Regional growth and local convergence: Evidence for Portugal.

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Abstract:
It is widely known that regional disparities do not lead to economic growth. By this, it is meant that convergence among regions might be responsible for a propensity to national growth. In the same way, if there is a sub regional division (with different economic realities) the same phenomenon should be verified. Thus, sub-regional convergence should lead to regional growth. This regional desegregation of space (in political terms) varies from country to country.

In the Portuguese case, one of the most accepted divisions is made by NUTs, with three level of desegregation. Level 3 NUTs are still desegregated into municipalities (which are a smaller portion of space that usually share the same economic and social reality). The theoretical study of convergence relies on the use of a few measures. One of the best known is the β convergence: conditional and unconditional. The conclusions obtained in a previous study (by the same author) showed that conditional convergence improves the results for the convergence study. This measure estimates convergence as a function of per capita GDP (in purchasing power parity) and a battery of exogenous variables that contain information about technological level, industrial structure, human capital qualification, social conditions, etc. In order to attain information for this battery of exogenous variables it is used a proxy variable, which is the Human Development Index (HDI). This variable is published by UNDP every year and allows the international comparison of living conditions between countries. The Portuguese government uses the same approach to calculate a HDI for all municipalities. The estimation of conditional β convergence is made by a non-linear model regression, which is widely used in the theoretical economic study of convergence. Besides this estimation, other forms of regional convergence study will be applied, permitting a deeper analysis. The aim of this work is to estimate convergence in terms of Portuguese NUTs and to verify whether it is true that regions with higher convergence velocity rate also experiment higher growth rates. If this is true, this could constitute a policy opportunity, since governments should stimulate regional convergence, in order to attain national economic growth.

Keywords: Economic convergence; Regional clusters; Regional policy.

1. Introduction

Nowadays, the economic convergence is an issue that is occupying a lot of the economic research community, mainly in Europe. One of the most important questions around the European enlargement is the economic convergence. However, in order to have a sustainable growth in the European countries, it is necessary that one can assist to economic convergence between countries, and also within countries.

There is a large amount of literature in favour of regional convergence to attain greater national growth, but until recently, the economic success of a region was largely a reflection of the success of its country's economic policy. With the introduction of Euro, the question is not as it used to be. So the greater emphasis on regional policy is an opportunity to better develop national economic conditions. Rees and Sonnenhozner (2000) agree that competition among regions is likely to increasingly replace competition among individual countries [in European Union], and that good regional policy will be rewarded with capital spending to a larger extent than ever, while bad policy will be punished by an exodus of capital.

This constitutes a great argument in favour of the thesis that regional growth should be stimulated, as much as regional convergence. This article addresses this question to the promotion of regional clusters as a way to promote convergence among regions, due to the production specialization of production in sectors (industries) where the region has a competitive advantage.

The approaches adopted in the New Economic Geography suggest that, under certain circumstances, activity concentration will take place and stimulate growth. Most of the location theories assume fairly explicitly that activity agglomeration causes – or at least contributes significantly to - local economic growth. However, most of them do not take into consideration the existence of spillovers or external economies of scale.

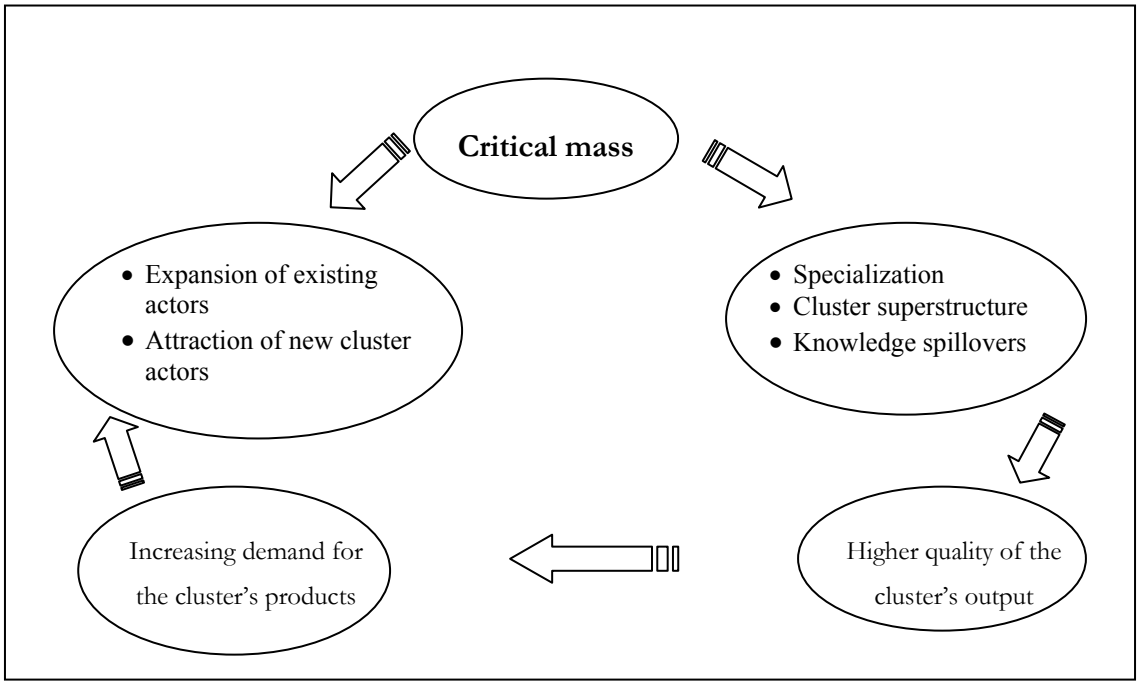
According to Nel and Makuwaza (2001, p. 4), Weber (1929, pp. 134-135) was the first location theorist to discuss agglomeration explicitly. They summarise his contribution as follows:

"He suggested that agglomeration ***economies*** *determine the favoured location only when the two main factors, transport orientations (minimum transport costs) and labour orientation (low labour costs sites) are not dominant. Hence, if transportation considerations result in industries concentrating close to raw materials supplies or markets, this does not represent agglomeration* [... in his theoretical terms]. *In a nutshell, Weber's point was that it would prove to be profitable for two or more firms to cluster at the same site if the agglomeration*

economies *gained there exceeded the additional transport costs incurred as a result of deviation from the minimum transport cost site"*

However, base-multiplier analysis creates an explicit path for growth, since the concentration of economic activity may be responsible for the creation of a virtuous cycle of growth. According to Ottaviano and Puga (1997), NEG-based models clearly assume that concentration leads to growth, on the basis that concentration is motivated by the existence of pecuniary externalities. Van den Berg (2000) describes this phenomenon and its effects by way of the figure presented below, with an explicit and important role for the achievement of critical mass:

Figure 1:The "virtuous cycle" of a cluster development



Source: Van den Berg (2000)

However, in examining the assertion that agglomeration leads to growth, one is inevitably drawn to Perroux's concept of the growth pole. His argument is that, if there are linkages between firms, then the region will surely experience growth. This is made on the assumption that firms source, sell and reinvest locally, and the owners and employees consume locally too. This is valid only for a closed economy or one that is "open" only to individual final consumers outside the region, otherwise, there is a possibility that interregional transactions between firms with differing "business power" could cause wealth

to leak out of the regional economy.

Nel and Makuwaza (2001) also refer to his contribution, calling attention to the fact that leader or propulsive industries, i.e. those that typically are of large dimensions, with substantial market power, and are leaders in innovation, are important in understanding economic growth. The ability of firms to generate innovation, which leads to growth, is dependent on the quantity, but perhaps more importantly on the *quality* of network relationships.

The concept of economies of scale is an important help for the understanding of growth mechanism attached to clusters. This is also an argument in favour of divergence. In some extent, economies of scale are needed and thus economic activity should be restricted to a specific geographic area.

2. Theoretical contributes on economic convergence

The (regional) economic convergence measure can be done using some methods, largely used on scientific literature. However, firstly it is expected some explanation on the meaning of real and nominal convergence. Real convergence is the term describing the process or tendency of countries / regions involved towards greater similarity or equality of real variables of the economies, while nominal convergence is about meeting certain criteria that refer to the nominal variables reflecting macroeconomic stability.

The Sigma convergence uses information about per capita GDP (pcGDP), based on the variance of a cross-section series. Thus the lower the value of pcGDP variance, stronger is the evidence of economic convergence. This ratio may also be weighted by the mean of pcGDP. The values obtained for σ convergence indicate convergence as they tend to zero.

$$\sigma = \frac{\text{var}(gdp_i)}{\text{var}(gdp_0)} \qquad \text{or} \qquad \sigma = \frac{Var(gdp_i) \,/\, mean(gdp_i)}{\text{var}(gdp_o) \,/\, mean(gdp_0)}$$

It is recommended that the second estimation is done since it is weighted by the mean of pcGDP. The use of this measure enables a analysis that is not unbiased by the level of wealth of the region. In this paper it will be always used the σ convergence weighted by the mean of pcGDP.

The neoclassical approach refers to the convergence issue in a less simplistic

mathematical way. The convergence velocity is obtained by a non linear regression model. The estimation of the per capita GDP growth is calculated in function of the initial level of per capita GDP. This is also known as β convergence. The theoretical model is as follows:

$$\frac{1}{T} Log\left(\frac{Y_{it}}{Y_{i0}}\right) = \alpha - \frac{1}{T}(1 - e^{-\beta.T}).Log\, Y_{i0} + \gamma\, X_{it} + u_{it}$$

where: Y_{it} is the GDP of region *i* in *t* period; X_{it} is a set of exogenous variables that might influence the pcGDP; T is the time period; α is the independent term, which is influenced by the technological development rate and β is the convergence term and gives information about the convergence rate or the convergence velocity. The β convergence refers to the negative correlation existing between the initial values of per capita GDP and its growth rate. This means that the poorest countries /regions tend to grow faster than richest ones. The β convergence is a necessary, but not sufficient condition for the existence of convergence. The β convergence is also (obviously) necessary but not sufficient condition for the existence of σ convergence (being the opposite not necessarily true). This means that one can find β convergence without finding σ convergence, however, the existence of β convergence should tend to generate σ convergence.

Based on this model, the neoclassical theory makes a clear distinction, of what convergence is concerned. When one is studying convergence among regions with significant structural economic differences, β is estimated considering X_{it} in the model, which is expected to influence the per capita GDP growth rate. This is the so-called conditional convergence. On the other hand, there are cases where regions converge to the same terminal point - steady state – and one is not assuming that there is significant structural differences. These differences are related with technological development, industrial organization, human capital qualification, and other structural factors, such as social living conditions. In this case, the estimation does not consider the X_{it} variable. This type of convergence is usually called as unconditional convergence and the estimated model is as follows:

$$\frac{1}{T} Log\left(\frac{Y_{it}}{Y_{i0}}\right) = \alpha - \frac{1}{T}(1 - e^{-\beta.T}).Log\, Y_{i0} + u_{it}$$

3. Empirical evidence for Portuguese regions

3.1 Data

The data used was provided by the Departamento de Planemanento e Prospectiva (DPP), and includes information for the period 1970-2001. The availability of data was for the years: 1970; 1981; 1991, 1995; 1997; 1999 and 2001. The years within the periods, for which the data was not available were estimated using a annual average growth rate.

The Portuguese economic data system usually uses a division by NUT's (3 levels), which are homogeneous territorial units. NUT's level I correspond to the biggest territorial area and NUT's level III is the most disaggregated approach. The data used in this article refers to all the NUT's (in 3 levels) and to all the Portuguese municipalities, which constitute an administrative and political local division.

In the estimation process there were two key variables:

- GDP Index (GDPI): This index measures the real per capita GDP and is calculated by the relation: $\frac{observedvalue - \min value}{\max value - \min value}$. The decision of including an index as a value for pcGDP variable is related to the data provision. The database did not included values for real pcGDP so, in order to be sure that there were no data collection differences, the GDPI was the choosen variable.
- Human Development Index (HDI), which aggregates information about education, life expectancy; comfort and income.

As the variables are both constructed as an index, there was no need for standardization, since they belong to the same scale.

3.2 Methodology

The first step in this study was the decision to calculate the values for the variables corresponding to the years that were missing. This option seemed to be better than estimating convergence for years in a non-regular annual basis. The convergence velocity was only estimated for NUT's level 3.

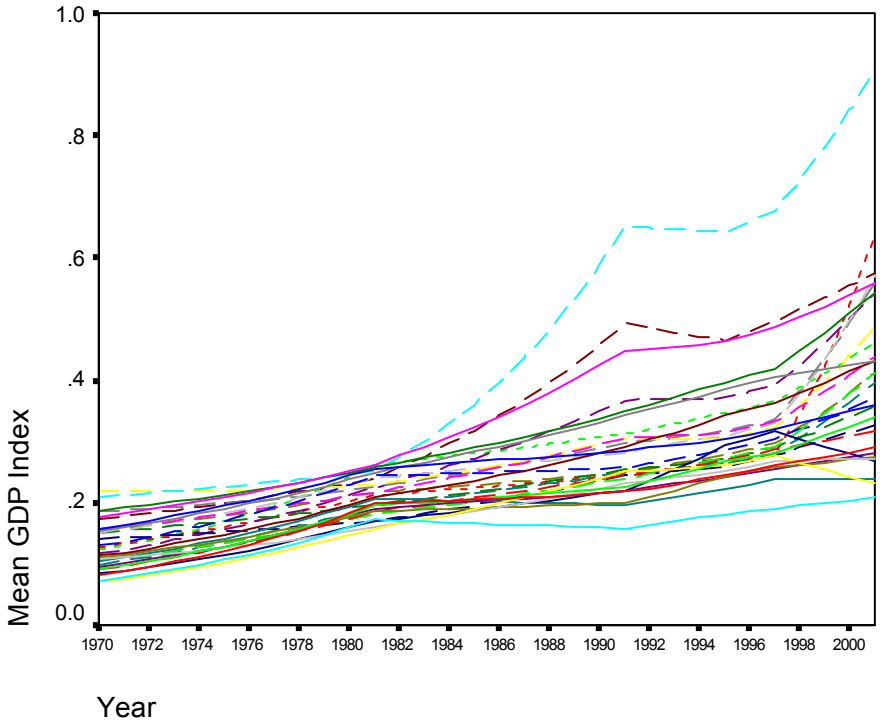
The results were obtained by non-linear least squares, using the Levenberg-Marquardt method, which is an algorithm that uses the method of steepest descent to determine the step size when the results are far from the minimum. The software was asked

to stop iterations when the sum of squares convergence was 1^{-8}.

3.3 Results

Before the estimation of convergence the GDPI and HDI were plotted to find some possible evidence in a very general way. The results are presented in the next two figures:

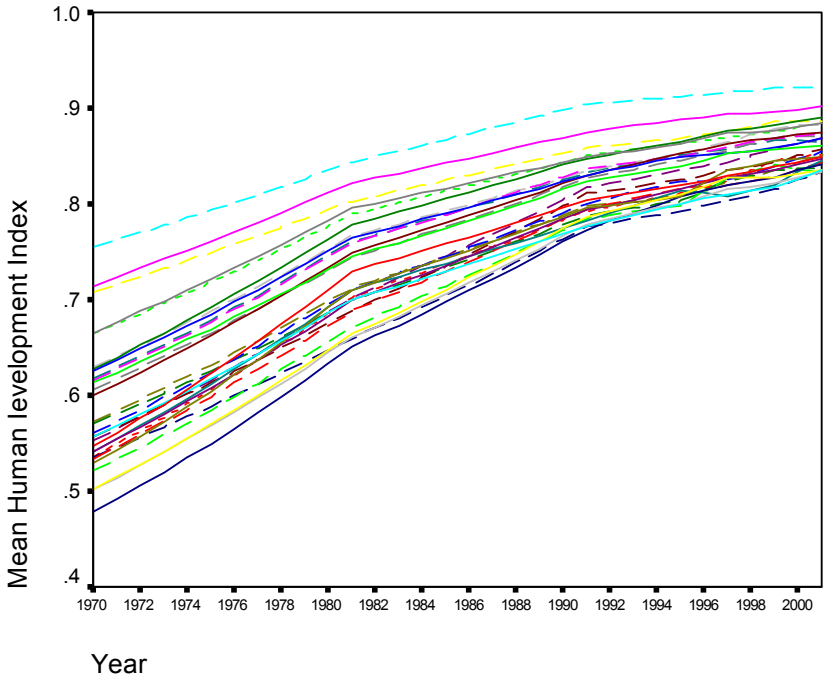
Figure 1: GDP Index for Portuguese NUT's 1971-2001



The graphic shows clear evidence that 1981 is the beginning of a new period for pcGDP in Portugal. In fact, after this year, regions demonstrate high differences in terms of pcGDP growth rate.

This is why it was made a second estimation of convergence for the period above referred, using conditional convergence since it provides mores explanation power. Estimation results show that after 1981 convergence occurred at 6.82% while it has been much lower in the period 1971- 2001 (4.87%). The results above referred are based on the calculation of β conditional convergence. This fact leads us to think that convergence might have been higher due to the evolution of human development index, and this is shown in next figure.

Figure 2: Human Development Index for Portuguese NUT's 1971-2001



This growth tendency and convergence between regions might be a result of the structural European funds. According to this point, also Solanes and Maria-Dolores (2001) estimated the impact of European Structural Funds on economic convergence. The conclusions obtained show that Structural funds contributed to long-run general convergence by gradually modifying the structural parameters. More important is that, these authors concluded that funds improved regional equilibrium and economic welfare. This means that the aim of diminishing economic disparities among regions in Europe was achieved, mostly on the basis of living conditions, rather then only based on economic indicators such as GDP. After having drawn these preliminary conclusions we are, now, in conditions of calculating the convergence results as shown in the next table:

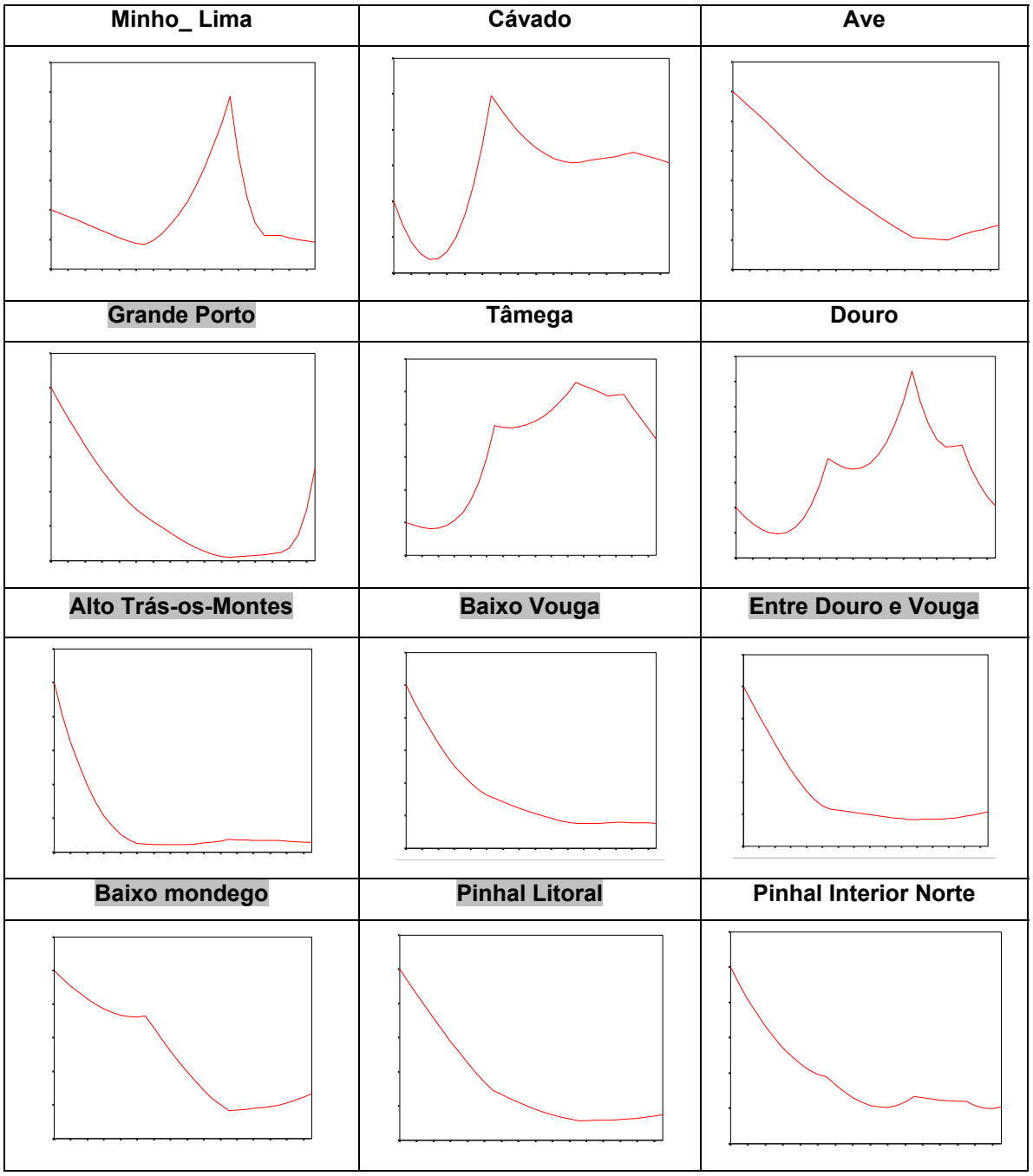
Table 1: Results for convergence in NUT's III for Portugal

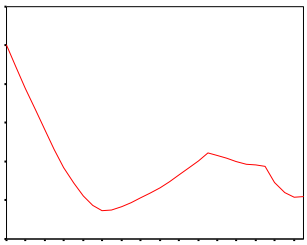
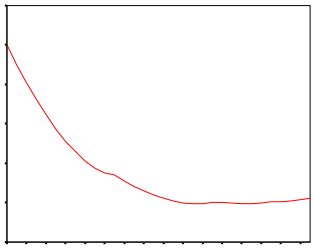
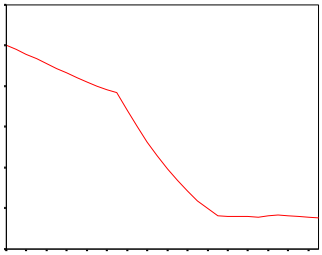
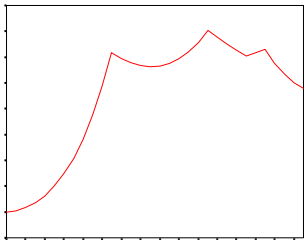
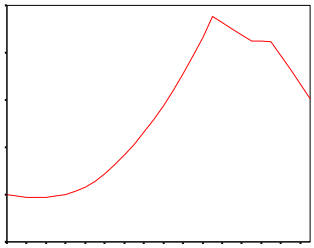
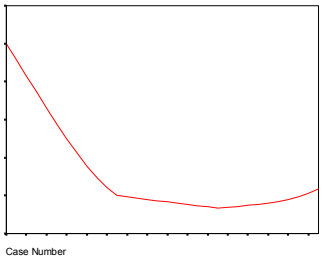
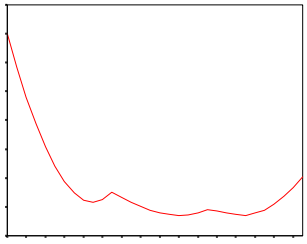
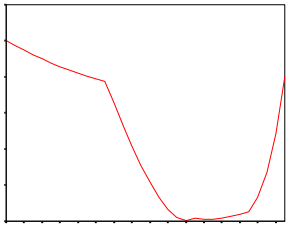
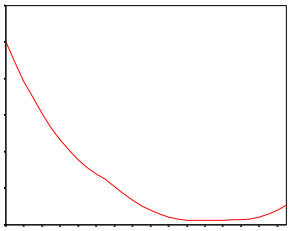
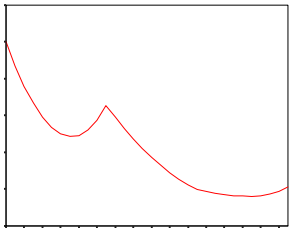
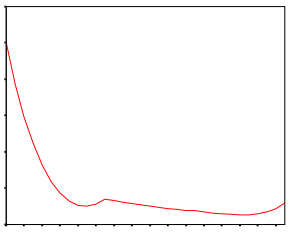
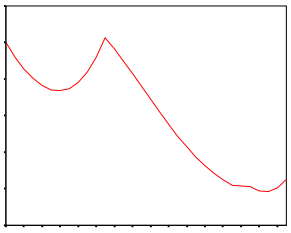
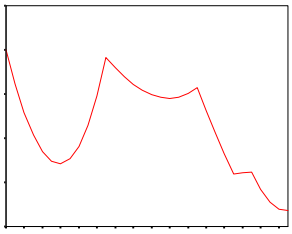
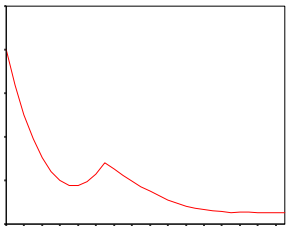
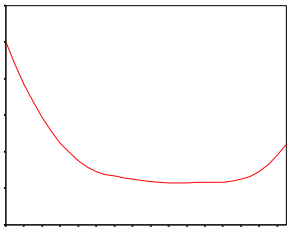
		1970-2001				1981-2001	
	Sigma Convergence	Conditional Beta Convergence		Unconditional Beta Convergence		Conditional Beta Convergence	
NUT III		β	R^2	β	R^2	β	R^2
Minho Lima	3.03	4.63%	0.384	2.89%	0.316	6.64%	0.742
Cávado	2.91	6.37%	0.671	2.64%	0.242	9.12%	0.949
Ave	0.82	6.28%	0.634	2.53%	0.490	11.71%	0.929
Grande Porto	0.91	7.06%	0.763	2.58%	0.427	10.72%	0.943
Tâmega	4.05	5.60%	0.433	3.08%	0.254	9.20%	0.827
Douro	8.79	4.78%	0.317	1.84%	0.144	9.84%	0.853
Alto Trás-os-Montes	0.49	6.81%	0.760	3.12%	0.463	9.36%	0.931
Baixo Vouga	0.80	6.50%	0.698	2.68%	0.411	8.91%	0.890
Baixo Mondego	1.27	5.65%	0.623	2.16%	0.348	7.82%	0.902
Pinhal Litoral	0.66	6.16%	0.741	3.06%	0.590	7.72%	0.903
Pinhal Interior Norte	0.90	5.67%	0.691	2.80%	0.435	7.71%	0.920
Pinhal Interior Sul	6.21	4.32%	0.350	1.77%	0.164	6.32%	0.834
Dão-Lafões	1.45	4.57%	0.447	2.73%	0.375	6.73%	0.867
Serra da Estrela	1.35	4.45%	0.374	2.77%	0.339	5.47%	0.876
Beira Interior Norte	8.17	4.01%	0.191	1.48%	0.081	6.53%	0.612
Beira Interior Sul	6.98	5.56%	0.597	1.28%	0.089	8.58%	0.882
Cova da Beira	0.72	4.96%	0.502	3.06%	0.457	8.46%	0.871
Oeste	2.17	6.04%	0.632	1.58%	0.188	8.58%	0.804
Grande Lisboa	2.31	4.54%	0.814	1.03%	0.088	7.98%	0.873
Península Setúbal	0.36	4.33%	0.721	2.61%	0.457	6.17%	0.876
Médio Tejo	1.19	6.46%	0.624	2.91%	0.395	8.83%	0.819
Lezíria do Tejo	1.04	6.79%	0.765	2.61%	0.316	7.82%	0.822
Alentejo Litoral	3.11	4.93%	0.659	1.40%	0.143	6.30%	0.748
Alto Alentejo	2.84	2.89%	0.478	1.26%	0.136	3.35%	0.574
Alentejo Central	0.96	6.54%	0.693	2.21%	0.276	8.37%	0.823
Baixo Alentejo	0.95	4.29%	0.617	1.96%	0.325	5.11%	0.722
Algarve	3.69	3.44%	0.353	0.99%	0.089	5.39%	0.770
R. A. dos Açores	5.76	3.36%	0.229	1.45%	0.130	5.31%	0.672
R. A. da Madeira	3.98	2.47%	0.239	1.35%	0.183	2.15%	0.341
Entre Douro e Vouga	0.65	6.19%	0.603	3.38%	0.463	9.56%	0.931
Overral territory	1.36	4.87%	0.569	2.51%	0.363	6.82%	0.76142

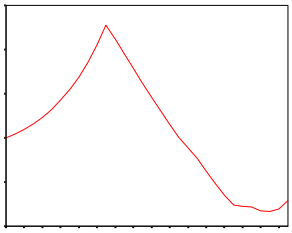
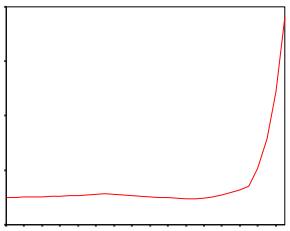
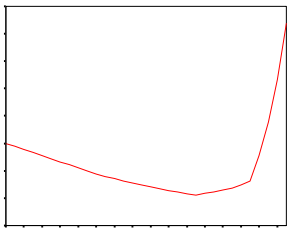
The first column shows σ convergence calculated on a region basis. The results show the variation that pcGDP verified on every region for the global period. However, these results do not show the evolution of σ convergence, since it is based on the variance among

regions and the variance among years. Thus, the values obtained for the first column represent a global value for σ convergence for that region, just providing a picture of a cross-variance (among municipalities and over time) within the NUT. In order to have a better picture of the evolution of σ convergence figure 3 shows its evolution for the period under consideration (1971-2001).

Figure 3: Evolution of σ convergence in Portuguese NUTs

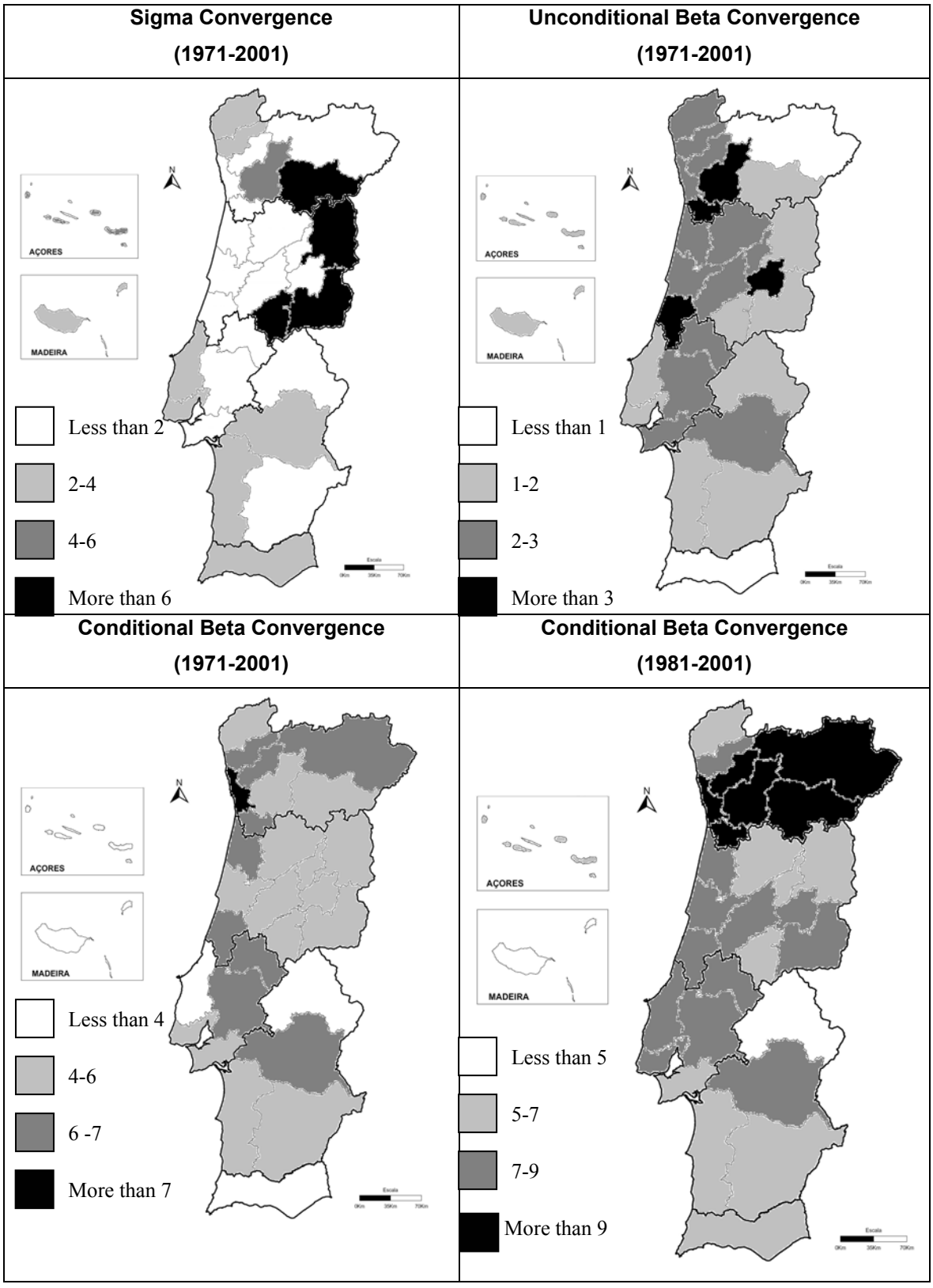


Pinhal Interior Sul	Dão Lafões	Serra da Estrela
		
Beira Interior Norte	**Beira Interior Sul**	**Cova da Beira**
		
Oeste	**Grande Lisboa**	**Peninsula de Setúbal**
		
Médio Tejo	**Leziria do Tejo**	**Alentejo Litoral**
		
Alto Alentejo	**Alentejo Central**	**Baixo Alentejo**
		

Algarve	R. A. Açores	R.A. Madeira
		

The results obtained in table 1 can be mapped as one can see bellow, for a better picture of the results.

Figure 4: Mapping convergence for Portugal



The table one shows two strong evidences: the first one is that, including the variable HDI improves the model with regard to R^2 values and the second is that, different approaches on the measure of convergence produces different results. However, there are still some conclusions to be drawn and some regions that show convergence in all approaches.

If one tries to construct a top 10 table with regard to NUTs convergence, one will find most certainly some coincidences. The empirical results show that the NUT's with greater convergence tendency (combining all approaches) are: Ave; Grande Porto; Douro; Entre Douro e Vouga; Alto Trás-os-Montes; Tâmega; Cávado; Baixo Vouga; Médio Tejo and Oeste. In order to better understand the Geographical location of regions, a map is available in Appendix I. It is also important to note that a strong emphasis was putted on the convergence study for the period 1981-2001 since it better represents the actual situation of Portuguese regional disparities.

A Study developed by Silva (2002) identified the main industrial districts for Portugal. This information might be useful to verify whether NUT's with greater tendency to internally converge do, in fact, have also greater production specialization. In order to do so, Silva used 4 variables: industrialization rate; manufacturing specialization coefficient; density of employment in small and medium firms and industrial agglomeration index. The output generated 16 industrial districts (municipalities) as shown in next table:

Table 2: Industrial Districts in Portuguese Municipalities

Municipality	**NUT III**
Águeda	Baixo Vouga
Feira	Entre Douro e Vouga
Oliveira de Azemeis	Entre Douro e Vouga
Barcelos	Cávado
Guimarães	Ave
Vila Nova de Famalicão	Ave
Covilhã	Cova da Beira
Alcobaça	Oeste
Marinha Grande	Pinhal Litoral
Felgueiras	Tâmega
Lousada	Tâmega
Santo Tirso	Ave
Alcanena	Médio Tejo
S.J. Madeira	Entre Douro e Vouga
Paços de Ferreira	Tâmega
Paredes	Tâmega

Source: Silva (2002)

As the results show, there is strong evidence that regions with production specialization municipalities do achieve higher convergence rates.

The above referred nuts, according to initial assumptions are expected to converge more, not only internally, but also in the whole. After estimating once again conditional convergence one can verify that this group converged on a 59% basis, while all the other nuts (without production specialized municipalities) only converged at a 47% rate.

However there is still some considerations to make about this issue.

1. Silva's study only took into consideration manufacturing industries. However it does not seem to exist significant differences between the effects of a manufacturing cluster and a non-manufacturing one. The inclusion of non-manufacturing clusters should increase the quality of the analysis, since it is assumed that those clusters would also have positive externalities and spillovers. Thus it is possible that there are still some areas, with non-manufacturing industries agglomeration, which were not included in the analysis.
2. NUTs with higher convergence rate were identified with the existence of only a few municipalities with specialization of production. However, in some cases, NUT's are formed by a larger number of municipalities. This fact indicates the strong possibility of a spreading effect on the neighbourhood by the local clusters.
3. Related with the previous point, it is still possible that the spillovers generated by a cluster go beyond the administrative frontier of the NUT, spreading its effects outside of it.
4. The results do not evidence the tourism cluster in Algarve nor there is evidence of greater convergence. The existence of this agglomeration is common sense thus seeming contradictory. This fact raises a question: may only manufacturing industries be sources of convergence?
5. The assumption that industrial districts (or regional production specialization) leads to higher rates of productivity might be useful to conclude that the convergence found in those regions derive from higher productivity rather than the existence of potential clusters.
6. Some regions found convergence by the lack of productivity. This means that some NUTs have great homogeneity of low productive municipalities, verifying convergence within the NUT but not with productive NUTs.

It is also common sense that Lisboa e Vale do Tejo do have a great concentration of automobile industry, and, once again, it is not visible in the results. In fact, the question raised here is whether the cluster identification should be done via relative weight of firms in the region or by absolute number of firms (also true for any other variable). The argument that clusters lead to growth rely mostly on the basis that it generates pecuniary externalities and thus, growth. If the number of firms does not achieves the minimum for the existence of critical mass, mentioned earlier on this paper, it might not be possible the existence of positive externalities. The fact that the number of firms in some sector represents a large and important share of firms in that region does not guarantee that there is enough critical mass to encourage growth and promote innovation. What enables regions to grow is the amount of (successful and productive) linkages between firms. As the absolute number of firms grows, the probability of generating interesting links grows too. This suggests that it is more important to know the absolute number of firms rather than to know what share in the region those firms represent. This issue could constitute a basis for further research, as much as what are the determinants of the critical mass. By this it is meant that it should be a level beyond which, clusters are able to produce benefits for the economy. But what determines this level? Is it the number of firms, or value added? Does this point vary across regions, industries or economic characteristics?

4. Conclusions

After the estimation work and the results discussion there are a few points that apparently drawn to important questions.

The first evidence is that in the Portuguese case, the clustering phenomenon leads to growth and convergence within the regions and between the regions. This fact proves that clusters generate mechanisms of equal growth and living conditions.

However the cluster tendency should be studied among all industries no matter they are manufacturing or not. The existing stylised studies do, mostly, only rely on manufacturing industries when they are trying to evidence clusters. However, all the industries are able to generate linkages and positive relationships between firms, enhancing and reinforcing innovation. If the number and quality of relationships is the most important variable in the determination of a cluster it is not its relative size on the regions that determines the importance of the cluster and the tendency for growth. Thus clustering studies

should be done on a basis of absolute values for the number of firms, and the determination of the critical mass.

After all these considerations, the clustering of activity is likely to constitute a goal on regional policy with great returns, since it promotes growth and internal convergence. As it also promotes convergence between regions, it should be developed as a national policy goal too.

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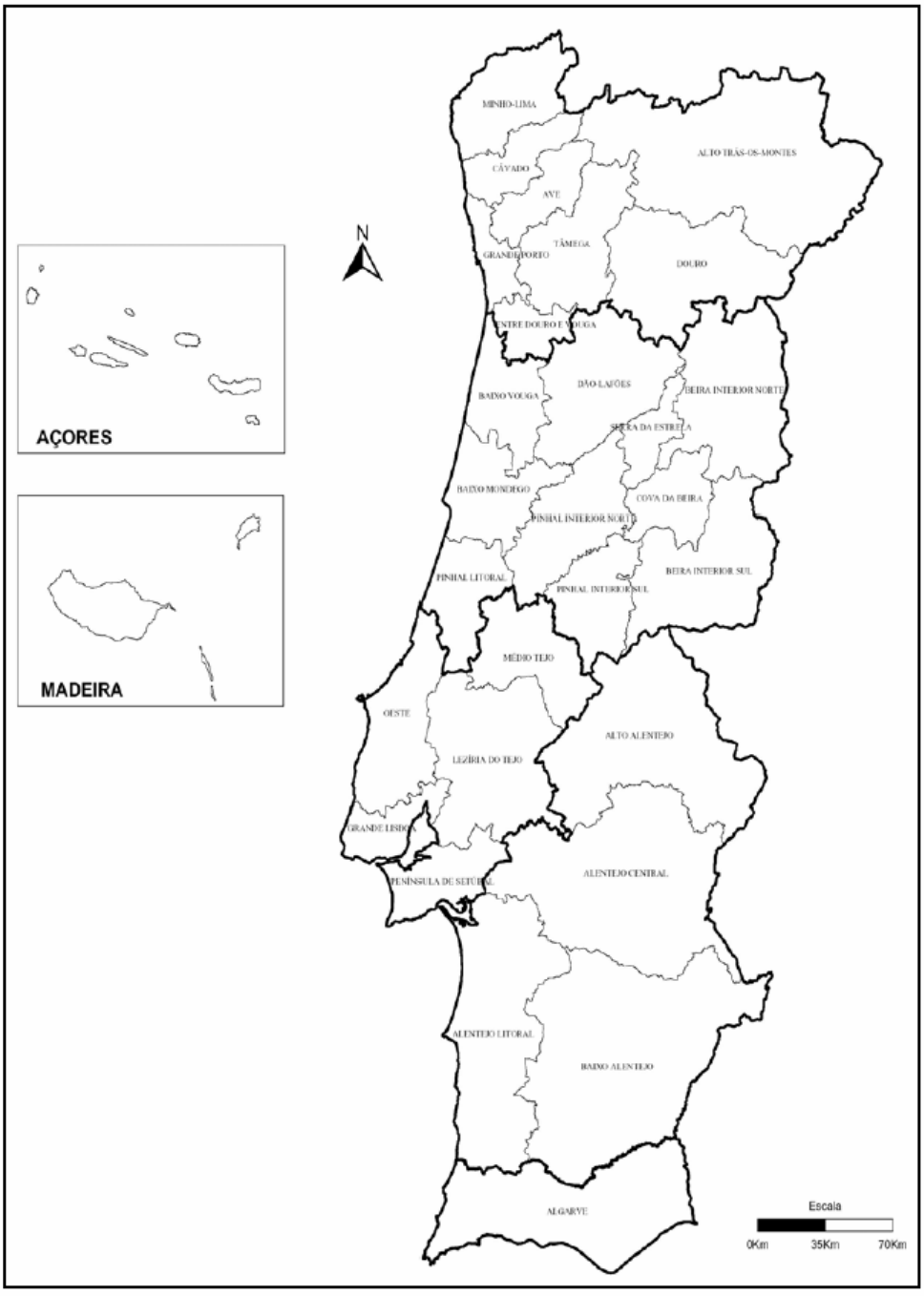
Appendix 1

Figure 5: Portuguese division by NUT III



Source: http://www.dpp.pt