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APPLICATION OF KEYNESIAN THEORY AND NEW ECONOMIC GEOGRAPHY IN PORTUGAL. DIFFERENCES AND SIMILARITIES

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ABSTRACT

With this work we try to analyse the agglomeration process in the Portuguese regions, using the New Economic Geography models. In these models the base idea is that where has increasing returns to scale in the manufactured industry and low transport costs, there is agglomeration. This work aims to test, also, the Verdoorn Law, with the alternative specifications of (1)Kaldor (1966), for the 28 NUTS III Portuguese in the period 1995 to 1999. It is intended to test, yet in this work, the alternative interpretation of (2)Rowthorn (1975) about the Verdoorn's Law for the same regions and periods. With this study we want, also, to test the Verdoorn´s Law at a regional and a sectoral levels (NUTs II) for the period 1995-1999. The importance of some additional variables in the original specification of Verdoorn´s Law is yet tested, such as, trade flows, capital accumulation and labour concentration. This study analyses, also, through cross-section estimation methods, the influence of spatial effects in productivity in the NUTs III economic sectors of mainland Portugal from 1995 to 1999, considering the Verdoorn relationship.

Keywords: new economic geography; Verdoorn law; spatial autocorrelation; Portuguese regions.

1. INTRODUCTION

Kaldor rediscovered the Verdoorn law in 1966 and since then this Law has been tested in several ways, using specifications, samples and different periods. However, the conclusions drawn differ, some of them rejecting the Law of Verdoorn and other supporting its validity. (3)Kaldor (1966, 1967) in his attempt to explain the causes of the low rate of growth in the UK, reconsidering and empirically investigating Verdoorn's Law, found that there is a strong positive relationship between the growth of labor productivity (p) and output (q), i.e. p = f (q). Or alternatively between employment growth (e) and the growth of output, ie, e = f (q).

Another interpretation of Verdoorn's Law, as an alternative to the Kaldor, is presented by (4)Rowthorn (1975, 1979). Rowthorn argues that the most appropriate specification of Verdoorn's Law is the ratio of growth of output (q) and the growth of labor productivity (p) with employment growth (e), i.e., q = f (e) and p = f (e), respectively (as noted above, the exogenous variable in this case is employment). On the other hand, Rowthorn believes that the empirical work of Kaldor (1966) for the period 1953-54 to 1963-64 and the (5)Cripps and Tarling (1973) for the period 1951 to 1965 that confirm Kaldor's Law, not can be accepted since they are based on small samples of countries, where extreme cases end up like Japan have great influence on overall results.

2. 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 data for the period from 1995 to 1999, disaggregated at regional level, obtained from the INE (National Accounts 2003).

4. EMPIRICAL EVIDENCE OF THE VERDOORN'S LAW

At Table 1, with results of estimations presented for each of the sectors and in the period 1995 to 1999, to stress that the industry has the greatest increasing returns to scale (9.091), followed by services (1.996).

Table 1: Analysis of economies of scale through the equation Verdoorn, Kaldor and Rowthorn, for each of the economic sectors and NUTS III of Portugal, for the period 1995 to 1999

Agriculture						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn[(1)]	0.010 (0.282)	0.053 (0.667)	0.542	1.690	23	
Verdoorn $p_i = a + bq_i$	0.023* (3.613)	1.105* (17.910)	1.959	0.745	110	
Kaldor $e_i = c + dq_i$	-0.023* (-3.613)	-0.105** (-1.707)	1.959	0.026	110	---
Rowthorn1 $p_i = \lambda_1 + \varepsilon_1 e_i$	-0.032* (-5.768)	-1.178* (-9.524)	1.713	0.452	110	
Rowthorn2 $q_i = \lambda_2 + \varepsilon_2 e_i$	-0.032* (-5.768)	-0.178 (-1.441)	1.713	0.019	110	
Industry						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn[(1)]	0.017 (0.319)	0.053 (0.673)	0.195	2.380	23	
Verdoorn	-0.014* (-2.993)	0.890* (18.138)	2.253	0.749	110	
Kaldor	0.014* (2.993)	0.110* (2.236)	2.253	0.044	110	9.091
Rowthorn1	0.053* (6.739)	-0.617* (-3.481)	2.069	0.099	110	
Rowthorn2	0.053* (6.739)	0.383* (2.162)	2.069	0.041	110	
Services						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn[(1)]	0.003 (0.306)	0.096* (8.009)	0.773	2.492	23	
Verdoorn	0.007 (1.098)	0.499* (6.362)	2.046	0.269	110	
Kaldor	-0.007 (-1.098)	0.502* (6.399)	2.046	0.271	110	1.996
Rowthorn1	0.059* (19.382)	-0.432* (-5.254)	1.993	0.201	110	
Rowthorn2	0.059* (19.382)	0.568* (6.895)	1.993	0.302	110	
All Sectors						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn[(1)]	0.007 (0.188)	0.090* (2.524)	0.203	2.588	23	
Verdoorn	-0.015* (-3.245)	0.851* (13.151)	2.185	0.611	110	
Kaldor	0.015* (3.245)	0.149* (2.308)	2.185	0.046	110	6.711
Rowthorn1	0.057* (13.017)	-0.734* (-5.499)	2.092	0.216	110	
Rowthorn2	0.057* (13.017)	0.266** (1.989)	2.092	0.035	110	

Note: (1) cross-section Estimation * Coefficient statistically significant at 5%, ** Coefficient statistically significant at 10%, GL, Degrees of freedom; EE, Economies of scale.

Analyzing the coefficients of each of the estimated equations with the two estimation methods considered (Table 2), to point out, now and in general, the values obtained with both methods have some similarities. For agriculture, it appears that the Verdoorn coefficient has an elasticity outside acceptable limits, since it is above unity.

At the industry level Verdoorn coefficient (with an elasticity between 0.957 and 0.964, respectively, for the method of fixed effects and random effects) indicates the existence of strong increasing returns to scale, as expected, in the face of that by Kaldor, the industry is the engine of growth showing strong gains in productivity.

Table 2: Analysis of sectoral economies of scale in five NUTS II of Portugal Continental, for the period 1995-1999

Agriculture									
	M.E.	**Const.**	**q_i**	**C_i/Q_i**	**F_i/Q_{ik}**	**E_i/E_n**	**DW**	**R^2**	**G.L.**
Verdoorn	DIF		1.112* (10.961)	0.066 (0.177)	-0.153* (-2.283)	-0.717 (-0.295)	1.901	0.945	11
	GLS	0.483* (2.597)	1.117* (14.538)	-0.668 (-1.560)	-0.182* (-3.594)	0.065 (0.152)	2.501	0.945	9
Industry									

	M.E.	Const.	q_i	C_i/Q_i	F_i/Q_{ik}	E_i/E_n	DW	R^2	G.L.
Verdoorn	DIF		0.957* (5.425)	0.213* (2.303)	-0.001 (-0.041)	-4.787* (-2.506)	2.195	0.930	11
	GLS	-0.089 (-0.591)	0.964* (3.620)	0.217 (1.558)	-0.023 (-0.515)	0.042 (0.135)	2.818	0.909	9
Services									
	M.E.	**Const.**	q_i	C_i/Q_i	F_i/Q_{ik}	E_i/E_n	**DW**	R^2	**G.L.**
Verdoorn	DIF		1.021* (5.430)	-0.116* (-2.587)	-0.020 (-0.856)	-5.458** (-1.895)	1.369	0.846	11
	GLS	-1.590 (-0.734)	1.084* (5.577)	-0.106* (-2.319)	-0.020 (-0.815)	-5.985** (-2.063)	1.629	0.717	9
All Sectors									
	M.E.	**Const.**	q_i	C_i/Q_i	F_i/Q_{ik}	E_i/E_n	**DW**	R^2	**G.L.**
Verdoorn	DIF		0.905* (4.298)	-0.342* (-4.872)	-0.090* (-4.430)	-3.102* (-2.178)	1.402	0.919	11
	GLS	1.559 (1.675)	0.859* (3.776)	-0.371* (-4.665)	-0.096* (-4.404)	-3.158* (-2.098)	1.459	0.912	9

Note: * Coefficient statistically significant at 5%, ** Coefficient statistically significant at the 10% ME, estimation method, Const., Constant; Coef., Coefficient, GL, degrees of freedom; DIF method of estimation with fixed effects and variables in differences; GLS method of estimation with random effects; C/Q, capital accumulation; F/Q, trade flow; E/E labor concentration.

In the services the Verdoorn coefficient, although statistical significance is greater than one.

For the total regions, the Verdoorn equation presents results that confirm the existence of strong growing economies to scale, with additional variables to show statistical significance.

In a general analysis of Table 2, we verified the presence of strong economies of scale in the industry, confirming Kaldor's theory that this is the only sector with substantial gains in production efficiency.

This part of the study will examine the procedures of specification by (8)Florax e al. (2003) and will firstly examine through OLS estimates, the relevance of proceeding with estimate models with spatial lag and spatial error components with recourse to LM specification tests.

The results concerning the OLS estimates of the Verdoorn's equation, without spatial variables) with spatial specification tests are presented in Tables 3. In the columns concerning the test only values of statistical relevance are presented.

Table 3: OLS cross-section estimates of Verdoorn's equation with spatial specification tests (1995-1999)

Equation: $p_{it} = \alpha + \beta q_{it} + \mu_{it}$

	Con.	Coef.	JB	BP	KB	M'I	LM_l	LMR_l	LM_e	LMR_e	R^2	N.O.
Agriculture	0.013* (3.042)	0.854* (9.279)	1.978	5.153*	5.452*	0.331*	0.416	7.111*	8.774*	15.469*	0.759	28
Industry	-0.029* (-3.675)	1.032* (9.250)	3.380	2.511	1.532	-0.037	1.122	2.317	0.109	1.304	0.758	28
Services	0.033* (3.971)	0.169 (1.601)	1.391	1.638	1.697	0.212*	4.749*	1.987	3.607*	0.846	0.055	28
Total of sectors	0.002 (0.411)	0.659* (8.874)	1.585	5.174*	4.027*	0.030	0.008	0.087	0.069	0.149	0.742	28

Note: JB, Jarque-Bera test to establish parameters; BP, Breusch-Pagan test for heteroskedasticity; KB, Koenker-Bassett test for heteroskedasticity: M'I, Moran's I statistics for spatial autocorrelation; LM_l, LM test for spatial lag component; LMR_l, robust LM test for spatial lag component; LM_e, LM test for spatial error component; LMR_e, robust LM test for spatial error component;R^2, coefficient of adjusted determination; N.O., number of observations; *, statistically significant for 5%

From the table 3 the existence of growing scaled income in agriculture and in the total of all sectors is confirmed. Industry shows itself to be a sector with very strong growing scaled income, since, despite Verdoorn's coefficient being highly exaggerated it is very close to unity and when the null hypothesis is tested as β=1, a t-statistic of 0.287 is obtained. As it is a highly reduced value, it is accepted that industry is subject to strong scaled income.

The results for ML estimates with spatial effects for agriculture and services are presented in table 4.

Table 4: Results for ML estimates for Verdoorn's equation with spatial effects (1995-1999)

	Constant	Coefficient	Coefficient$^{(S)}$	Breusch-Pagan	R^2	N.Observations
Agriculture	0.016* (1.961)	0.988* (14.291)	0.698* (4.665)	4.246*	0.852	28
Services	0.011 (0.945)	0.134 (1.464)	0.545* (2.755)	3.050**	0.269	28

Note: Coefficient$^{(S)}$, spatial coefficient for the spatial error model for agriculture and the spatial lag model for services; *, statistically significant to 5%; **, statistically significant to 10%.

Only in agriculture the Verdoorn's coefficient improves with the consideration of spatial effects, since it goes from 0.854 to 0.988.

5. EMPIRICAL EVIDENCE OF THE NEW ECONOMIC GEOGRAPHY

According to Table 5, with the results obtained in the estimations for the period 1995 to 1999, although the estimation results with the model equation of Thomas (with agricultural employment as a force anti- agglomeration) are more satisfying, considering the parameter values μ less than unity as would be expected in view of economic theory. Note that when considering the stock of housing as centrifugal force, although the results show evidence of greater economies of scale (as noted by the data analysis, because the close relationship between this variable and nominal wages) are statistically less satisfactory. There is also that $\sigma/(\sigma-1)$ values are always higher than unity, is confirmed also for this period the existence of increasing returns to scale, although with a moderate size, given the value $\sigma(1-\mu)$, i.e. 1.830, in the model Thomas. Since as noted above, when $\sigma(1-\mu)>1$ increasing returns to scale are sufficiently weak or the fraction of the manufactured goods sector is sufficiently low and the range of possible equilibria depends on the costs of transportation. Should be noted that the parameter τ is not statistical significance in Krugman model and present a very low value in the model of Thomas, a sign that transportation costs have left the already small importance that had in the previous period, which is understandable given the improvements in infrastructure that have been check in Portugal, mainly through the structural supports that have come to our country after the appointed time our entry into EEC (European Economic Community), within a set of programs financed by various funds, including Cohesion Fund, among others.

Table 5: Results of estimations of the models of Krugman, Thomas and Fujita et al., in temporal differences, for the period 1995-1999, with panel data (the level of NUTS III)

Krugman Model in differences

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

Parameters and R^2	**Values obtained**
σ	7.399** (1.914)
μ	1.158* (15.579)
τ	0.003 (0.218)
R^2	0.199
DW	2.576
SEE	0.023
Nº observations	112
$\sigma/(\sigma-1)$	1.156

Thomas Model in differences (with agricultural workers to the H)

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

Parameters and R^2	**Values obtained**
σ	18.668 (3.329)
μ	0.902 (106.881)

τ	0.061* (2.383)
R^2	0.201
DW	2.483
SEE	0.023
Nº observations	112
$\sigma/(\sigma-1)$	1.057
$\sigma(1-\mu)$	1.830

Thomas Model in differences (with housing stock to the H)

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

Parameters and R^2	**Values obtained**
σ	11.770 (1.205)
μ	1.221* (8.993)
τ	0.003 (0.314)
R^2	0.173
DW	2.535
SEE	0.024
Nº observations	112

Fujita et al. Model in differences

$$\Delta \log(w_{it}) = \sigma^{-1}\left[\begin{array}{l}\log(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} T_{ijt}^{-(\sigma-1)}) - \\ \log(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} T_{ijt-1}^{-(\sigma-1)})\end{array}\right] + \Delta\psi_{it}$$

Parameters and R^2	**Values obtained**
σ	5.482* (4.399)
μ	1.159* (14.741)
R^2	0.177
DW	2.594
SEE	0.023
Nº observations	112
$\sigma/(\sigma-1)$	1.223

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

6. CONCLUSIONS

In light of what has been said above, we can conclude the existence of agglomeration processes in Portugal (around Lisboa e Vale do Tejo) in the period 1995 to 1999, given the transport costs are low and it was shown by $\sigma/(\sigma-1)$ and the $\sigma(1-\mu)$ values obtained in the estimations made with the reduced forms of the models presented above, there are increasing returns to scale in manufacturing in the Portuguese regions. This is because, according to the New Economic Geography, in a situation with low transport costs and increasing returns to scale, productive linkages can create a circular logic of agglomeration, with links "backward" and "forward". What makes the producers are located close to their suppliers (the forces of supply) and consumers (demand forces) and vice versa. The driver of the process is the difference in real wages, i.e., locations that, for some reason, have higher real wages attract more workers (which are also potential consumers), calls "forward" which, in turn, attract more companies to meet the requirements of demand, calls "backward." With a greater concentration of companies in the

same location, the products are shifted to lower distances, saving on transport costs and, as such, prices may be lower, nominal wages may be higher and so on. On the other hand, when certain factors are real estate (land), they act as centrifugal forces that oppose the centripetal forces of agglomeration. The result of the interaction between these two forces, traces the evolution of the spatial structure of the economy.

At NUTs III, the results of the estimations made for each of the economic sectors, in the period (1995-1999), notes that the industry provides greater increasing returns to scale, followed by services. Agriculture, on the other hand, has overly high values.

At NUTs II, the consideration of new variables (ratio GFCF /output ratio flow of goods/output and the variable concentration), in the equation of Verdoorn, little improvement have in the Verdoorn coefficient. Finally, it should be noted that the Verdoorn coefficient captures much of the agglomeration effects and is therefore not necessary to express explicitly these effects.

With the cross-section estimates, it can be seen, that sector by sector the growing scaled income is much stronger in industry and weaker or non-existent in the other sectors, just as proposed by Kaldor. With reference to spatial autocorrelation, Moran's I value is only statistically significant in agriculture and services. Following the procedures of Florax et al. (2003) the equation is estimated with the spatial error component for agriculture and the spatial lag component for services, it can be seen that it is only in agriculture that Verdoorn's coefficient improves with the consideration of spatial effects.

So, with different ways the two theories say the same, in other words, we have, in this period, regional divergence in Portugal.

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