Application of convergence theories and new economic geography in Portugal. An alternative analysis

Martinho, Vítor João Pereira Domingues

Escola Superior Agrária, Instituto Politécnico de Viseu

2011

APPLICATION OF CONVERGENCE THEORIES AND NEW ECONOMIC GEOGRAPHY IN PORTUGAL. AN ALTERNATIVE ANALYSIS

Vitor João Pereira Domingues Martinho

Unidade de I&D do Instituto Politécnico de Viseu
Av. Cor. José Maria Vale de Andrade
Campus Politécnico
3504 - 510 Viseu
(PORTUGAL)
e-mail: vdmartinho@esav.ipv.pt

ABSTRACT

The aim of this paper is to present a further contribution to the analysis of absolute convergence, associated with the neoclassical theory, of the sectoral productivity at regional level. Presenting some empirical evidence of absolute convergence of productivity for each of the economic sectors in each of the regions of mainland Portugal (NUTS II) in the period 1986 to 1994. This work aims, also, to study the Portuguese regional agglomeration process (NUTs II), using the linear form the New Economic Geography models that emphasize the importance of spatial factors (distance, costs of transport and communication) in explaining of the concentration of economic activity in certain locations.

Keywords: convergence; agglomeration; Portuguese regions; linear models panel data.

1. INTRODUCTION

The purpose of this the work is to analyze the absolute convergence of output per worker (as a "proxy" of labor productivity), with the equation of (1)Islam (1995), based on the (2)Solow model (1956).

With this work it is intended, also, to explain and 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 (3)(Fujita et al., 2000).

2. THE MODELS

The models of the convergence and new economic geography are developed in several works like (4-5)Martinho (2011a and 2011b).

3. DATA ANALYSIS

Considering the variables on the models referred previously and the availability of statistical information, we used the following data disaggregated at regional level. Annual data for the periods 1986 to 1994 and 1987 to 1994 corresponding to the five regions of mainland Portugal (NUTS II), for the different economic sectors and the total economy of these regions. These data were obtained from Eurostat (Eurostat Regio of Statistics 2000).

4. EMPIRICAL EVIDENCE OF ABSOLUTE CONVERGENCE, PANEL DATA

Table 1 presents the results of absolute convergence of output per worker, obtained in the panel estimations for each of the economic sectors and the sectors to the total level of NUTS II, from 1986 to 1994 (a total of 45 observations, corresponding to regions 5 and 9 years).

The convergence results obtained in the estimations carried out are statistically satisfactory to each of the economic sectors and all sectors of the NUTS II.

Table 1: Analysis of convergence in productivity for each economic sectors of the five NUTS II of Portugal, for the period 1986 to 1994

Agriculture											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.558 (1.200)						-0.063 (-1.163)	-0.065	1.851	0.034	38
LSDV		4.127* (4.119)	4.207* (4.116)	4.496* (4.121)	4.636* (4.159)	4.549* (4.091)	-0.514* (-4.108)	-0.722	2.202	0.352	34
GLS	0.357 (0.915)						-0.040 (-0.871)	-0.041	1.823	0.020	38
Industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	2.906* (2.538)						-0.292* (-2.525)	-0.345	1.625	0.144	38
LSDV		6.404* (4.345)	6.459* (4.344)	6.695* (4.341)	6.986* (4.369)	6.542* (4.334)	-0.667* (-4.344)	-1.100	1.679	0.359	34
GLS	3.260* (2.741)						-0.328* (-2.729)	-0.397	1.613	0.164	38
Manufactured Industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.806** (1.853)						-0.186** (-1.845)	-0.206	1.935	0.082	38
LSDV		6.625* (4.304)	6.669* (4.303)	6.941* (4.303)	6.903* (4.318)	6.626* (4.293)	-0.699* (-4.301)	-1.201	1.706	0.357	34
GLS	1.655** (1.753)						-0.171** (-1.745)	-0.188	1.946	0.074	38
Services											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	5.405* (4.499)						-0.554* (-4.477)	-0.807	1.874	0.345	38
LSDV		7.193* (5.290)	7.169* (5.301)	7.313* (5.284)	7.153* (5.292)	7.273* (5.293)	-0.741* (-5.275)	-1.351	2.051	0.451	34
GLS	5.627* (4.626)						-0.577* (-4.604)	-0.860	1.886	0.358	38
Services (without public sector)											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	5.865* (4.079)						-0.589* (-4.073)	-0.889	1.679	0.304	38
LSDV		6.526* (4.197)	6.523* (4.195)	6.635* (4.191)	6.506* (4.176)	6.561* (4.192)	-0.658* (-4.188)	-1.073	1.684	0.342	34
GLS	5.027* (3.656)						-0.505* (-3.649)	-0.703	1.682	0.260	38
All sectors											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	3.166* (3.603)						-0.328* (-3.558)	-0.397	1.785	0.250	38
LSDV		6.080* (5.361)	6.030* (5.374)	6.308* (5.347)	6.202* (5.379)	6.193* (5.359)	-0.643* (-5.333)	-1.030	2.181	0.460	34
GLS	3.655* (3.916)						-0.379* (-3.874)	-0.476	1.815	0.283	38

Note: Const. Constant; Coef., Coefficient, TC, annual rate of convergence; * Coefficient statistically significant at 5%, ** Coefficient statistically significant at 10%, GL, Degrees of freedom; LSDV, method of fixed effects with variables dummies; D1 ... D5, five variables dummies corresponding to five different regions, GLS, random effects method.

5. EQUATION LINEARIZED AND REDUCED OF THE REAL WAGES, WITH THE VARIABLES INDEPENDENT NATIONALLY AGGREGATED

Thus, the equation of real wages that will be estimated in its linear form, will be a function of the following explanatory variables:

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{pt} + f_2 \ln T_{rpt} + f_3 \ln G_{pt} + f_4 \ln \lambda_{pt} + f_5 \ln w_{pt} + f_6 \ln T_{prt} + f_7 \ln P_{rt}, \quad (1)$$

where:

- ω_{rt} is the real wage in region r (5 regions) for each of the manufacturing industries (9 industries);
- Ypt is the gross value added of each of the manufacturing industries at the national level;
- Gpt is the price index at the national level;
- λ_{pt} is the number of workers in each industry, at national level;

- Wpt is the nominal wage for each of the industries at the national level;
- Trpt is the flow of goods from each of the regions to Portugal;
- Tprt is the flow of goods to each of the regions from Portugal;
- Prt is the regional productivity for each industry;
- p indicates Portugal and r refers to each of the regions.

The results obtained in the estimations of this equation are shown in Tables 2 and 3.

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	**lnY$_{pt}$**	**lnT$_{rpt}$**	**lnG$_{pt}$**	**ln λ_{pt}**	**lnw$_{pt}$**	**lnT$_{prt}$**		
Coefficient	**f$_1$**	**f$_2$***	**f$_3$***	**f$_4$**	**f$_5$***	**f$_6$***	**R^2**	**DW**
LSDV								
Coefficients	-0.038	0.674	-0.967	0.025	0.937	-0.594	0.810	1.516
T-stat.	(-0.970)	(4.227)	(-7.509)	(0.511)	(15.239)	(-3.787)		
L. signif.	(0.333)	(0.000)	(0.000)	(0.610)	(0.000)	(0.000)		
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	**lnY$_{pt}$**	**lnT$_{rpt}$**	**lnG$_{pt}$**	**ln λ_{pt}**	**lnw$_{pt}$**	**lnT$_{prt}$**	**lnP$_{rt}$**		
Coefficient	**f$_1$***	**f$_2$***	**f$_3$***	**f$_4$***	**f$_5$***	**f$_6$***	**f$_7$***	**R^2**	**DW**
LSDV									
Coefficients	-0.259	0.557	-0.884	0.256	0.883	-0.493	0.258	0.858	1.560
T-stat.	(-7.064)	(4.422)	(-9.671)	(5.919)	(19.180)	(-3.996)	(10.443)		
L. signif.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
Degrees of freedom	289								
Number of obervations	302								
Standard deviation	0.126 **T.HAUSMAN - 7086.989***								

(*) Coefficient statistically significant at 5%.

This equation 1 estimated of real wages presents satisfactory results 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.

6. LINEARIZED AND REDUCED EQUATION OF REAL WAGES, WITH THE VARIABLES INDEPENDENT REGIONALLY DISAGGREGATED

Following the equation of real wages reduced and in a linear form, but now with the independent variables disaggregated at regional level, in other words, considered only for the region being analyzed, and not for the whole of Portugal, as in the previous equation. Although this equation does not consider the effect of nearby regions of r in this region, aims to be a simulation to determine the effect of the regions in their real wages, that is:

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{rt} + f_2 \ln T_{rpt} + f_3 \ln G_{rt} + f_4 \ln \lambda_{rt} + f_5 \ln w_{rt} + f_6 \ln T_{prt} \qquad (2)$$

where:

- ω_{rt} is the real wage in the region r, for each of the manufacturing industries;
- Yrt is the gross value added of each of the manufacturing industries at the regional level;
- Grt is the price index at the regional level;
- λ_{rt} is the number of workers in each industry, at regional level;
- Wrt is the nominal wage per employee in each of the manufacturing industries at regional level;
- Trpt is the flow of goods from each region to Portugal;
- Tprt is the flow of goods to each of the regions from Portugal.

Table 4 presents the results of estimating equation 2 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.**	**lnY$_{rt}$**	**lnT$_{rpt}$**	**lnG$_{rt}$**	**ln λ_{rt}**	**lnw$_{rt}$**	**lnT$_{prt}$**		
Coefficients	**f_0***	**f_1***	**f_2***	**f_3***	**f_4***	**f_5***	**f_6***	**R^2**	**DW**
Random effects									
Coefficients	1.530	0.101	0.629	-0.571	-0.151	0.516	-0.506	0.670	1.858
T-stat.	(3.355)	(4.147)	(4.625)	(-10.218)	(-5.364)	(13.357)	(-3.985)		
L. signif.	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
								0.756	1.934
LSDV		0.098*	0.559*	-0.624*	-0.155*	0.619*	-0.411*		
		(4.129)	(4.449)	(-11.380)	(-6.130)	(16.784)	(-3.511)		
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%.

7. ALTERNATIVE EQUATIONS TO THE EQUATIONS 1 AND 2

We also made two alternative estimates in order to test the existence of multicollinearity among the explanatory variables, considering all the variables by the weight of the work in every industry and every region in the total industry in this region for the equation 1 and the weight of work in every industry and every region in the national total of this industry for the equation 2, following procedures of (6)Hanson (1998). It is noted that the results are very similar to those previously presented to the estimates of equations 1 and 2, which allows us to verify the absence of statistics infractions.

8. EQUATION OF THE AGGLOMERATION

In the analysis of the Portuguese regional agglomeration process, using models of New Economic Geography in the linear form, we pretend to identify whether there are between Portuguese regions, or not, forces of concentration of economic activity and population in one or a few regions (centripetal forces). These forces of attraction to this theory, are the differences that arise in real wages, since locations with higher real wages, have better conditions to begin the process of agglomeration. Therefore, it pretends to analyze the factors that originate convergence or divergence in real wages between Portuguese regions. Thus, given the characteristics of these regions will be used as the dependent variable, the ratio of real wages in each region and the region's leading real wages in this case (Lisboa e Vale do Tejo), following procedures of (9)Armstrong (1995) and (10)Dewhurst and Mutis-Gaitan (1995). So, which contribute to the increase in this ratio is a force that works against clutter (centrifugal force) and vice versa.

Thus:

$$\ln\left(\frac{\omega_{rt}}{\omega_{lt}}\right) = a_0 + a_1 \ln Y_{nt} + a_2 \ln T_{rl} + a_3 \ln L_{nt} + a_4 \ln P_{rt} + a_5 \ln RL_{rmt} + a_6 \ln RL_{rgt} + a_7 RL_{rkt} + a_8 \ln RL_{rnt} \qquad (3)$$

where:

- Ynt is the national gross value added of each of the manufacturing industries considered in the database used;
- Trl is the flow of goods from each region to Lisboa e Vale do Tejo, representing the transportation costs;
- Lnt is the number of employees in manufacturing at the national level;
- Prt is the regional productivity (ratio of regional gross value added in manufacturing and the regional number of employees employed in this activity);
- RLrmt is the ratio between the total number of employees in regional manufacturing and the regional number of employees, in each manufacturing (agglomeration forces represent inter-industry, at regional level);

- RLrgt is the ratio between the number of regional employees in each manufacturing and regional total in all activities (represent agglomeration forces intra-industry, at regional level);
- RLrkt is the ratio between the number of regional employees in each manufacturing, and regional area (representing forces of agglomeration related to the size of the region);
- RLrnt is the ratio between the number of regional employees, in each of the manufacturing industries, and the national total in each industry (agglomeration forces represent inter-regions in each of the manufacturing industries considered).

The index r (1,..., 5) represents the respective region, t is the time period (8 years), n the entire national territory, k the area (km2), l the region Lisboa e Vale do Tejo, g all sectors and m manufacturing activity (9 industries).

The results of the estimations made regarding equation 3 are shown in Tables 5 and 6. 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**	**lnY$_{nt}$**	**lnT$_{rl}$**	**lnL$_{nt}$**	**lnRL$_{rmt}$**	**lnRL$_{rgt}$**	**lnRL$_{rkt}$**	**lnRL$_{rnt}$**		
Coef.	**a_0**	**a_1**	**a_2**	**a_3**	**a_4**	**a_5**	**a_6**	**a_7**	**R^2**	**DW**
Random ef.										
V.Coef.	-3.991	-0.040	0.012	0.390	-0.413	-0.507	-0.228	0.368	0.253	1.474
T-stat.	(-3.317)	(-1.353)	(1.469)	(4.046)	(-4.799)	(-4.122)	(-4.333)	(4.249)		
L. sign.	(0.001)	(0.177)	(0.143)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
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**	**lnY$_{nt}$**	**lnT$_{rl}$**	**lnL$_{nt}$**	**lnP$_{rt}$**	**lnRL$_{rmt}$**	**lnRL$_{rgt}$**	**lnRL$_{rkt}$**	**lnRL$_{rnt}$**		
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.	-3.053	-0.240	0.015	0.486	0.218	-0.266	-0.333	-0.141	0.230	0.455	1.516
T-stat.	(-2.991)	(-7.182)	(2.026)	(5.934)	(8.850)	(-3.494)	(-3.102)	(-3.067)	(3.026)		
L. sign.	(0.003)	(0.000)	(0.044)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.003)		
										0.649	1.504
LSDV	-0.307*	-0.033*	0.330*	0.256*	-0.049	0.011	-0.027	0.006			
	(-9.259)	(-4.821)	(5.701)	(8.874)	(-0.972)	(0.169)	(-0.968)	(0.137)			
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.

9. CONCLUSIONS

We find some signs of convergence, analyzing the results of the estimations with the models of the neoclassical theory.

With the new economic geography models, it appears that the explanatory power of the independent variables considered, 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). On the other hand, given the existence of "backward and forward" linkages and agglomeration economies, represented in the variables Rlrmt and RLrgt, we can affirm the existence of growing scale economies in the Portuguese manufacturing industry during the period considered. 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.

So, we can say for this period that we find some signs of convergence, but are not strong enough to avoid the disparities between the Portuguese regions.

10. REFERENECES

1. N. Islam. Growth Empirics : A Panel Data Approach. Quarterly Journal of Economics, 110, 1127-1170 (1995).
2. R. Solow. A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics (1956).
3. M. Fujita; P. Krugman; and J.A. Venables. The Spatial Economy: Cities, Regions, and International Trade. MIT Press, Cambridge 2000.
4. V.J.P.D. Martinho. Sectoral convergence in output per worker between Portuguese regions. MPRA Paper 32269, University Library of Munich, Germany (2011a).
5. V.J.P.D. Martinho. Regional agglomeration in Portugal: a linear analysis. MPRA Paper 32337, University Library of Munich, Germany (2011b).
6. G. Hanson. Regional adjustment to trade liberalization. Regional Science and Urban Economics (28), 419-444 (1998).