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APPLICATION OF KEYNESIAN AND CONVERGENCE THEORIES IN PORTUGAL. DIFFERENCES AND SIMILARITIES

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ABSTRACT

This work aims to test 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, also 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, yet, 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 also tested, such as, trade flows, capital accumulation and labour concentration. This study analyses, yet, 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. The aim of this paper is, also, to present a further contribution, with panel data, to the analysis of absolute convergence, associated with the neoclassical theory, and conditional, associated with endogenous growth theory, of the sectoral productivity at regional level (from 1995 to 1999). The structural variables used in the analysis of conditional convergence is the ratio of capital/output, the flow of goods/output and location ratio.

Keywords: Verdoorn law; convergence; 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.

It should be noted, finally, that several authors have developed a body of work in order to test the Verdoorn's Law in a regional context, including (6-11)Martinho (2004, 2005, 2011a, 2011b, 2011c and 2011d).

There are many authors who have dedicated themselves to issues of convergence, with very different theoretical assumptions, trying to investigate how these issues or do not explain the regional differences. For example, the authors associated with the Neoclassical theory, as (12)Solow (1956), consider that the tendency is, for the labor mobility, to alleviate, in the medium and long term, the regional disparities. This, because these authors consider the mobility of factors as a function of wages and the supply of resources as exogenous. Thus, what determines the mobility factor is their compensation.

In another context, it appears that the current trend of several economic theories is to consider that the labor mobility accentuates regional disparities. Even writers in the line of neoclassical theory, as Barro and (13)Sala-i-Martin (1991), associated with endogenous growth theory, now admit that the mobility of labor reacts to processes of convergence and reduce regional disparities, but only if some conditions are met. That is, left to disappear the idea of absolute convergence for the same "steady state" of neoclassical influence, to a perspective of conditional convergence for differents "steady states" (14-17)(Martinho, 2011e, 2011f, 2011g and 2011h).

2. THE MODELS

The models of the keynesian and convergence theories are developed in several works like Martinho (2004, 2005, 2011a, 2011b, 2011c and 2011d) and Martinho (2011e, 2011f, 2011g and 2011h).

3. DATA ANALYSIS

Considering the variables on the models, presented 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	
Kaldor $p_i = a + bq_i$	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 (18)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%

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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 $\beta = 1$, 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 ABSOLUTE CONVERGENCE, PANEL DATA

Are presented subsequently in Table 5 the results of the absolute convergence of output per worker, obtained in the panel estimations for each of the sectors and all sectors, now at the level of NUTS III during the period 1995 to 1999.

The results of convergence are statistically satisfactory for all sectors and for the total economy of the NUTS III.

Table 5: Analysis of convergence in productivity for each of the economic sectors at the level of NUTS III of Portugal, for the period 1995 to 1999

Agriculture						
Method	Const.	Coef.	T.C.	DW	R^2	G.L.
Pooling	0.017 (0.086)	-0.003 (-0.146)	-0.003	2.348	0.000	110
LSDV		-0.938* (-9.041)	-2.781	2.279	0.529	83
GLS	-0.219* (-3.633)	0.024* (3.443)	0.024	1.315	0.097	110
Industry						
Method	Const.	Coef.	T.C.	DW	R^2	G.L.
Pooling	0.770* (4.200)	-0.076* (-4.017)	-0.079	1.899	0.128	110
LSDV		-0.511* (-7.784)	-0.715	2.555	0.608	83
GLS	0.875* (4.154)	-0.086* (-3.994)	-0.090	2.062	0.127	110
Services						
Method	Const.	Coef.	T.C.	DW	R^2	G.L.
Pooling	0.258 (1.599)	-0.022 (-1.314)	-0.022	1.955	0.016	110
LSDV		-0.166* (-5.790)	-0.182	2.665	0.382	83
GLS	0.089 (0.632)	-0.004 (-0.303)	-0.004	1.868	0.001	110
All sectors						
Method	Const.	Coef.	T.C.	DW	R^2	G.L.
"Pooling"	0.094 (0.833)	-0.005 (-0.445)	-0.005	2.234	0.002	110
LSDV		-0.156* (-3.419)	-0.170	2.664	0.311	83
GLS	0.079 (0.750)	-0.004 (-0.337)	-0.004	2.169	0.001	110

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.

6. EMPIRICAL EVIDENCE OF CONDITIONAL CONVERGENCE WITH PANEL DATA

This part of the work aims to analyze the conditional convergence of labor productivity sectors (using as a "proxy" output per worker) between the different NUTS II of Portugal, from 1995 to 1999.

Given these limitations and the availability of data, it was estimated in this part of the work the equation of convergence introducing some structural variables, namely, the ratio of gross fixed capital/output (such as "proxy" for the accumulation of capital/output), the flow ratio of goods/output (as a "proxy" for transport costs) and the location quotient (calculated as the ratio between the number of regional employees in a given sector and the number of national employees in this sector on the ratio between the number regional employment and the number of national employees) ((4) Sala-i-Martin, 1996).

Table 6: Analysis of conditional convergence in productivity for each of the sectors at NUTS II of Portugal, for the period 1995 to 1999

Agriculture

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.1	Coef.2	Coef.3	Coef.4	DW	R^2	G.L.
Pooling	0.114 (0.247)						-0.020 (-0.392)	0.388 (0.592)	0.062 (1.267)	-0.062 (-1.160)	2.527	0.136	15
LSDV		5.711* (2.333)	5.856* (2.385)	6.275* (2.299)	6.580* (2.383)	6.517* (2.431)	-0.649* (-2.248)	-0.134 (-0.134)	-0.132 (-0.437)	-0.102 (-0.189)	2.202	0.469	11
GLS	-0.020 (-0.221)						-0.004 (-0.416)	0.284 (1.419)	0.059* (4.744)	-0.053* (-4.163)	2.512	0.797	15

Industry

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.1	Coef.2	Coef.3	Coef.5	DW	R^2	G.L.
Pooling	3.698* (4.911)						-0.336* (-5.055)	0.269* (3.229)	-0.125* (-3.888)	-0.297* (-3.850)	2.506	0.711	15
LSDV		4.486* (6.153)	4.386* (6.700)	4.435* (7.033)	4.335* (6.967)	4.111* (6.977)	-0.421* (-6.615)	0.530* (6.222)	0.018 (0.412)	-0.397 (-0.854)	2.840	0.907	11
GLS	3.646* (4.990)						-0.332* (-5.144)	0.279* (3.397)	-0.123* (-3.899)	-0.290* (-3.828)	2.597	0.719	15

Manufactured industry

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.1	Coef.2	Coef.3	Coef.6	DW	R^2	G.L.
Pooling	0.468 (0.690)						-0.053 (-0.870)	0.285* (4.502)	0.013 (0.359)	0.010 (0.167)	2.177	0.804	15
LSDV		2.850** (2.065)	2.461** (2.081)	2.068** (2.067)	1.851** (2.022)	1.738* (2.172)	-0.123 (-1.772)	0.296* (5.185)	-0.097 (-1.448)	-1.119 (-1.787)	1.770	0.923	11
GLS	0.513 (0.729)						-0.057 (-0.906)	0.289* (4.539)	0.009 (0.252)	0.008 (0.123)	2.169	0.800	15

Services

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.1	Coef.2	Coef.3	Coef.7	DW	R^2	G.L.
Pooling	0.472 (1.209)						-0.046 (-1.110)	-0.118 (-1.653)	-0.013 (-1.401)	0.081** (2.071)	2.367	0.268	15
LSDV		1.774 (1.329)	1.831 (1.331)	2.140 (1.324)	1.955 (1.344)	2.217 (1.345)	-0.109 (-1.160)	-0.137 (-1.400)	-0.075 (-1.380)	-0.698 (-1.024)	2.393	0.399	11
GLS	0.238 (0.790)						-0.022 (-0.718)	-0.079 (-0.967)	-0.008 (-1.338)	0.060* (2.126)	1.653	0.613	15

All sectors

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.1	Coef.2	Coef.3	Coef.4	Coef.5	Coef.7	DW	R^2	G.L.
Pooling	0.938 (0.910)						-0.077 (-1.04)	-0.152 (-0.88)	-0.011 (-0.71)	-0.029 (-0.28)	-0.057 (-0.20)	0.005 (0.009)	2.738	0.458	13
LSDV		-0.797 (-0.67)	-0.645 (-0.54)	-0.545 (-0.41)	-0.521 (-0.42)	-0.263 (-0.20)	0.011 (0.130)	-0.483* (-2.72)	-0.155* (-2.79)	0.085 (0.802)	0.465 (1.279)	0.344 (0.590)	2.591	0.792	9
GLS	1.018 (0.976)						-0.088 (-1.16)	-0.182 (-1.14)	-1.034 (-1.03)	-0.026 (-0.26)	-0.050 (-0.17)	0.023 (0.043)	2.676	0.854	13

Note: Const. Constant; Coef1., Coefficient of convergence; Coef.2, Coefficient of the ratio capital/output; Coef.3, Coefficient of the ratio of flow goods/output; Coef.4, Coefficient of the location quotient for agriculture; Coef.5, Coefficient of industry location quotient; Coef.6, Coefficient of the location quotient for manufacturing; Coef.7, Coefficient quotient location of services; * Coefficient statistically significant at 5%, ** statistically significant coefficient 10%; GL, Degrees of freedom; LSDV, Method of variables with fixed effects dummies; D1 ... D5, five variables dummies corresponding to five different regions.

Therefore, the data used and the results obtained in the estimations made, if we have conditional convergence, that will be in industry, but not in the manufactured industry.

7. CONCLUSIONS

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.

The convergence theory, in this period, is not clear about the regional tendency in Portugal, so the conclusions about the regional convergence are not consistent.

So, we can say which the two theories follow different ways, but find very similar conclusions about the Portuguese regional tendency.

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