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APPLICATION OF KEYNESIAN THEORY AND NEW ECONOMIC GEOGRAPHY IN PORTUGAL. AN ALTERNATIVE ANALYSIS

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ABSTRACT

This work aims to test the Verdoorn Law, with the alternative specifications of (1)Kaldor (1966), for five Portuguese regions (NUTS II) from 1986 to 1994. It is intended to test, even in this work, the alternative interpretation of (2)Rowthorn (1975) of the Verdoorn's Law for the same regions and periods. The results of this work will be complemented with estimates of these relationships to other sectors of the economy than the industry (agriculture and services sectors) and for the total economy of each region. This work aims, yet, to study the Portuguese regional agglomeration process, 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. In a theoretical context, it is intended, also, 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.

Keywords: agglomeration; polarization; Portuguese regions; linear models.

1. INTRODUCTION

With this work it is intended to explain the complementarily, similarities and differences between the clustering models, associated with the New Economic Geography (3)(Fujita et al., 2000), and polarization, associated with the Keynesian tradition (4)(Targetti et al., 1989). It is pretended also studying the Portuguese regional agglomeration and polarization processes. For the agglomeration process we use the linear form of the New Economic Geography models that emphasize the importance of factors in explaining the spatial concentration of economic activity in certain locations. The polarization process is mainly based in the very known Verdoorn law. (5)Verdoorn (1949) was the first author to reveal the importance of the positive relationship between the growth of labor productivity and output growth, arguing that the causality is from output to productivity, thus assuming that labor productivity is endogenous. An important finding of the empirical relationship is the elasticity of labor productivity with respect to output that according to Verdoorn is approximately 0.45 on average, external limits between 0.41 and 0.57. This author also found that the relationship between productivity growth and output growth reflects a kind of production technology and the existence of increasing returns to scale, which contradicts the hypothesis of neoclassical constant returns to scale, or decreasing, and absolute convergence Regional.

2. DESCRIPTION OF THE MODELS

The models of the keynesian theory and new economic geography are developed in several works like (6-7)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 THE VERDOORN'S LAW

The results in Table 1, obtained in the estimations carried out with the equations of Verdoorn, Kaldor and Rowthorn for each of the sectors of the economy and for the total economy of each of the five regions

considered, to state the following.

The industry is the sector that has the biggest increasing returns to scale, followed by agriculture and service sector. Services without the public sector present values for the income scale unacceptable and manufacturing presents surprisingly very low values, reflecting a more intensive use of labor.

It should be noted, finally, for this set of results the following: Verdoorn's equation is the most satisfactory in terms of statistical significance of the coefficient obtained and the degree of explanation in the various estimations. There is, therefore, that productivity is endogenous and generated by the growth of regional and sectoral output.

Table 1: Analysis of economies of scale through the equation Verdoorn, Kaldor and Rowthorn, for each of the economic sectors and the five NUTS II of Portugal, for the period 1986 to 1994

Agriculture						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn $p_i = a + bq_i$	0.042* (5.925)	0.878* (12.527)	1.696	0.805	38	8.197
Kaldor $e_i = c + dq_i$	-0.042* (-5.925)	0.123** (1.750)	1.696	0.075	38	
Rowthorn1 $p_i = \lambda_1 + \varepsilon_1 e_i$	-0.010 (-0.616)	-0.621** (-1.904)	1.568	0.087	38	
Rowthorn2 $q_i = \lambda_2 + \varepsilon_2 e_i$	-0.010 (-0.616)	0.379 (1.160)	1.568	0.034	38	
Industry						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn	-12.725* (-4.222)	0.992* (8.299)	2.001	0.587	37	125.000
Kaldor	12.725* (4.222)	0.008 (0.064)	2.001	0.869	37	
Rowthorn1	15.346* (9.052)	-0.449* (-3.214)	1.889	0.326	37	
Rowthorn2	15.346* (9.052)	0.551* (3.940)	1.889	0.776	37	
Manufactured Industry						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn	8.296* (4.306)	0.319* (2.240)	1.679	0.139	37	1.468
Kaldor	-8.296* (-4.306)	0.681* (4.777)	1.679	0.887	37	
Rowthorn1	12.522* (12.537)	-0.240* (-2.834)	1.842	0.269	37	
Rowthorn2	12.522* (12.537)	0.760* (8.993)	1.842	0.891	37	
Services						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn	-0.045* (-3.253)	0.802* (6.239)	1.728	0.506	38	5.051
Kaldor	0.045* (3.253)	0.198 (1.544)	1.728	0.059	38	
Rowthorn1	0.071* (4.728)	-0.694* (-3.607)	1.817	0.255	38	
Rowthorn2	0.071* (4.728)	0.306 (1.592)	1.817	0.063	38	
Services (without public sector)						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn	-0.074* (-4.250)	1.020* (7.695)	1.786	0.609	38	---
Kaldor	0.074* (4.250)	-0.020 (-0.149)	1.786	0.001	38	
Rowthorn1	0.076* (4.350)	-0.903* (-4.736)	1.847	0.371	38	
Rowthorn2	0.076* (4.350)	0.097 (0.509)	1.847	0.007	38	
All Sectors						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**

Verdoorn	-0.020* (-2.090)	0.907* (8.367)	1.595	0.648	38	10.753
Kaldor	0.020* (2.090)	0.093 (0.856)	1.595	0.019	38	
Rowthorn1	0.056* (6.043)	-0.648* (-2.670)	2.336	0.255	32	
Rowthorn2	0.056* (6.043)	0.352 (1.453)	2.336	0.225	32	

Note: * Coefficient statistically significant at 5%, ** Coefficient statistically significant at 10%, GL, Degrees of freedom; EE, Economies of scale.

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	**$\ln Y_{pt}$**	**$\ln T_{rpt}$**	**$\ln G_{pt}$**	**$\ln \lambda_{pt}$**	**$\ln w_{pt}$**	**$\ln T_{prt}$**		
Coefficient	**f_1**	**f_2***	**f_3***	**f_4**	**f_5***	**f_6***	**R^2**	**DW**
LSDV								
Coefficients	-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	**$\ln Y_{pt}$**	**$\ln T_{rpt}$**	**$\ln G_{pt}$**	**$\ln \lambda_{pt}$**	**$\ln w_{pt}$**	**$\ln T_{prt}$**	**$\ln P_{rt}$**		
Coefficient	**f_1***	**f_2***	**f_3***	**f_4***	**f_5***	**f_6***	**f_7***	**R^2**	**DW**
LSDV									
Coefficients	-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 (8)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	$\ln Y_{nt}$	$\ln T_{rl}$	$\ln L_{nt}$	$\ln RL_{rmt}$	$\ln RL_{rgt}$	$\ln RL_{rkt}$	$\ln RL_{rnt}$		
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.	-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. SOME FINAL CONCLUSIONS

In the estimates made for each of the economic sectors, with the Verdoorn law, it appears that the industry is the largest that has increasing returns to scale, followed by agriculture and service sector.

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.

For this period the new economic geography and the Keynesian theory say the same about the Portuguese regions development.

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