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2011

WHAT SAID THE NEW ECONOMIC GEOGRAPHY ABOUT PORTUGAL? AN ALTERNATIVE APPROACH

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ABSTRACT

With this work we try to analyse the agglomeration process in Portugal, using the New Economic Geography models, in a linear and in a non linear way. In a non linear way, of referring, as summary conclusion, that with this work the existence of increasing returns to scale and low transport cost, in the Portuguese regions, was proven and, because this, the existence of agglomeration in Portugal. We pretend, also, in a linear way to explain the complementarily of clustering models, associated with the New Economic Geography, and polarization associated with the Keynesian tradition. As a summary conclusion, we can say which the agglomeration process shows some signs of concentration in Lisboa e Vale do Tejo and the productivity factor significantly improves the results that explain the regional clustering in Portugal. The aim of this paper is to analyze, yet, the relationship between the regional industry clustering and the demand for labor by companies in Portugal. Again, the results are consistent with the theoretical developments of the New Economic Geography, namely the demand for labor is greater where transport costs are lower and where there is a strong links "backward and forward" and strong economies of agglomeration.

Keywords: new economic geography; linear and non linear models; Portuguese regions.

1. INTRODUCTION

With this study we mainly aimed to analyze the process of agglomeration across regions (NUTS II) of Portugal, using non linear models of New Economic Geography, in particular, developments considered by (1)Krugman (1991), (2)Thomas (1997), (3)Hanson (1998) and (4)Fujita et al. (2000). We will also try to compare the results obtained by the empirical models developed by each of these authors.

In a theoretical context, it is intended to explain the complementarily of clustering models, associated with the New Economic Geography, and polarization associated with the Keynesian tradition, describing the mechanisms by which these processes are based. It is pretended also studying the Portuguese regional agglomeration process, using the linear form the New Economic Geography models that emphasize the importance of factors in explaining the spatial concentration of economic activity in certain locations.

We will, also, focus on the relationship between agglomeration and regional demand for labor in industry, analyzing the effect of three forces of agglomeration, transport costs that encourage companies to put up with their activities in regions with relative low cost access to foreign markets; linkage "backward and forward" that give companies an incentive to put near their buyers and suppliers; and economies of agglomeration ("spillover effects ") that tend to reinforce the concentration of economic activity, ie, companies benefit from being together, even if they have or not business relationships with each other and can benefit from, for example, experience accumulated by other companies. It is considered therefore that these three forces create the conditions for which there is agglomeration, through processes of growth pattern circular and cumulative, and where there is concentration there is greater demand for labor by firms (Hanson, 1998).

2. THE NON LINEAR MODEL

The models are that presented and developed in (5-8)Martinho (2011a, 2011b, 2011c and 2011d). We think is not important present again this models here in this work. Is for us most important here to stress the analyze about the results and about the conclusions, trying find differences and similarities.

3. ESTIMATIONS MADE WITH THE NON LINEAR MODEL

Analysis of the results presented in Table 1, obtained in the estimations for the period 1987 to 1994, it appears that these are slightly different for the reduced equations of the three models considered, with the estimates made with the equation of the Thomas model present statistically better results. Possibly because it is an equation to work harder and thus beyond the centripetal forces of agglomeration processes favorable to consider also the centrifugal forces of anti-agglomeration by immobile factors. Anyway, the point that it confirms the results obtained with the estimates of three equations of some importance, but small, transport costs, given the low values of the parameter τ. Looking at the increasing returns to scale, calculating, as noted, the value

$\sigma/(\sigma-1)$, it appears that this is always greater than one, reflecting the fact that there were increasing returns in the Portuguese regions in this period. It should be noted also that the parameter values μ are unreasonably high in all three estimations, however, as stated (9)Head et al. (2003) there is a tendency for these values fall around the unit in most empirical work.

Table 1: Results of estimations of the models of Krugman, Thomas and Fujita et al., in temporal differences, for the period 1987-1994, with panel data (at NUTS II level)

Krugman Model in differences

$$\Delta \log(w_{it}) = \sigma^{-1} \begin{bmatrix} \log(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}}) - \\ \log(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}}) \end{bmatrix} + \Delta v_{it}$$

Parameters and R^2	Values obtained
σ	5.110* (3.611)
μ	1.262* (6.583)
τ	0.862** (1.622)
R^2	0.111
DW	1.943
SEE	0.196
Nº observations	284
$\sigma/(\sigma-1)$	1.243

Thomas Model in differences

$$\Delta \log(w_{it}) = \sigma^{-1} \begin{bmatrix} \log(\sum_j Y_{jt}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}}) - \\ \log(\sum_j Y_{jt-1}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt-1}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt-1}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}}) \end{bmatrix} + \Delta \eta_{it}$$

Parameters and R^2	Values obtained
σ	9.076* (2.552)
μ	1.272* (21.181)
τ	0.713* (2.053)
R^2	0.145
DW	1.932
SEE	0.192
Nº Observações	284
$\sigma/(\sigma-1)$	1.124

Fujita et al. Model in differences

$$\Delta \log(w_{it}) = \sigma^{-1} \begin{bmatrix} \log(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} T_{ijt}^{-(\sigma-1)}) - \\ \log(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} T_{ijt-1}^{-(\sigma-1)}) \end{bmatrix} + \Delta \psi_{it}$$

Parameters and R^2	Values obtained
σ	2.410* (31.706)
μ	1.612* (3.178)
R^2	0.111
DW	1.990
SEE	0.215
Nº Observações	302
$\sigma/(\sigma-1)$	1.709

Note: Figures in brackets represent the t-statistic. * Coefficients statistically significant to 5%. ** Coefficient statistically significant 10%.

4. ESTIMATIONS MADE WITH THE LINEAR MODEL

The results are satisfactory in terms of statistical significance of coefficients, the degree of adjustment and autocorrelation of errors. For the signs of the estimated coefficients that represent the respective elasticities, taking into account the expected by the economic theory, we confirm that, apart the gross value added, the price index and the nominal wages per employee, all coefficients have the expected signs.

Table 2: Estimation of the equation of real wages with the independent variables aggregated at national level (without productivity), 1987-1994

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{pt} + f_2 \ln T_{rpt} + f_3 \ln G_{pt} + f_4 \ln \lambda_{pt} + f_5 \ln w_{pt} + f_6 \ln T_{prt}$$

Variable	**$\ln Y_{pt}$**	**$\ln T_{rpt}$**	**$\ln G_{pt}$**	**$\ln \lambda_{pt}$**	**$\ln w_{pt}$**	**$\ln T_{prt}$**		
Coefficient	**f_1**	**f_2***	**f_3***	**f_4**	**f_5***	**f_6***	**R^2**	**DW**
LSDV Coefficients T-stat. L. signif.	-0.038 (-0.970) (0.333)	0.674 (4.227) (0.000)	-0.967 (-7.509) (0.000)	0.025 (0.511) (0.610)	0.937 (15.239) (0.000)	-0.594 (-3.787) (0.000)	0.810	1.516
Degrees of freedom	290							
Number of obervations	302							
Standard deviation	0.146 **T.HAUSMAN - 416.930**							

(*) Coefficient statistically significant at 5%.

Table 3: Estimation of the equation of real wages with the independent variables aggregated at national level (with productivity), 1987-1994

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{pt} + f_2 \ln T_{rpt} + f_3 \ln G_{pt} + f_4 \ln \lambda_{pt} + f_5 \ln w_{pt} + f_6 \ln T_{prt} + f_7 \ln P_{rt}$$

Variable	**$\ln Y_{pt}$**	**$\ln T_{rpt}$**	**$\ln G_{pt}$**	**$\ln \lambda_{pt}$**	**$\ln w_{pt}$**	**$\ln T_{prt}$**	**$\ln P_{rt}$**		
Coefficient	**f_1***	**f_2***	**f_3***	**f_4***	**f_5***	**f_6***	**f_7***	**R^2**	**DW**
LSDV Coefficients T-stat. L. signif.	-0.259 (-7.064) (0.000)	0.557 (4.422) (0.000)	-0.884 (-9.671) (0.000)	0.256 (5.919) (0.000)	0.883 (19.180) (0.000)	-0.493 (-3.996) (0.000)	0.258 (10.443) (0.000)	0.858	1.560
Degrees of freedom	289								
Number of obervations	302								
Standard deviation	0.126 **T.HAUSMAN - 7086.989***								

(*) Coefficient statistically significant at 5%.

Table 4 presents the results where the independent variables are disaggregated at regional level. About the signs of the coefficients, it appears that these are the expected, given the theory, the same can not be said of the variable λ_{rt} (number of employees). However, it is not surprising given the economic characteristics of regions like the Norte (many employees and low wages) and Alentejo (few employees and high salaries), two atypical cases precisely for opposite reasons. Analyzing the results in Tables 2, 3 and 4 we confirm the greater explanatory power of the variables when considered in aggregate at the national level.

Table 4: Estimation of the equation of real wages with the independent variables disaggregated at the regional level

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{rt} + f_2 \ln T_{rpt} + f_3 \ln G_{rt} + f_4 \ln \lambda_{rt} + f_5 \ln w_{rt} + f_6 \ln T_{prt},$$

Variables	**Const.**	**$\ln Y_{rt}$**	**$\ln T_{rpt}$**	**$\ln G_{rt}$**	**$\ln \lambda_{rt}$**	**$\ln w_{rt}$**	**$\ln T_{prt}$**		
Coefficients	**f_0***	**f_1***	**f_2***	**f_3***	**f_4***	**f_5***	**f_6***	**R^2**	**DW**
Random effects Coefficients T-stat. L. signif.	1.530 (3.355) (0.001)	0.101 (4.147) (0.000)	0.629 (4.625) (0.000)	-0.571 (-10.218) (0.000)	-0.151 (-5.364) (0.000)	0.516 (13.357) (0.000)	-0.506 (-3.985) (0.000)	0.670	1.858
LSDV		0.098* (4.129)	0.559* (4.449)	-0.624* (-11.380)	-0.155* (-6.130)	0.619* (16.784)	-0.411* (-3.511)	0.756	1.934
Degrees of freedom	295 - 289								
Number of obervations	302 - 302								
Standard deviation	0.155 - 0.165 **T.HAUSMAN - 72.843***								

(*) Coefficient statistically significant at 5%.

Two different estimates were made, one without the variable productivity (whose results are presented in Table 5) and one with this variable (Table 6).

Table 5: Estimation of the agglomeration equation without the productivity

$$\ln\left(\frac{\omega_{rt}}{\omega_{lt}}\right) = a_0 + a_1 \ln Y_{nt} + a_2 \ln T_{rl} + a_3 \ln L_{nt} + a_4 \ln RL_{rmt} + a_5 \ln RL_{rgt} + a_6 RL_{rkt} + a_7 \ln RL_{rnt}$$

Variab.	Constant	$\ln Y_{nt}$	$\ln T_{rl}$	$\ln L_{nt}$	$\ln RL_{rmt}$	$\ln RL_{rgt}$	$\ln RL_{rkt}$	$\ln RL_{rnt}$		
Coef.	a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7	R^2	DW
Random ef. V.Coef. T-stat. L. sign.	-3.991 (-3.317) (0.001)	-0.040 (-1.353) (0.177)	0.012 (1.469) (0.143)	0.390 (4.046) (0.000)	-0.413 (-4.799) (0.000)	-0.507 (-4.122) (0.000)	-0.228 (-4.333) (0.000)	0.368 (4.249) (0.000)	0.253	1.474
Degrees of freedom	293									
Number of obervations	302									
Standard deviation	0.126 **T.HAUSMAN - 1.870**									

(*) Coefficient statistically significant at 5%.
(**) Coefficient statistically significant at 10%.

Table 6: Estimation of the agglomeration equation with the productivity

$$\ln\left(\frac{\omega_{rt}}{\omega_{lt}}\right) = a_0 + a_1 \ln Y_{nt} + a_2 \ln T_{rl} + a_3 \ln L_{nt} + a_4 \ln P_{rt} + a_5 \ln RL_{rmt} + a_6 \ln RL_{rgt} + a_7 RL_{rkt} + a_8 \ln RL_{rnt}$$

Variab.	Constant	$\ln Y_{nt}$	$\ln T_{rl}$	$\ln L_{nt}$	$\ln P_{rt}$	$\ln RL_{rmt}$	$\ln RL_{rgt}$	$\ln RL_{rkt}$	$\ln RL_{rnt}$		
Coef.	a_0*	a_1*	a_2*	a_3*	a_4*	a_5*	a_6*	a_7*	a_8*	R^2	DW
Random eff. V.Coef. T-stat. L. sign.	-3.053 (-2.991) (0.003)	-0.240 (-7.182) (0.000)	0.015 (2.026) (0.044)	0.486 (5.934) (0.000)	0.218 (8.850) (0.000)	-0.266 (-3.494) (0.001)	-0.333 (-3.102) (0.002)	-0.141 (-3.067) (0.002)	0.230 (3.026) (0.003)	0.455	1.516
LSDV	-0.307* (-9.259)	-0.033* (-4.821)	0.330* (5.701)	0.256* (8.874)	-0.049 (-0.972)	0.011 (0.169)	-0.027 (-0.968)	0.006 (0.137)		0.649	1.504
Degrees of freedom	292 - 285										
Number of obervations	302 - 302										
Standard deviation	0.116 - 0.136 **T.HAUSMAN - 33.578***										

(*) Coefficient statistically significant at 5%.

Comparing the values of two tables is confirmed again the importance of productivity (Prt) in explaining the wage differences. On the other hand improves the statistical significance of coefficients and the degree of explanation.

5. ESTIMATIONS MADE WITH THE MODEL OF THE RELATIONSHIP BETWEEN AGGLOMERATION AND REGIONAL DEMAND FOR LABOR

In all estimations made, for the period 1986-1994, with panel data, the best results, according to the theory, are obtained in the estimations with variables "dummies", with differences and random effects estimates which are given in the table below. Were considered 45 "dummies", one for each individual, since the data relate to five regions and nine manufacturing industries. In Table 7 each line refers to an industry for the five regions considered, and each column refers to a region for the nine industries, always in the order mentioned above. Thus, the sixth line of "dummies" refers to food that is not used for worsen statistically the estimation results, possibly because it was an industry with specific features, since the amount depends on agriculture.

However, the Hausman test indicates that the best results are the estimates of fixed effects. Anyway, we present the results obtained in the three estimations, even to serve as a comparison. Explore will be, above all, the results obtained in the estimations with variables "dummies" because they were statistically more satisfactory. It should be noted also that the dependent variable was not considered in growth rate, since this way the results were statistically weaker. Were also carried out simulations considering the variables productivity and unemployment in the equation, but because worsen the results statistically and induce the appearance of strange signs for the coefficients, we chose not to consider.

Table 7: Estimation of the equation for employment

	LSDV[1]					**D**[2]	**GLS**[3]
							ϕ_0 -1.878[5]* (-4.424)[6]
	D_1[4] -0.970[5] (-0.379)[6]	**D_2**[4] -1.575[5] (-0.616)[6]	**D_3**[4] -1.470[5]* (-0.575)[6]	**D_4**[4] 6.782[5] (2.579)[6]	**D_5**[4] (b)		
	D_6[4] -0.620[5] (-0.242)[6]	**D_7**[4] -0.576[5] (-0.225)[6]	**D_8**[4] -1.910[5] (-0.748)[6]	**D_9**[4] -8.344[5]* (-3.229)[6]	**D_{10}**[4] -4.204[5] (-1.634)[6]		
	D_{11}[4] 1.967[5] (0.768)[6]	**D_{12}**[4] -3.757[5] (-1.465)[6]	**D_{13}**[4] -1.344[5] (-0.526)[6]	**D_{14}**[4] -0.100[5] (-0.039)[6]	**D_{15}**[4] -10.038[5]* (-2.553)[6]		
	D_{16}[4] 0.658[5] (0.257)[6]	**D_{17}**[4] 0.792[5] (0.310)[6]	**D_{18}**[4] -3.394[5] (-1.327)[6]	**D_{19}**[4] -4.587[5]** (-1.763)[6]	**D_{20}**[4] -2.234[5] (-0.868)[6]		
	D_{21}[4] 0.986[5] (0.385)[6]	**D_{22}**[4] -0.780[5] (-0.305)[6]	**D_{23}**[4] -2.052[5] (-0.803)[6]	**D_{24}**[4] 0.149[5] (0.058)[6]	**D_{25}**[4] -1.317[5] (-0.512)[6]		
	D_{26}[4] (c)	**D_{27}**[4] (c)	**D_{28}**[4] (c)	**D_{29}**[4] (c)	**D_{30}**[4] (c)		
	D_{31}[4] 0.223[5] (0.087)[6]	**D_{32}**[4] -2.587[5] (-1.009)[6]	**D_{33}**[4] -3.329[5] (-1.303)[6]	**D_{34}**[4] -8.367[5]* (-3.240)[6]	**D_{35}**[4] -13.384[5]* (-3.314)[6]		
	D_{36}[4] -0.073[5] (-0.029)[6]	**D_{37}**[4] -0.685[5] (-0.268)[6]	**D_{38}**[4] -1.420[5] (-0.556)[6]	**D_{39}**[4] -5.311[5]* (-2.049)[6]	**D_{40}**[4] -1.921[5] (-0.747)[6]		
	D_{41}[4] 0.881[5] (0.344)[6]	**D_{42}**[4] -1.352[5] (-0.529)[6]	**D_{43}**[4] -3.327[5] (-1.302)[6]	**D_{44}**[4] -6.699[5]* (-2.591)[6]	**D_{45}**[4] -7.784[5]* (-3.025)[6]		
	ϕ_1 0.119[5]* (2.086)[6]					ϕ_1 0.122[5]* (2.212)[6]	ϕ_1 0.112[5]* (1.973)[6]
	ϕ_2 0.018[5]** (1.879)[6]					ϕ_2 0.012[5] (1.286)[6]	ϕ_2 0.022[5]* (2.179)[6]
	ϕ_3 1.301[5]* (3.241)[6]					ϕ_3 1.127[5]* (2.918)[6]	ϕ_3 0.979[5]* (2.443)[6]
	ϕ_4 0.731[5]* (1.989)[6]					ϕ_4 0.661[5]** (1.867)[6]	ϕ_4 0.549[5] (1.492)[6]
	ϕ_5 -0.759[5]* (-4.357)[6]					ϕ_5 -0.744[5]* (-4.525)[6]	ϕ_5 -0.581[5]* (-3.401)[6]
R^2 adjusted	0.987					0.217	0.683

Durbin-Watson	2.298	2.086	2.068
Hausman Test Chi-square	7777.548*(a)		

(1) Estimation with 45 variables "dummies", one for each manufacturing industry, (2) Estimation with differences, (3) Estimation with random effects, (4) Variables "Dummies" (5) value of the coefficient, (6) T - statistic * coefficient statistically significant at the 5% level, ** coefficient statistically significant at 10% (a) reject the hypothesis of random effects, (b) not considered this "dummy" values to present strangers: (c) Do not consider these "dummies" by statistically worse results

To highlight the fact that almost all coefficients of the variables "no dummy" have an elasticity less than unity, with the exception of "backward and forward" linkages, which indicates the importance of these linkages in explaining the relative employment. Analyzing the results of the estimation for the variables "no dummy" there is, as might be expected, given the developments of the New Economic Geography, a positive relationship between relative employment and relative nominal wages, the positive effect is confirmed also in relation to the "backward and forward" linkages (ratio between the number of employees in total manufacturing in each region and the number of employees in each manufacturing considered in this region for the same ratio at national level) and in relation to economies of agglomeration (ratio between the number of employees in each manufacturing industry in a given region and the total number of employees in all economy of that region, on the same ratio found at national level). On the other hand, confirms the negative relationship between demand of employment and transport costs and the ratio of the distribution of employment across industries (the ratio of the sum square of the number of employees in total manufacturing (other than that is being analyzed) of a given region and the total number of employees throughout the economy of this region, for the same sum considered at national level).

6. CONCLUSIONS

In light of what has been said above, we can conclude, with the non linear models, the existence of agglomeration processes in Portugal (around Lisboa e Vale do Tejo) in the period 1987 to 1994, given the low transport costs. On other hand, there are increasing returns to scale in manufacturing in the Portuguese regions.

With the linear models, it appears that the explanatory power of the independent variables considered in models of the New Economic Geography, is more reasonable, when these variables are considered in their original form, in other words, in the aggregate form for all locations with strong business with that we are considering (in the case studied, aggregated at national level to mainland Portugal). However, the agglomeration process of the Portuguese regions, analyzing the set of coefficients of the estimations, in Lisboa e Vale do Tejo is not impressive, but when we look at the data this region has a greater potential of attractiveness of the population and economic activity. This is because that's where real wages are more uniform across different industries and higher than in other regions. However, the estimation results reflect some strange situations, in the face of the theory, namely the fact the Norte has the highest value of employees in manufacturing, the highest gross value added in this industry, but has the lowest real wages, explained possibly by the great weight of the textile industry in this region. The same we verify, but precisely in the contrary to the Alentejo. Perhaps, a finer spatial unit could help to explain these strange situations, but the lack of data for the NUTS III prevents this analysis. Anyway, the direct effect of considering large spatial units is reduced (as can be seen in Table 6 with the value obtained for the variable RLrkt, or -0141). Despite some inconsistencies found in the face of the theory, it was possible to identify a set of centripetal forces (forces that favor the agglomeration) and a set of centrifugal forces (forces that work against agglomeration).

On the other hand, given the existence of "backward and forward" linkages and agglomeration economies, represented in the variables RIrmt and RLrgt, we can affirm the existence of growing scale economies in the Portuguese manufacturing industry during the period considered. This taking into account the mentioned by (10)Marshall (1920) which in modern terminology argued that increasing returns to scale occur in industry, in the face of "spillover" effects, advantages of market expertise and "backward" and "forward" linkages associated with large local markets. Therefore, the trend during this period was for the regional divergence in Portugal, considering what referred by Hanson (1998), in other words, "The interaction of scale economies and transport costs creates a centripetal force, to use Krugman's language, that causes firms to agglomerate in industry centers".

It should be noted also that different estimates were made without the productivity variable and with this variable in order to be analyzed the importance of this variable in explaining the phenomenon of agglomeration. It seems important to carry out this analysis, because despite the economic theory consider the wages that can be explained by productivity, the new economic geography ignores it, at least explicitly, in their models, for reasons already mentioned widely, particular those related to the need to make the models tractable.

Finally, is important to refer the importance of the transportation costs in explaining the spatial issues, reinforced by the fact that the estimates made with the seven NUTS II Portugal (including Madeira and Açores) present values much worse than when considering only the five NUTS II. What makes sense, since the real wage developments do not follow the increase in transport costs from the continent for these two Portuguese islands.

From the last results, we can also say that transportation costs are again important because, in addition to the statistical significance of the coefficient associated with this variable, the regions closer to the Lisboa e Vale do Tejo has the greater flow of goods to this region. There are also "backward and forward" linkages between the different manufacturing industries, there are economies of agglomeration ("spillover effects ") between firms and industries and there is a distribution, more or less uniform, of the employment across different industries. Productivity and unemployment have no influence in explaining the demand for industrial work at the regional level, given the results obtained in the estimations, when these variables were considered.

So, we can conclude which the results from the several estimations are consistent and which the new economic geography said that in Portugal we have spatial divergence between the continental regions and the transport costs play here a important role.

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