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THE SPATIAL CONVERGENCE OF KNOWLEDGE IN PORTUGAL^{*}

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Abstract

Human resources are an essential element in territorial development. When these are characterized by a high level of training, they also enhance a number of effects in fundamental areas of binomial territorial-social cohesion. In this respect, the existence of higher education institutions throughout the territory allows the spread of human resources' qualification but, by itself, does not guarantee the retention of these resources in different regions. Thus, the objective of this paper is to undertake a spatial analysis of convergence of knowledge through studying the evolution of the percentage of population with higher education in the periods elapsed between the last three censuses in Portugal. Although that percentage has risen appreciably, the convergence is shown to be (very) insignificant.

Keywords: *Census, Convergence Analysis, Higher Education, Spatial Econometrics.*

JEL-Codes: *C23, I23, O15, R12.*

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1. INTRODUCTION

Human resources are an essential element in territorial development. When they are characterized by a high level of training, they enhance a series of effects which are essential in the relationship between territorial and social cohesion (Rego & Caleiro, 2010; Rego & Caleiro, 2012; Rego et al., 2012). In this regard, the existence of higher education institutions across the territory allows a delocalised qualification of human resources but, by itself, does not warrant the implantation of these resources in the various regions. Therefore, the main objective of this paper is to analyse the spatial convergence of knowledge through studying the evolution of the percentage of the population with higher education in the periods elapsed between the last three censuses in Portugal, i.e. between 1991-2001 and 2001-2011.

In the majority of empirical studies, regional (or spatial) economic convergence is studied from the viewpoint of the GDP growth *per capita* (see the work of Barro and Sala-i-Martin). However, since human capital is a key factor in economic growth it seems important to know the spatial distribution of that kind of capital and whether regions have converged in terms of the stock of qualified human resources. In fact, a relevant spatial convergence of knowledge is expected to be reflected in spatial convergence in terms of economic growth, or even of unemployment rates.

Regarding conditional convergence of average *per capita* income in the regions of mainland Portugal,¹ Guerreiro (2014) concludes that the percentage of the workforce with higher education is a significant variable in distinguishing the 'steady state'² of regional economies. As mentioned in Tano (2014), concerning an empirical study in Sweden, the spatial distribution of human capital influences regional differences in terms of economic growth and prosperity. This study reveals a regional clustering of human capital in Sweden, with special relevance for major urban areas. In Portugal, when regional differences in terms of average remuneration are analysed, most above-average municipalities are located (with rare exceptions) in the metropolitan areas of Lisbon and Oporto, justified precisely by the concentration of highly qualified human capital (associated with highly-paid occupations) in these regions (Guerreiro, 2014).

¹ This study aims to ascertain whether the Portuguese standard of living depends on place of residence. Convergence is studied in terms of income (*per capita* average wages) in the municipalities of continental Portugal.

² Steady state, in that growth is constant and may even be equal to zero. This "steady state", in each economy tends to converge in the medium and long term, according to Lee (1995), depending on the "social skills", which may support or inhibit the use of the "relative delay potential" in the growth process.

The remainder of the paper is structured as follows: Section 2 presents and describes the data; Section 3 uses a spatial econometrics methodology to study the potential process of convergence; Section 4 concludes.

2. DESCRIPTION OF THE DATA

The data correspond to the percentage of the resident population in the mainland that, at the time of the 1991, 2001 and 2011 censuses, had completed higher education.³ The geographical unit considered corresponds to NUTs 3.⁴

Figures 1, 2 and 3 show geographical representation of the data.⁵

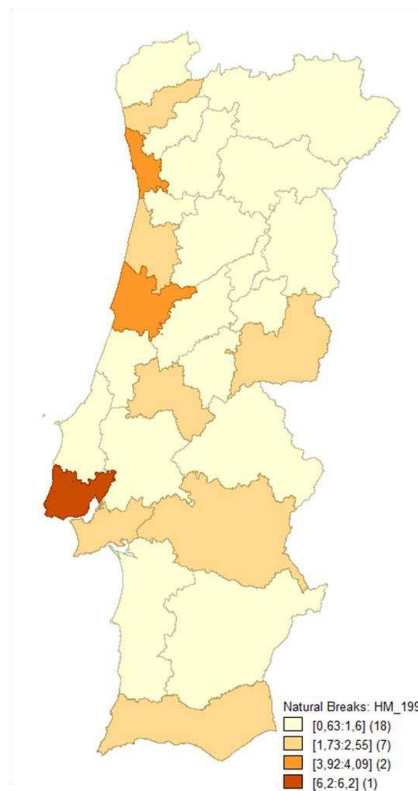


Figure 1: Percentage of the population with higher education in 1991

³ The source of the data – which can be found in an attachment – is the National Institute of Statistics.

⁴ At this level of geographical disaggregation, the distinction of data by gender is not available for the 1991 Census, which meant it was only possible to analyse the (possible) convergence process of the population with higher education, by gender, in the period 2001-2011.

⁵ The figures were produced using the GeoDaTM 1.4.6, available at <http://geodacenter.asu.edu/>.

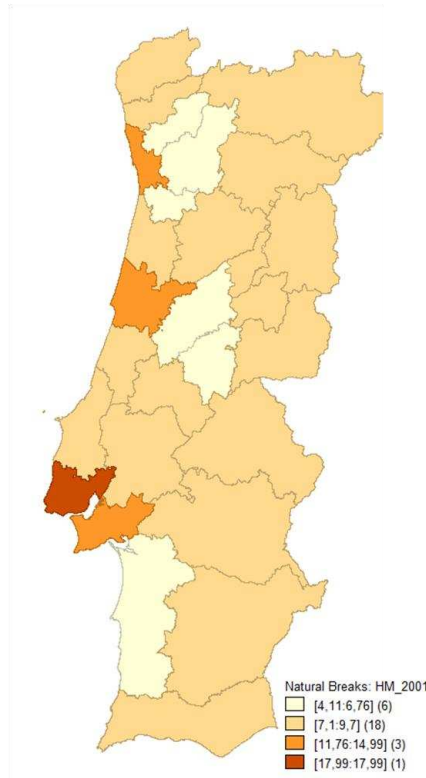


Figure 2: Percentage of the population with higher education in 2001

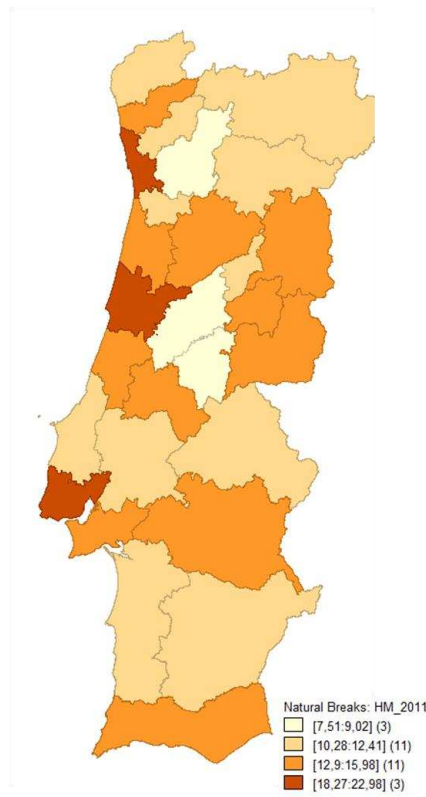


Figure 3: Percentage of the population with higher education in 2011

In general terms, the Portuguese population, especially in the period 1991-2001, registered a significant increase in terms of higher education, and in more specific terms, i.e. in certain regions and notably in the period 2001-2011.⁶ This increase, could represent regional harmonization, as the three major University clusters around Lisbon, Porto and Coimbra stand out clearly in the figures. This process will be studied in the following section.

3. THE PROCESS OF SPATIAL CONVERGENCE

The spatial convergence process of the population rates with higher education – understood as an approximation of the values for these proportions – will be studied using standard spatial econometrics methodology, i.e. by comparing the values recorded for each geographical unit, in this case NUTs 3, with the values recorded for neighbouring geographical units (Guerreiro & Caleiro, 2012). Traditionally, neighbourhood relationships are defined through a spatial weights matrix in which, for example, a weight is 0 if geographical units do not share a common border (or at least one point) and 1 otherwise. More recently (and more appropriately) this dichotomy has been replaced by the consideration that spatial weights are, for example, an inverse function of the geographical distance between geographical units, or more specifically, between their centroids (Chen, 2013).

The largest towns being considered the centroids of NUTs 3 (according to the number of inhabitants), the matrix of distances between the centroids of the NUTS 3 of mainland Portugal can be observed in Figure 4.

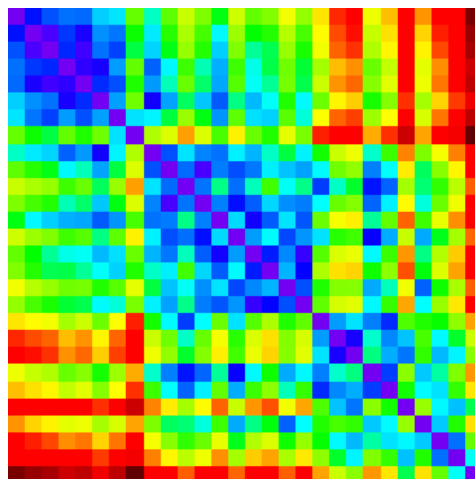


Figure 4: Matrix of the distance in kilometres between NUTs

⁶ This increase in values implied that, for the sake of comparability in the two periods under analysis, standardisation was performed (Chen, 2013).

In order to check how observations have evolved, it is important to distinguish a possible local convergence process between one NUT and its neighbouring NUTs and another possible regional one, between the NUT and its neighbouring NUTs and the national average. Four quadrants can then be distinguished: (NE: NUT and neighbours above the national average; NW: NUT below national average and neighbours above national average; SW: NUT and neighbours below national average; SE: NUT above national average and neighbours below national average).

Nevertheless, it is important to check the location in the 4 quadrants, and whether that location has changed to another quadrant, possibly towards the bisecting line (indicating a local approach) and/or towards the origin (indicating a regional convergence).⁷

Application of this methodology produced the results shown in Figures 5 and 6.⁸

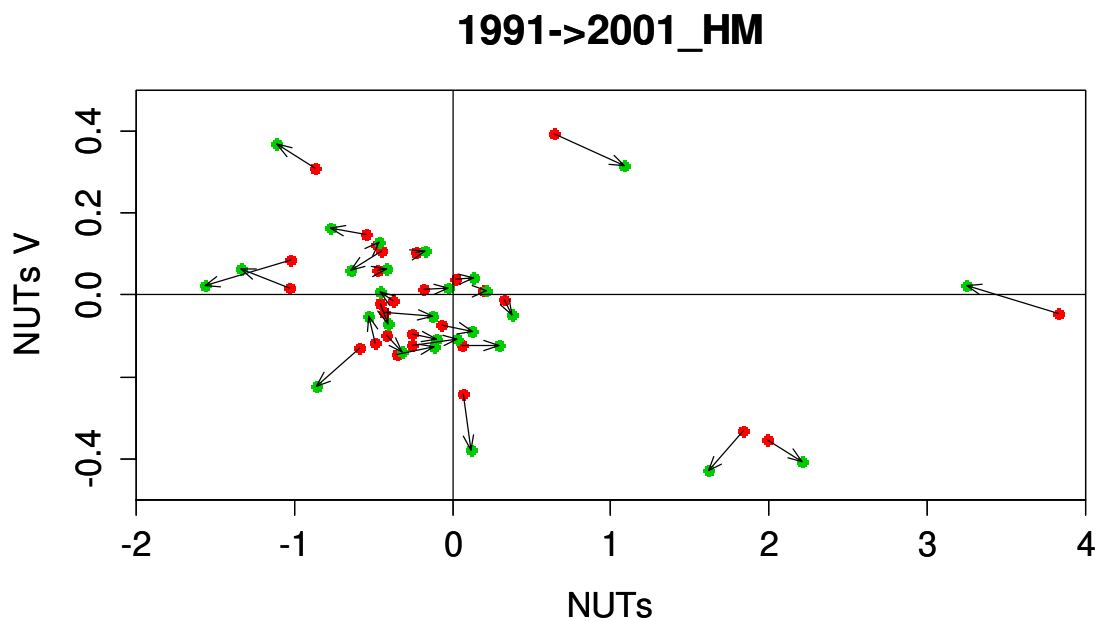


Figure 5: Spatial convergence process between 1991 and 2001

⁷ It should be noted that as the data is standardized, the national average coincides with the value 0.

⁸ The figures were produced using the arrows command of the R graphics package.

2001->2011_HM

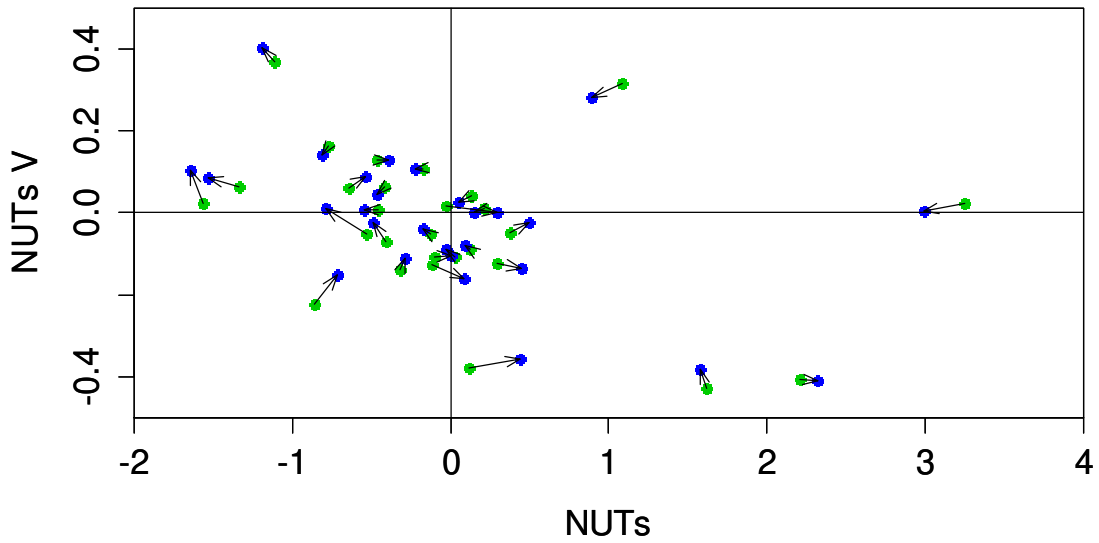


Figure 6: Spatial convergence process between 2001 and 2011

As Figures 5 and 6 clearly identify, there was some 'movement' in the period 1991-2001, but of very little significance in terms of changes in positions in the quadrants, this being even more evident in the period 2001-2011.

The movements between the quadrants of the spatial autocorrelation scatter plot in the periods 1991-2001 and 2001-2011 can be found, respectively, in Tables 1 and 2, and in Figures 7 and 8.

Table 1: Location movements by quadrants (1991-2001)

From\To	NE_1	NW_2	SW_3	SE_4
NE_1	3	0	0	0
NW_2	0	9	0	0
SW_2	0	1	7	2
SE_4	1	0	0	5

Table 2: Location movements by quadrants (1991-2001)

From\To	NE_1	NW_2	SW_3	SE_4
NE_1	4	0	0	0
NW_2	1	9	0	0
SW_2	0	1	4	2
SE_4	0	0	1	6

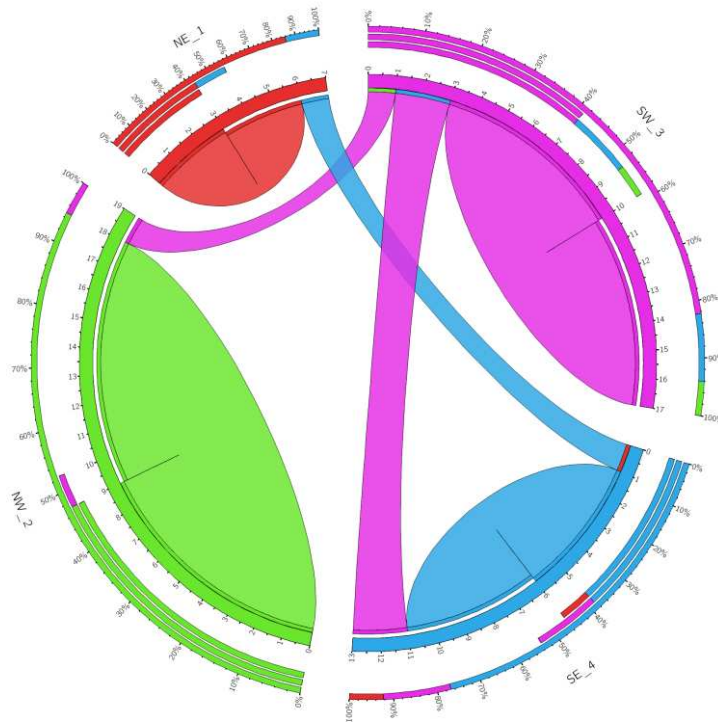


Figure 7: Movement between quadrants in the period 1991-2001⁹

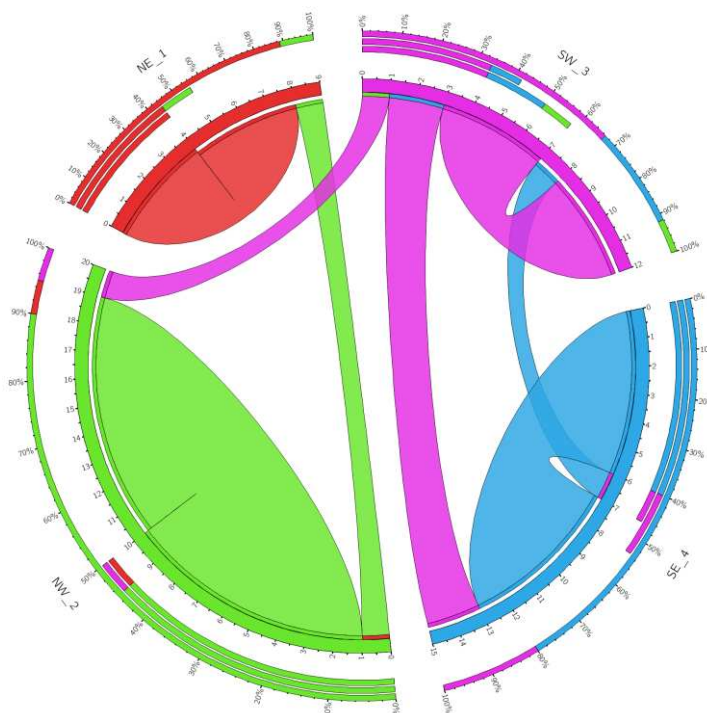


Figure 8: Movement between quadrants in the period 2001-2011

⁹ Figures 7 and 8 were produced with recourse to online CIRCOS. <http://mkweb.bcgsc.ca/tableviewer/visualize/>.

The possibility of discriminating by gender shows that, despite the male population indicating characteristics of greater mobility, the convergence process (in the period 2001-2011) did not alter significantly the relative position of the various NUTs concerning the proportion of their population with higher education.

4. CONCLUSION

According to many economic indicators, Portugal is known to be a country with regional inequalities, and this is also apparently true regarding the location of its most skilled human resources.

The main objective of this paper is therefore to analyze the spatial convergence of knowledge through studying the evolution of the percentage of population with higher education in the periods elapsed between the last three censuses in Portugal, i.e. between 1991-2001 and 2001-2011. Indeed, the Portuguese population registered, in general terms especially in the 1991-2001 period, a significant increase in terms of higher education, and more specifically, i.e., in some regions, particularly in the period 2001-2011.

This paper showed that, despite qualifications, measured by the percentage of the resident population with higher education, having risen considerably (from 1991 to 2011), in Portugal, the process of regional convergence (of knowledge) was of (very) little significance.

As for the implications of that result, it casts some doubt on the results of alleged territorial cohesion policies. It is known that the lower the starting level of inequality, the easier it is to reach the convergence process (Caleiro, 2009). From this point of view, in terms of policy lessons, it becomes urgent to resort to measures that indeed contribute to reversing the (spatial) divergence process which obviously characterizes Portugal.

Regarding potential avenues for new analysis, it seems important to consider other variables that are also attributable to the potential effects of possessing a certain level of knowledge, for example, productivity levels or unemployment rates (differentiated by level of education).

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Annexes

Table 3: Percentage of the resident population with higher education

	HM_1991	HM_2001	H_2001	M_2001	HM_2011	H_2011	M_2011
Minho-Lima	1.29	7.45	6.57	8.22	11.36	9.81	12.72
Cávado	1.89	8.95	7.81	10.02	14.47	12.42	16.37
Ave	1.14	6.14	5.23	7.01	10.60	8.95	12.14
Grande Porto	3.92	13.28	12.41	14.08	18.27	16.74	19.64
Tâmega	0.64	4.11	3.26	4.93	7.51	5.92	9.02
Entre Douro e Vouga	1.30	6.76	5.70	7.78	11.20	9.36	12.92
Douro	1.33	7.71	6.61	8.74	12.03	10.20	13.71
Alto Trás-os-Montes	1.31	8.25	6.66	9.76	12.41	9.96	14.67
Baixo Vouga	2.18	9.70	8.59	10.73	14.64	12.66	16.46
Baixo Mondego	4.09	14.99	13.83	16.03	20.74	18.72	22.55
Pinhal Litoral	1.60	8.55	7.15	9.87	13.98	11.69	16.12
Pinhal Interior Norte	0.81	5.43	4.48	6.32	9.02	7.40	10.49
Dão-Lafões	1.52	8.32	7.13	9.42	13.01	11.13	14.70
Pinhal Interior Sul	0.63	4.76	4.23	5.24	7.90	6.58	9.10
Serra da Estrela	1.25	7.10	5.96	8.15	10.36	8.71	11.83
Beira Interior Norte	1.52	8.71	7.26	10.03	12.90	10.53	15.04
Beira Interior Sul	1.88	9.46	8.46	10.39	14.48	12.63	16.15
Cova da Beira	1.41	8.29	7.32	9.19	13.29	11.47	14.96
Oeste	1.26	7.28	6.14	8.38	11.68	9.70	13.53
Grande Lisboa	6.20	17.99	17.74	18.22	22.98	21.80	24.03
Península de Setúbal	2.55	11.76	10.69	12.77	15.98	14.26	17.55
Médio Tejo	1.73	8.98	7.84	10.04	13.31	11.33	15.10
Lezíria do Tejo	1.55	8.12	7.02	9.17	12.24	10.26	14.08
Alentejo Litoral	1.18	6.40	5.21	7.59	10.28	8.34	12.19
Alto Alentejo	1.38	7.30	6.43	8.12	11.18	9.53	12.71
Alentejo Central	1.83	9.00	7.77	10.15	13.17	11.09	15.09
Baixo Alentejo	1.27	7.42	5.83	8.98	11.45	9.21	13.59
Algarve	2.04	9.24	8.12	10.33	13.50	11.35	15.54



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Figure 9: Map of Portuguese NUTS 3