading people to migrate from the region with more workers to the region with less ("price index effect").

3. METHODOLOGY AND DATA DESCRIPTION

It is not easy, nor is there consensus on the methodology to measure or assess empirically the effects of clustering of economic activities.[1] In this work, we seek to combine concentration measurements with the new tools of spatial econometrics, based on the methodology followed by R. Guillain and J. Le Gallo (2010). As a measure of concentration we use the locational Gini Coefficient whose expression is given by:

$$G_m = \frac{1}{4\bar{\mu}_x}\frac{1}{n(n-1)}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|x_i - x_j\right| \quad (1)$$

Where:

G_m, represents the locational Gini coefficient of economic sector m;

n, the number of municipalities;

$$x_{i(j)} = \frac{\text{Municipality i'(j') share of employment in sector m}}{\text{Municipality i'(j') share of total employment}}$$

And finally,

$$\bar{\mu}_x = \frac{\sum_{i=1}^{n} x_i}{n}$$

The locational Gini coefficient of a sector assumes zero value when the distribution of the respective employment is uniform in all the municipalities. If the total employment in a sector of economic activity is concentrated in a single municipality the locational Gini

[1] See for alternative methods: **Ellison, Glenn and Edward L. Glaeser.** 1997. "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach." *Journal of Political Economy*, 105, 889-927.

coefficient takes the value 0.5. The locational Gini coefficient is a good indicator of the degree of concentration or dispersion of a sector of economic activity. However it does not reveal information about the pattern of geographic distribution nor on the specific location of possible clusters. That is, assuming that there is a phenomenon of concentration of workforce of a particular economic sector in some cities, it may be useful to know if there is a specific pattern of distribution of these cities and, if so, the location of these clusters or agglomerated cities. Taking the metaphor of dartboard approach of Glenn Ellison and Edward L. Glaeser (1997) we do not know if the darts are concentrated close to each other making an agglomeration in one or another spot or if the darts were thrown blindfolded and were randomly assigned, however the same number of darts may have been released (same concentration indicating equal locational Gini coefficient but different levels of agglomeration).

Therefore, although concentration measurement is a standard procedure in determining location patterns it is equally necessary to measure the level of agglomeration in addition, that is, the geographical position of the spatial units and the distance between them, which is not captured by the locational Gini coefficient. Thus, it becomes essential to complement locational Gini coefficient with another index that measures the degree of agglomeration, or the level of spatial autocorrelation of the distribution (R. Guillain and J. Le Gallo, 2010).

Moran's I statistic seeks to answer this question. It measures the spatial autocorrelation which can be defined as the relation between the normalized deviation of a variable at a specific location and the normalized deviation in neighboring geographic units for the same variable, or, in other words, as the coincidence between spatial proximity and similar values, simultaneously. Considering a row-standardized contiguity matrix (type queen) w, the Moran's I statistic is given by:

$$I_m = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i-\bar{\mu}_x)(x_j-\bar{\mu}_x)}{\sum_{i=1}^{n}(x_i-\bar{\mu}_x)^2} \qquad (2)$$

The spatial weight matrix w is a contiguity matrix in which $w_{i,j} = 1$ if i and j are neighbors, $w_{i,j} = 0$ otherwise and $w_{i,i} = 0$, by convention. The Moran's I Statistic constitutes a measure of spatial autocorrelation for a given attribute, ranging from -1 to 1 like any other correlation index. A Moran's I Statistic close to zero (technically, close to -1

/ (n-1)) indicates a random pattern. When above -1/(n-1) (toward +1), it indicates a tendency toward clustering and when below -1 / (n-1) (toward -1) it indicates a tendency toward dispersion.

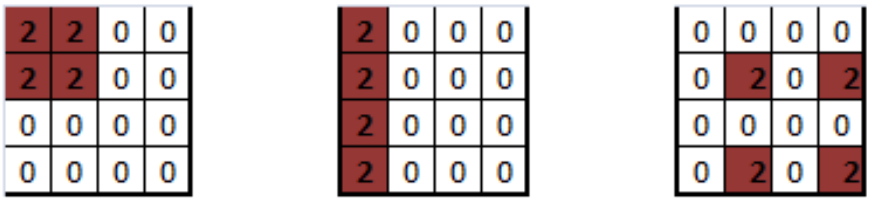


Figure 3: Same locational Gini coefficients but different autocorrelation (different Moran's I)

However these three cases show the same locational Gini coefficient and so the same level of concentration, in Figure 3 we have three different levels of polarization, that is, three different patterns of agglomeration. Clearly the strongest autocorrelation is in the left case, due to the greater proximity between similar values, then in the case of the middle.

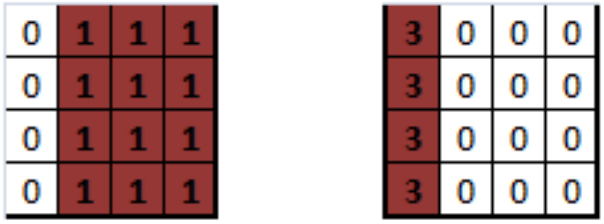


Figure 4: Same Moran's I statistic but different locational Gini coefficients

In Figure 4 both cases show the same Moran's I statistic, as we can see by the agglomeration patterns that are the same, but the concentration levels are clearly different. The locational Gini coefficient is higher in the right case because the activity is distributed in less spatial units than in the left case.

The locational Gini coefficient and the Moran's I Statistic give us valuable indications on the tendency of economic sectors to concentrate and form clusters (Giuseppe Arbia, 2001). However, it tells us nothing about the spatial location of these

specific manifestations of agglomeration. Thus, these global indexes if relevant can be an invitation to explore other local measures of agglomeration. The statistical LISA (Local Indicator of Spatial Association) decomposes the Moran's I Statistic in order to identify the individual contribution of each local site (in this case, each municipality). It measures for each geographical unit the spatial autocorrelation of the variable between this unit and all the neighboring units according to the criteria of the spatial weight matrix. The local version of Moran's I Statistic index for each municipality *i* is given by (Luc Anselin, 1995):

$$I_i = \frac{\sum_j w_{ij}(x_i - \bar{\mu}_x)(x_j - \bar{\mu}_x)}{\frac{\sum_{i=1}^{n}(x_i - \bar{\mu}_x)^2}{n}} \qquad (3)$$

Where notation j concerns only the neighboring values of municipalities i. As such, Local Indicators of Spatial Association (LISA) indicate the presence or absence of significant spatial clusters at a local level. A randomization approach is used to generate a spatially random reference distribution to assess statistical significance with 999 permutations. The observation of the position of each municipality in the four quadrants of the Moran scatter plot for each sector of economic activity allows the distinction of four different categories:

- Municipality with a high proportion of workforce in the sector m and positive autocorrelation with the neighborhood: type HH (high-high);
- Municipality with a high proportion of workforce in the sector m and negative autocorrelation with the neighborhood: type HL (high-low);
- Municipality with low proportion of workforce in the sector m and positive autocorrelation with the neighborhood: type LL (low-low);
- Municipality with low proportion of workforce in the sector m and negative autocorrelation with the neighborhood: type LH (low-high).

The Moran Significance Map, unlike the Moran Map shows only those geographical units where the LISA is significant and identifies each type of unit with a color. In our analysis, we are particularly interested in the types HH and HL; the first representing the centrifugal dynamics and the second because of its shadow effect on the neighborhood.

The study area corresponds to the Portuguese continental territory. For this study we used data of workforce employed in enterprises according to the CAE-Rev.3 (Classification of Economic Activities) available in the Regional Statistical Yearbook of the National Statistics Institute (INE, IP, System Integrated Business Accounts) for the biennium 2009-2010, and disaggregated across the 284 municipalities of mainland Portugal (see Tables 3 and 4). In a first level of aggregation, we studied the manufacturing sector taken as a whole (sector C), the construction sector (sector F) and the tourism sector (sector I). In a second approach, we disaggregate the manufacturing industry in various subsectors, namely: footwear (15), textiles and clothing (13 +14), wood, cork and furniture (16 +31), chemical and rubber (20 +21 +22 +23), metallurgy and basic metal products (24+25), automobile (29 +30 +33), food and beverages (10 +11) and machinery and equipment (26 +27 +28). These choices were strongly influenced by the availability of data which forces us to aggregate several related subsectors.

4. RESULTS AND DISCUSSION

Based on data for the eleven sectors and subsectors described above, we proceed with an analysis of the more global measures of concentration and agglomeration (locational Gini coefficient and Moran's I statistic), followed by the analysis of local clusters.

Table 1 shows for each sector and subsectors the locational Gini coefficient, the Moran's I Statistic and the respective rankings.[2] For the three global sectors (tourism, construction and manufacturing), we find relatively low concentration, which is natural considering its higher degree of aggregation. As for the Moran's I Statistic, we find that it is in the manufacturing sector that agglomeration effects are higher, followed by tourism and construction. The case of tourism should be interpreted with caution since this tendency for aggregation of municipalities may be related only to geographical and climatic factors rather than socio-economic dynamics. As for construction, like other people-oriented service sectors, the phenomenon of agglomeration reflects mostly the population densities rather than sectorial dynamics.

Activities	Loc.Gini	Ranking	Moran's I	Ranking
Footwear	0,4729	1	0,2533	9
Textiles and clothing	0,4075	2	0,5684	1
Machinery and equipment	0,3978	3	0,2684	8
Automobile	0,3740	4	0,1559	11
Chemical and rubber	0,3164	5	0,3712	5
Wood, cork and furniture	0,2876	6	0,2840	7
Food and beverages	0,2645	7	0,2385	10
Metallurgy and metal products	0,2296	8	0,4758	3
Tourism	0,1916	9	0,4641	4
Construction	0,1813	10	0,2963	6
Manufactory sector	0,1465	11	0,5595	2

Table 1

[2] All Moran's I Statistic proved highly significant.

Observing the various sub-sectors of the manufacturing sector, and crossing the locational Gini coefficient and the Moran's I Statistic, we can distinguish four patterns of concentration / agglomeration. Firstly we have the subsectors with high concentration of activities with a strong tendency to aggregate. Textiles and clothing fall into this category. In these municipalities we have a high proportion of workers in those subsectors and this concentration tends to spread through other neighboring municipalities. Secondly we have the subsectors with high concentration of activities but with a lower tendency for aggregation.[3] Footwear, automotive and machinery and equipment sectors belong to this group. In this case, technological factors associated with economies of scale seem to be dominant, despite some sprawl dynamic. Thirdly, we have economic sub-sectors less concentrated but with a strong tendency to agglomerate represented by a single subsector, metals and metal products. In this pattern, the dynamics of agglomeration between several municipalities supersede the measures of concentration that remain moderate. Finally, there is a rather undefined pattern with a low concentration and low tendency to aggregate, in which fall the remaining sub-sectors of the manufacturing industry: chemical and rubber, wood, cork and furniture and food and beverages.

Figures 5 and 6 represent the Moran Scatter plot for each sector. The Moran Scatter plots classify municipalities according to the level of employment (x-axis) of a given sector and about the relationship that exists with the neighborhood (y-axis). Thus Moran Scatter plots are divided into four quadrants: HH (red), HL (purple), LL (light blue) and LH (light green). Municipalities with a typical configuration, which provide a positive autocorrelation, are HH and LL while atypical municipalities that configure negative autocorrelation are those listed in quadrants HL and LH. As already mentioned, all sectors studied have a positive and statistically significant Moran's I, so most of the municipalities are in typical configuration quadrants, as we can also conclude by Table 2.

[3] A small tendency yet positive and significant.

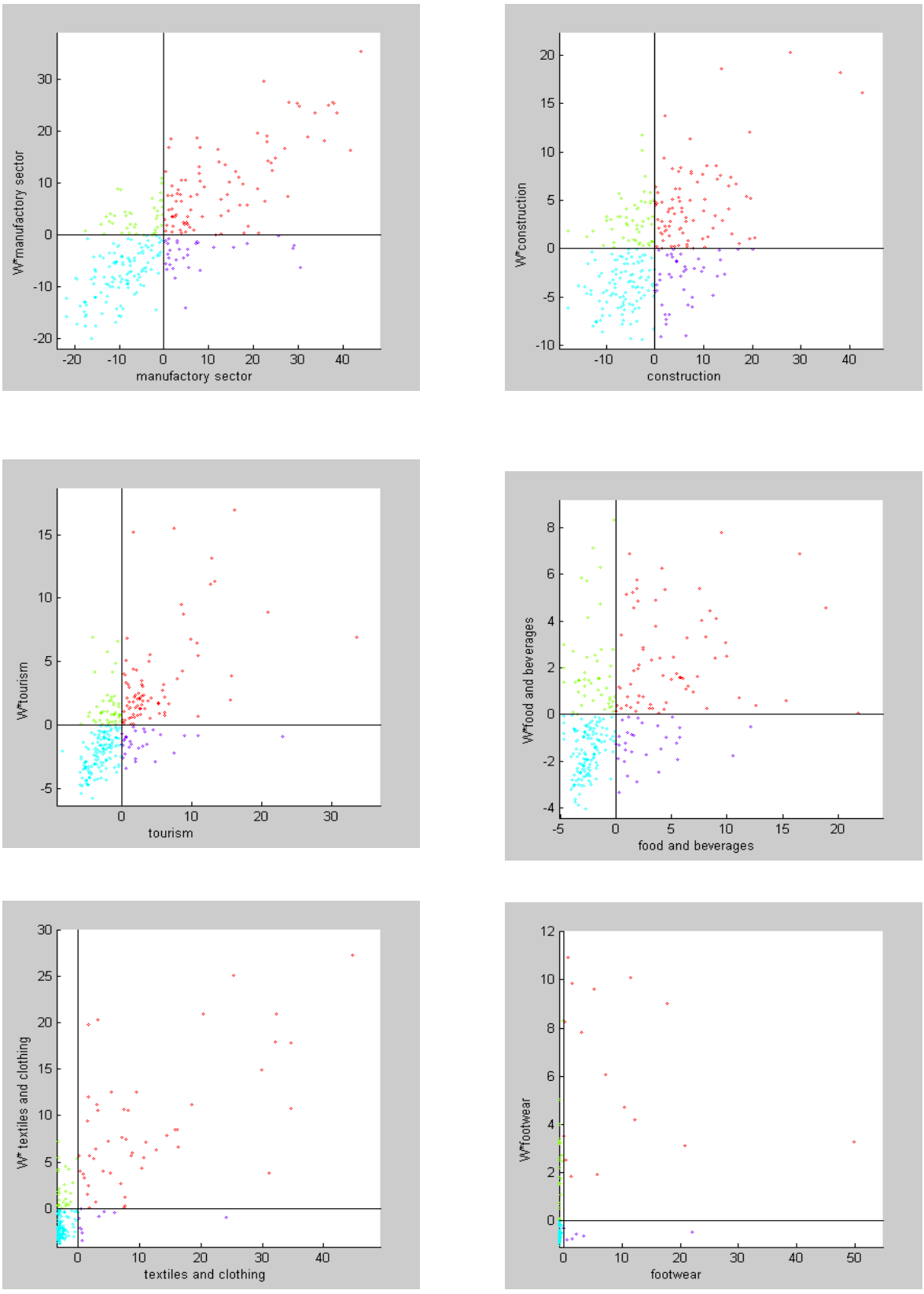


Figure 5: Moran Scatterplots 1

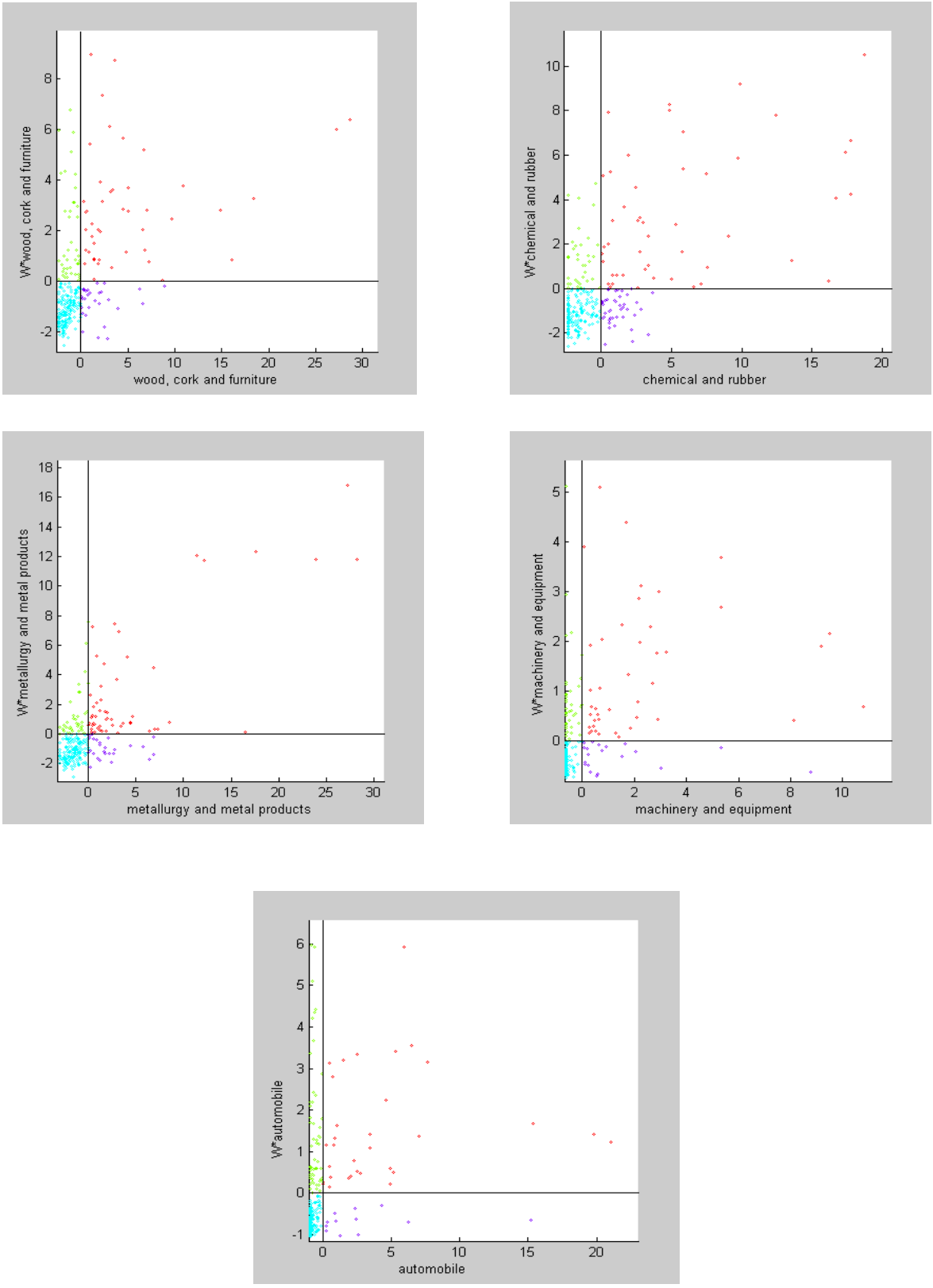


Figure 6: Moran Scatterplots 2

Activities	Types of municipalities (absolute frequency)				Types of municipalities (relative frequency - %)			
	HH	HL	LH	LL	HH	HL	LH	LL
Footwear	16	6	22	234	5,76	2,16	7,91	84,17
Textiles and clothing	50	11	26	191	17,99	3,96	9,35	68,71
Machinery and equipment	43	20	40	175	15,47	7,19	14,39	62,95
Automobile	32	12	55	179	11,51	4,32	19,78	64,39
Chemical and rubber	48	41	34	155	17,27	14,75	12,23	55,76
Wood, cork and furniture	45	28	42	163	16,19	10,07	15,11	58,63
Food and beverages	67	30	49	132	24,10	10,79	17,63	47,48
Metallurgy and metal products	54	27	39	158	19,42	9,71	14,03	56,83
Tourism	78	29	42	129	28,06	10,43	15,11	46,40
Construction	82	42	51	103	29,50	15,11	18,35	37,05
Manufactory sector	86	32	40	120	30,94	11,51	14,39	43,17

Table 2

Figures 7-10 represent the Moran Significance map and help us to understand better the patterns of geographic location. The different types HH, LL, LH and HL appear on maps respectively marked in red, blue, light blue and pink. We have chosen not to display the maps relating to the construction and machinery and equipment because we have not found any clear pattern of clustering. The first map, Figure 7 (left), represents the manufacturing sector. It clearly shows a pattern of industrial location in three relatively distinct poles: the first corresponds to the municipalities of Leiria and Marinha Grande, a second corresponding to the district of Aveiro and a third covers a number of municipalities between Porto and Braga, thus covering the regions of Grande Porto and Ave. The second map, Figure 7 (right) corresponds to the tourism sector, with a clear geographic concentration in the south (Algarve) and in the Alentejo coast, motivated, in our view, essentially by climatic factors.

The next maps (Figures 8-10) illustrate the spatial distribution of the several manufactory subsectors described above. Figure 8 (left) corresponds to the Moran Significance Map of textiles and clothing subsector and identifies two industrial spots. The first one is localized in the north of Porto and includes the Vale do Ave, and part of the

Cávado and Minho-Lima regions. Therein lays the stronghold of the Portuguese textile industry. The second spot, in the central region, covers part of the Serra da Estrela and Cova da Beira regions and also includes the Guarda municipality. The first case is not surprising, considering the efforts made on modernization thus converting and adapting to globalization. These have been achieved mainly through multiple partnerships with various private and public research units.[4] The second case isn't so obvious and requires a closer look at the existing dynamics. Considering the existence of a spatial agglomeration in the Moran Significance Map, this leads us to believe that the wool sector is eventually resisting despite major closures that have dominated the last decades.

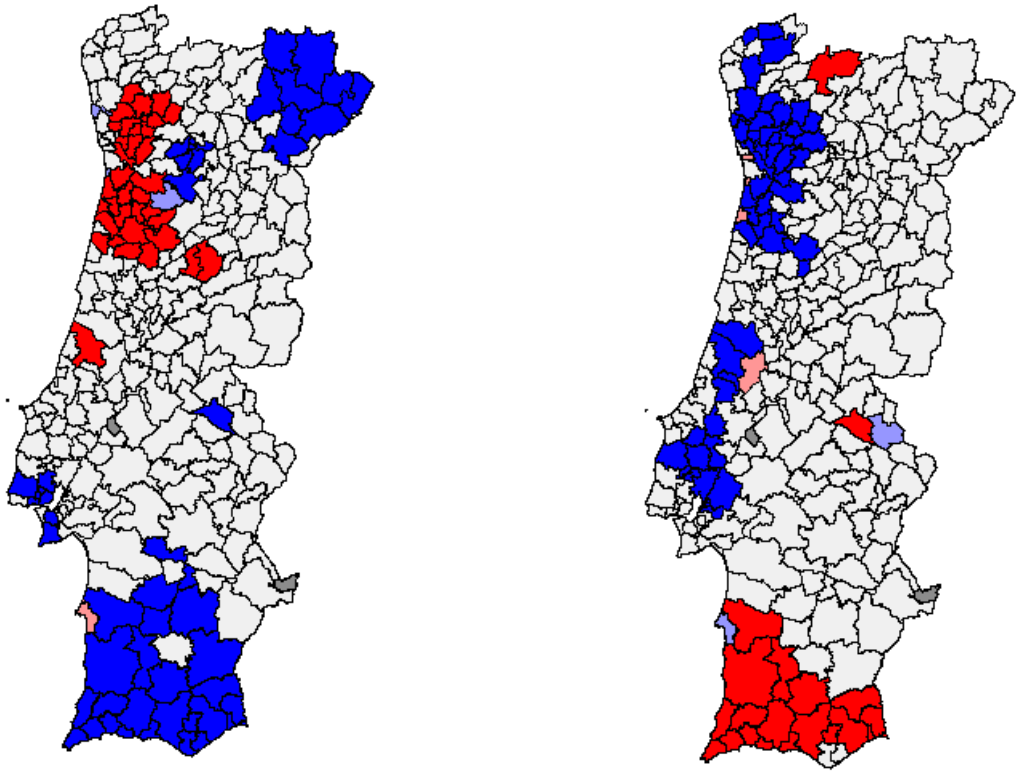


Figure 7: (left) Manufacturing sector / (right) Tourism

[4]The CITEVE - Technological Centre for the Textile and Clothing Industries of Portugal is an establishment localized in Famalicão created in 1986 aims to support the development of technical and technological capacities of textile and clothing, and by fostering the diffusion of innovation, promoting quality improvement and instrumental support for the definition of industrial policies for the sector.

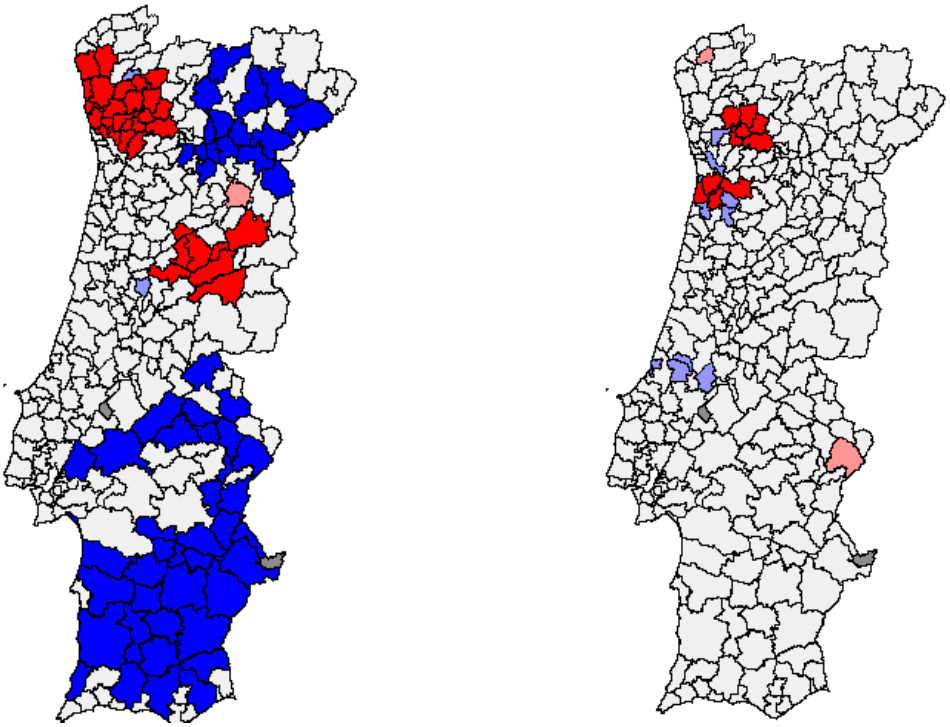


Figure 8: (left) Textile and clothing / (right) Manufacturing footwear

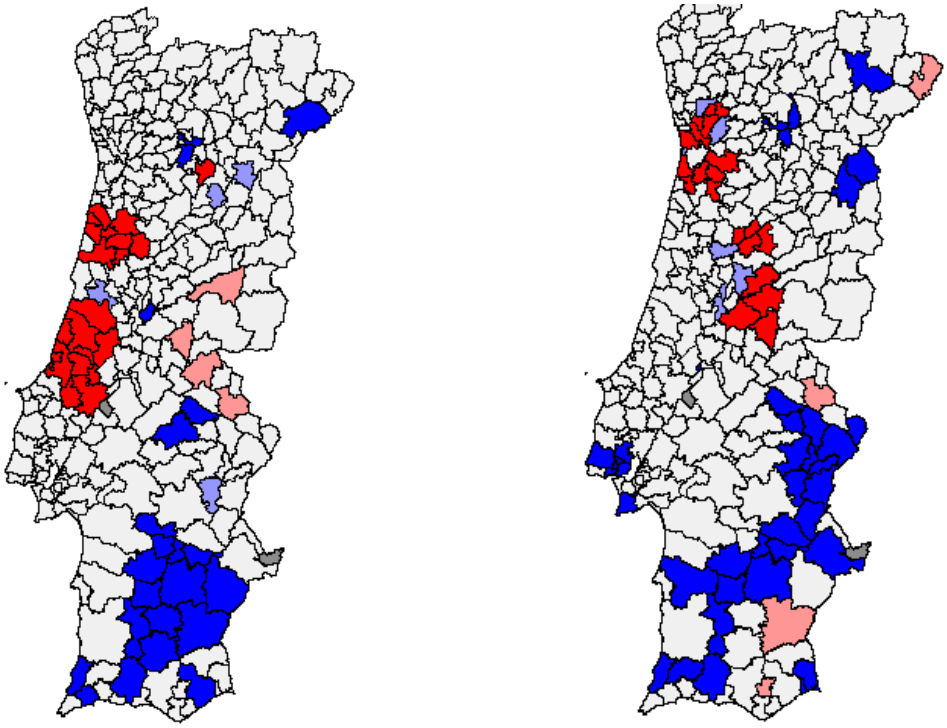


Figure 9: (left) Rubber and chemical products / (right) Wood, cork and furniture

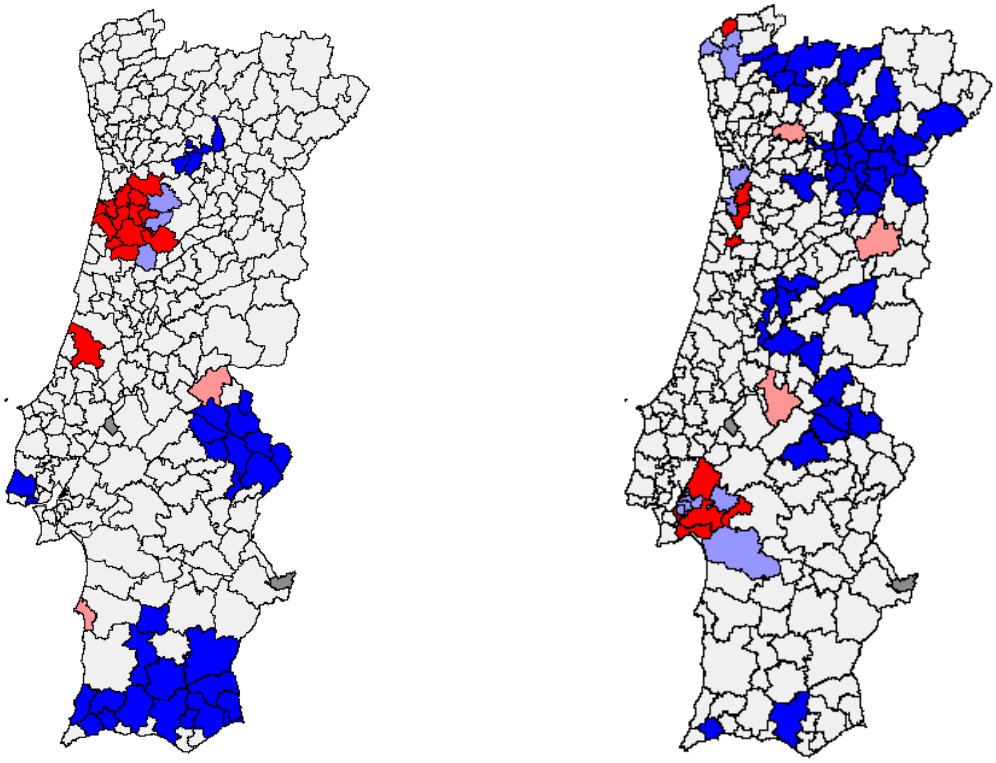


Figure 10: (left) Metallurgy and metal products / (right) Automobile industry

Figure 8 (right) describes the footwear sector and also displays two regional clusters, one located in the north of Portugal covering the municipalities of Vale do Ave (Guimarães, Fafe) and Tâmega (Amarante, etc.), and a second one in the region of Entre-Douro-e-Vouga (with the municipalities of Ovar, Santa Maria da Feira, S. João da Madeira, Oliveira de Azeméis and Arouca). Generally, we found several structures in both areas that may have originated these geographical agglomerations. Through such structures, local actors seek to collectively develop strategies in important areas such as research and development, vocational training or internationalization.[5]

The subsector of rubber and chemicals products, corresponding to the map in Figure 9 (left) includes chemicals and synthetic fibers, pharmaceuticals, rubber and plastics, being one of the most diversified sector. The map shows two agglomerations. The first comprises municipalities of the regions of Baixo-Vouga and Baixo-Mondego (Aveiro, Cantanhede,

[5] Examples: Footwear Technology Centre of Portugal in S. João da Madeira and APICCAPS - Portuguese Association of Manufacturers of Footwear, Components, Leather Goods and their substitutes based in Oporto.

Mortágua etc.). The second covers an extensive area including coastal municipalities ranging from Oeste to Pinhal Litoral and Lezíria regions (from Santarém to Pombal). The map also reveals some HL municipalities with a high concentration of workforce in this sector, but without sprawl effects in neighborhood. Usually they correspond to inland municipalities in which a single company can employ a significant proportion of the local workforce. Such is the case in Portalegre with the IMG Group, dedicated to the production of resin. The subsector of wood, cork and furniture Figure 9 (right) identifies three geographical agglomerations. The first is located in the center region (Sertã, Proença-a-Nova, Oleiros and Pampilhosa da Serra) while the second covers municipalities in the Baixo-Vouga and Entre-Douro-e-Vouga regions. Finally, the third case, located in the north region, corresponds to the most important cluster of furniture, with epicenter in the municipality of Paços-de-Ferreira (known as the furniture capital), sprawling to neighboring municipalities of Tâmega region. The lack of disaggregated information about the cork sector does not allow to confirm the existence of cork clusters, namely in the municipality of Santa Maria da Feira where the most important cork plant are concentrated. Figure 10 (left) identifies patterns of location for the sub-sector of metallurgy and metal products, with two spots, the first covering partially the municipality of Leiria and the second covering the regions of Baixo-Vouga (Aveiro, Anadia, Águeda, among others), Entre-Douro-e-Vouga (Oliveira-de-Azeméis, Vale-de-Câmara etc.) and also the municipality of Tondela. This subsector comprehends several activities such as the molding industry (in Marinha-Grande), manufacture of metallic structures, pipes and profiles, or even more differentiated sectors such as motorcycles or bicycles (with particular emphasis on the municipality of Águeda). Finally, we have the sub-sector of the automobile industry, Figure 10 (right), with a cluster clearly identified in the peninsula of Setúbal (Setúbal and Palmela municipalities among others) with epicenter in the Autoeuropa complex (Ford-Volkswagen). Other spots of the automobile industry appear in the Center in the municipalities of Oliveira de Azeméis, Albergaria-a-Velha and Oliveira do Bairro, mainly related to the components sector. The map also identifies some individual municipalities HL, like Guarda, which was an important center of automobile industry due to the localization of the Renault plant. Despite the de-location of the Renault plant, there remain component producing companies (like copper conductor cable).

5. CONCLUSION

The current policy guidelines for economic policies regarding sectorial development recognize the importance of physical space or geographical proximity as one of the crucial factor of success. Strategies for Collective Efficiency, launched by public authorities, mention the poles of competitiveness and clusters as structural elements of the development strategy. This dissertation does not seek to explain the social or economic mechanisms underlying geographical aggregation dynamics. Our aim is to give a contribution in the quantitative approach of these matters, thus seeking to assess as objectively as possible these agglomeration effects, combining instruments for measuring concentration with spatial econometrics techniques.

The results indicate different levels of concentration, not always correlated with the tendency to agglomerate. That is, we can have highly concentrated sectors with strong contagion effects to neighboring municipalities (textiles) and other, equally concentrates, but with less tendency to sprawl (automotive and footwear). Nevertheless, it should be emphasized that, to a greater or lesser degree, all sectors showed positive autocorrelation with a high degree of significance.

We identified several clusters at the regional level, highlighting tourism, textiles and clothing, footwear, wood and furniture, metallurgy and metal products and automobile production. The existence of these traditional activities invites us to recall the Porter report whose recommendations pointed precisely to the potentialities of these sectors (M. Porter, 1994). Although these results claim for a deeper analysis, if possible with higher levels of disaggregation for the sectors and geographical units, they aim to important geographical aggregated sectors, some of which struggling with difficulties and that should not be despised.

We must not overlook the importance of new emerging industries. But we must also, as Porter states, support our traditional sectors, with an innovative view, seeking to explore new technologies, new products and new processes, thus increasing the value chain of firms. By assuming the importance of territory and geographical proximity for the success of economic activities, we are, implicitly, mentioning the importance of the tacit part of knowledge that is not coded. This know-how is normally transmitted through organic or

informal channels, between different generations, and helps to characterize the culture and the social values of a region. It takes decades to build and should not be despised.

Geographic unit	Population
Norte	3743334
Minho-Lima	249851
Arcos de Valdevez	23971
Caminha	16512
Melgaço	9239
Monção	19333
Paredes de Coura	9196
Ponte da Barca	12950
Ponte de Lima	44340
Valença	14295
Viana do Castelo	91390
Vila Nova de Cerveira	8628
Cávado	414499
Amares	19990
Barcelos	124486
Braga	177562
Esposende	35762
Terras de Bouro	7290
Vila Verde	49410
Ave	524975
Fafe	53548
Guimarães	162453
Póvoa de Lanhoso	24360
Santo Tirso	69061
Trofa	41178
Vieira do Minho	13871
Vila Nova de Famalicão	135748
Vizela	24758
Grande Porto	1285732
Espinho	28547
Gondomar	175252
Maia	144581
Matosinhos	169266
Porto	207673
Póvoa de Varzim	67012
Valongo	99187
Vila do Conde	77669
Vila Nova de Gaia	316547
Tâmega	560208
Amarante	61649
Baião	20287
Cabeceiras de Basto	17468
Castelo de Paiva	16595
Celorico de Basto	19580
Cinfães	19728
Felgueiras	58945
Lousada	48124
Marco de Canaveses	55597
Mondim de Basto	8138
Paços de Ferreira	56737
Paredes	87525
Penafiel	71557
Resende	11370
Ribeira de Pena	6912

Geographic unit	Population
Entre Douro e Vouga	289349
Arouca	23489
Oliveira de Azeméis	70980
Santa Maria da Feira	148893
São João da Madeira	21789
Vale de Cambra	24199
Douro	207033
Alijó	13232
Armamar	6957
Carrazeda de Ansiães	6549
Freixo de Espada à Cinta	3762
Lamego	25363
Mesão Frio	4228
Moimenta da Beira	10873
Penedono	3246
Peso da Régua	16579
Sabrosa	6458
Santa Marta de Penaguião	7962
São João da Pesqueira	7857
Sernancelhe	5952
Tabuaço	6087
Tarouca	8294
Torre de Moncorvo	8615
Vila Flor	7309
Vila Nova de Foz Côa	7759
Vila Real	49956
Alto Trás-os-Montes	211689
Alfândega da Fé	5249
Boticas	5618
Bragança	34170
Chaves	43771
Macedo de Cavaleiros	16540
Miranda do Douro	7094
Mirandela	25284
Mogadouro	10116
Montalegre	11108
Murça	5970
Valpaços	18195
Vila Pouca de Aguiar	14685
Vimioso	4766
Vinhais	9126
Centro	2378485
Baixo Vouga	401312
Águeda	49720
Albergaria-a-Velha	26487
Anadia	31209
Aveiro	72760
Estarreja	28060
Ílhavo	41914
Mealhada	22356
Murtosa	9882
Oliveira do Bairro	23847
Ovar	58282
Sever do Vouga	12487
Vagos	24309

Geographic unit	Population
Baixo Mondego	327582
Cantanhede	38899
Coimbra	132436
Condeixa-a-Nova	18206
Figueira da Foz	62951
Mira	13299
Montemor-o-Velho	24664
Penacova	16787
Soure	20342
Pinhal Litoral	269475
Batalha	16090
Leiria	129468
Marinha Grande	38730
Pombal	59951
Porto de Mós	25237
Pinhal Interior Norte	136799
Alvaiázere	7574
Ansião	13369
Arganil	12454
Castanheira de Pêra	3074
Figueiró dos Vinhos	6714
Góis	4279
Lousã	19951
Miranda do Corvo	13847
Oliveira do Hospital	21432
Pampilhosa da Serra	4098
Pedrógão Grande	3996
Penela	6167
Tábua	12201
Vila Nova de Poiares	7645
Dão-Lafões	290617
Aguiar da Beira	6085
Carregal do Sal	10592
Castro Daire	16319
Mangualde	21112
Mortágua	10041
Nelas	14725
Oliveira de Frades	10622
Penalva do Castelo	8319
Santa Comba Dão	12172
São Pedro do Sul	19171
Sátão	13486
Tondela	30436
Vila Nova de Paiva	6395
Viseu	99604
Vouzela	11540
Pinhal Interior Sul	39473
Mação	6816
Oleiros	5569
Proença-a-Nova	8638
Sertã	15436
Vila de Rei	3015
Serra da Estrela	46733
Fornos de Algodres	5127
Gouveia	15073
Seia	26534

Table 3

Geographic unit	Population
Beira Interior Norte	107346
Almeida	6736
Celorico da Beira	8468
Figueira de Castelo Rodrigo	6411
Guarda	43932
Manteigas	3544
Meda	5599
Pinhel	9585
Sabugal	12870
Trancoso	10202
Beira Interior Sul	72058
Castelo Branco	53448
Idanha-a-Nova	9828
Penamacor	5449
Vila Velha de Ródão	3333
Cova da Beira	89713
Belmonte	7741
Covilhã	51390
Fundão	30582
Oeste	366839
Alcobaça	55549
Alenquer	47788
Arruda dos Vinhos	12718
Bombarral	13788
Cadaval	14714
Caldas da Rainha	53115
Lourinhã	25857
Nazaré	14322
Óbidos	11412
Peniche	28662
Sobral de Monte Agraço	10787
Torres Vedras	78130
Médio Tejo	230543
Abrantes	39418
Alcanena	14555
Constância	3721
Entroncamento	22353
Ferreira do Zêzere	9008
Ourém	51209
Sardoal	3732
Tomar	41538
Torres Novas	36756
Vila Nova da Barquinha	8256
Lisboa	2835388
Grande Lisboa	2034969
Amadora	170152
Cascais	190116
Lisboa	474697
Loures	192901
Mafra	74169
Odivelas	156985
Oeiras	172779
Sintra	458085
Vila Franca de Xira	145088

Geographic unit	Population
Península de Setúbal	800419
Alcochete	18439
Almada	165875
Barreiro	77330
Moita	71900
Montijo	41701
Palmela	64404
Seixal	179537
Sesimbra	55583
Setúbal	125653
Alentejo	751231
Alentejo Litoral	94577
Alcácer do Sal	12772
Grândola	13764
Odemira	25155
Santiago do Cacém	29194
Sines	13693
Alto Alentejo	114703
Alter do Chão	3333
Arronches	3188
Avis	4838
Campo Maior	8270
Castelo de Vide	3662
Crato	3587
Elvas	21915
Fronteira	3044
Gavião	3886
Marvão	3371
Monforte	3033
Mora	5107
Nisa	7348
Ponte de Sor	16835
Portalegre	23288
Alentejo Central	167608
Alandroal	5934
Arraiolos	7075
Borba	7305
Estremoz	14233
Évora	54290
Montemor-o-Novo	18277
Mourão	3395
Portel	7071
Redondo	6568
Reguengos de Monsaraz	11599
Sousel	5196
Vendas Novas	12370
Viana do Alentejo	5692
Vila Viçosa	8607

Geographic unit	Population
Baixo Alentejo	124386
Aljustrel	9279
Almodôvar	6977
Alvito	2705
Barrancos	1652
Beja	34073
Castro Verde	7747
Cuba	4635
Ferreira do Alentejo	7983
Mértola	7102
Moura	15953
Ourique	5284
Serpa	15157
Vidigueira	5842
Lezíria do Tejo	249959
Almeirim	22999
Alpiarça	8254
Azambuja	21902
Benavente	29175
Cartaxo	25337
Chamusca	10849
Coruche	19222
Golegã	5453
Rio Maior	21851
Salvaterra de Magos	21627
Santarém	63292
Algarve	435833
Albufeira	40211
Alcoutim	3000
Aljezur	5332
Castro Marim	6451
Faro	58650
Lagoa	25629
Lagos	29506
Loulé	66366
Monchique	5859
Olhão	45025
Portimão	50722
São Brás de Alportel	13063
Silves	36560
Tavira	25400
Vila do Bispo	5445
Vila Real de Santo António	18619

Table 4

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