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THE ECONOMIC THEORY AND THE PORTUGUESE MANUFACTURED INDUSTRY. ANOTHER APPROACH

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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 manufactured industry productivity at regional level and for the period from 1995 to 1999 (1)(Martinho, 2011a). This work aims, also, to test the Verdoorn Law, with the alternative specifications of (2)Kaldor (1966), for the five Portuguese regions (NUTS II), from 1995 to 1999. It is intended to test, yet in this work, the alternative interpretation of (3)Rowthorn (1975) about the Verdoorn's Law for the same regions and period (4)(Martinho, 2011b). This paper pretends, yet, to analyze the importance which the natural advantages and local resources are in the manufacturing industry location, in relation with the "spillovers" effects and industrial policies. To this, we estimate the Rybczynski equation matrix for the various manufacturing industries in Portugal, at regional level (NUTS II) and for the period 1995 to 1999 (5)(Martinho, 2011c).

Keywords: Verdoorn law; convergence theories; geographic concentration; panel data; manufactured industries; 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. (6)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 (7)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 (8)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.

(9)Islam (1995) developed a model about the convergence issues, for panel data, based on the (10)Solow model, (1956).

Taking into account the work of (11)Kim (1999), we seek, aldo, to analyze the importance of the natural advantages and local resources (specific factors of locations) have in explaining the geographic concentration over time in the Portuguese regions, relatively effects "spillovers" and industrial policies (in particular, the modernization and innovation that have allowed manufacturing in other countries take better advantage of positive externalities). For this, we estimated the Rybczynski equation matrix for the different manufacturing industries in the regions of Portugal, for the period 1995 to 1999. It should be noted that while the model of inter-regional trade, the Heckscher-Ohlin-Vanek, presents a linear relationship between net exports and inter-regional specific factors of locations, the Rybczynski theorem provides a linear relationship between regional production and specific factors of locations. In principle, the residual part of the estimation of Rybczynski, measured by the difference between the adjusted degree of explanation (R2) and the unit presents a approximated estimate of the importance not only of the "spillovers" effects, as considered by Kim (1999), but also of the industrial policies, because, industrial policies of modernization and innovation are interconnected with the "spillover" effects. However, it must be some caution with this interpretation, because, for example, although the growth of unexplained variation can be attributed to the growing importance of externalities "Marshallians" or "spillovers" effects and industrial policies, this conclusion may not be correct. Since the "spillovers" effects and industrial policies are measured as a residual part, the growth in the residual can be caused, also, for example, by growth in the randomness of the location of the products manufactured and the growing importance of external trade in goods and factors.

2. ALTERNATIVE SPECIFICATIONS OF VERDOORN'S LAW

The hypothesis of increasing returns to scale in industry was initially tested by Kaldor (1966) using the following relations:

$p_i = a + bq_i$, Verdoorn law (1)

$e_i = c + dq_i$, Kaldor law (2)

where pi, qi and ei are the growth rates of labor productivity, output and employment in the industrial sector in the economy i.

On the other hand, the mathematical form of Rowthorn specification is as follows:

$p_i = \lambda_1 + \varepsilon_1 e_i$, firts equation of Rowthorn (3)

$q_i = \lambda_2 + \varepsilon_2 e_i$, second equation of Rowthorn (4)

where $\lambda_1 = \lambda_2$ e $\varepsilon_2 = (1+\varepsilon_1)$, because $p_i=q_i-e_i$. In other words, $q_i - e_i = \lambda_1 + \varepsilon_1 e_i$, $q_i = \lambda_1 + e_i + \varepsilon_1 e_i$, so, $q_i = \lambda_1 + (1+\varepsilon_1)e_i$.

Rowthorn estimated these equations for the same OECD countries considered by Kaldor (1966), with the exception of Japan, and for the same period and found that ε_2 was not statistically different from unity and therefore ε_1 was not statistically different from zero. This author thus confirmed the hypothesis of constant returns to scale in manufacturing in the developed countries of the OECD. (12)Thirlwall (1980) criticized these results, considering that the Rowthorn interpretation of Verdoorn's Law is static, since it assumes that the Verdoorn coefficient depends solely on the partial elasticity of output with respect to employment.

3. CONVERGENCE MODEL

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

$$\Delta \ln P_{it} = c + b \ln P_{i,t-1} + v_{it} \qquad (5)$$

4. THE MODEL THAT ANALYZES THE IMPORTANCE OF NATURAL ADVANTAGES AND LOCAL RESOURCES IN AGGLOMERATION

According to Kim (1999), the Rybczynski theorem states that an increase in the supply of one factor leads to an increased production of the good that uses this factor intensively and a reduction in the production of other goods.

Given these assumptions, the linear relationship between regional output and offers of regional factors, may be the following:

$$Y = A^{-1}V,$$

where Y (nx1) is a vector of output, A (nxm) is a matrix of factor intensities or matrix input Rybczynski and V (mx1) is a vector of specific factors to locations.

For the output we used the gross value added of different manufacturing industries, to the specific factors of the locations used the labor, land and capital. For the labor we used the employees in manufacturing industries considered (symbolized in the following equation by "Labor") and the capital, because the lack of statistical data, it was considered, as a "proxy", the production in construction and public works (the choice of this variable is related to several reasons including the fact that it represents a part of the investment made during this period and symbolize the part of existing local resources, particularly in terms of infrastructure) and the gross formation of fixed capital in manufacturing. With regard to land, although this factor is often used as specific of the locations, the amount of land is unlikely to serve as a significant specific factor of the locations. Alternatively, in this work is used the production of various extractive sectors, such as a "proxy" for the land. These sectors include agriculture and fisheries (represented by "Agriculture") the forest ("Forest"), extractive industry of metallic mineral products ("Extraction1"), extractive industry of several products ("Extraction2") and energy production ("Energy"). The overall regression is then used as follows:

$$\ln Y_{it} = \alpha + \beta_1 \ln Labor_{it} + \beta_2 \ln Agriculture_{it} + \beta_3 \ln Floresty_{it} + \beta_4 \ln Extraction1_{it} + \beta_5 \ln Extraction2_{it} + \beta_6 \ln Energy_{it} + \beta_7 \ln Construction_{it} + \beta_8 \ln Capital_{it} + \varepsilon \quad (6)$$

In this context, it is expected that there is, above all, a positive relationship between the production of each of the manufacturing industry located in a region and that region-specific factors required for this industry, in particular, to emphasize the more noticeable cases, between food industry and agriculture, among the textile industry and labor (given the characteristics of this industry), among the industry of metal products and metal and mineral extraction and from the paper industry and forest.

5. DATA ANALYSIS

Considering the variables on the models presented previously and the availability of statistical information, we used the following data disaggregated at regional level. Annual data for the period 1995 to 1999, corresponding to the five regions of mainland Portugal (NUTS II), and for the several manufactured industries in those regions. The data are, also, relative to regional gross value added of agriculture, fisheries and forestry, extractive industry of metallic mineral products, extractive industry of several products, the industry of fuel and energy products and construction and public works. We used yet data relating to gross formation of fixed capital. These data were obtained from INE (National Accounts 2003).

6. EMPIRICAL EVIDENCE OF THE VERDOORN'S LAW

In Table 1 are the results of an estimation carried out for nine manufacturing industries disaggregated and together, as in the face of data availability (short period of time and lack of disaggregated data for these industries in NUTS III) this is a way to estimate considered the equations for the different manufacturing industries during this period. For the analysis of the data reveals that the values of the coefficients of the four equations are, respectively, 0.774, 0.226, -0.391 and 0.609 (all statistically significant), reflecting the increasing returns to scale increased slightly in this economic sector, i.e. of 2.551 (Table 1) to 4.425.

Table 1: Analysis of economies of scale through the equation Verdoorn, Kaldor and Rowthorn, for nine manufacturing industries together for the period 1995 to 1999 and five in mainland Portugal NUTS II

9 Manufactured Industry Together						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn $p_i = a + bq_i$	0.004 (0.766)	0.774* (20.545)	2.132	0.703	178	4.425
Kaldor $e_i = c + dq_i$	-0.004 (-0.766)	0.226* (6.010)	2.132	0.169	178	
Rowthorn1 $p_i = \lambda_1 + \varepsilon_1 e_i$	0.049* (4.023)	-0.391* (-3.392)	2.045	0.112	132	
Rowthorn2 $q_i = \lambda_2 + \varepsilon_2 e_i$	0.049* (4.023)	0.609* (5.278)	2.045	0.214	132	

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

7. EMPIRICAL EVIDENCE OF ABSOLUTE CONVERGENCE, PANEL DATA

Table 2 shows results also for each of the manufacturing industries of the NUTS II of Portugal, but now for the period 1995 to 1999.

Table 2: Analysis of convergence in productivity for each of the manufacturing industries at the five NUTS II of Portugal, for the period 1995 to 1999

Metals industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.108* (3.591)						-0.111* (-3.353)	-0.118	2.457	0.384	18
LSDV		1.476 (1.143)	1.496 (1.183)	1.503 (1.129)	1.451 (1.186)	1.459 (1.233)	-0.151 (-1.115)	-0.164	2.424	0.416	14
GLS	1.084* (7.366)						-0.108* (-6.866)	-0.114	2.176	0.724	18
Minerals industry											

Method	Const.	D_1	D_2	D_3	D_4	D_5	Coef.	T.C.	DW	R^2	G.L.
Pooling	-0.455 (-1.236)						0.052 (1.409)	0.051	1.601	0.099	18
LSDV		2.158* (2.222)	2.280* (2.265)	2.287* (2.227)	2.194* (2.248)	2.417* (2.306)	-0.221* (-2.192)	-0.250	1.359	0.567	14
GLS	-0.356 (-0.854)						0.042 (1.007)	0.041	1.628	0.053	18
Chemical industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.236 (1.026)						-0.115 (-0.966)	-0.122	1.049	0.049	18
LSDV		5.320* (4.493)	5.281* (4.452)	5.447* (4.449)	5.858* (4.711)	5.072* (4.501)	-0.525* (-4.470)	-0.744	2.432	0.702	14
GLS	3.136* (2.532)						-0.302* (-2.477)	-0.360	1.174	0.254	18
Electric goods industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.936 (1.289)						-0.196 (-1.271)	-0.218	1.945	0.082	18
LSDV		4.729 (1.504)	4.775 (1.507)	4.818 (1.490)	4.590 (1.463)	4.671 (1.519)	-0.482 (-1.488)	-0.658	2.038	0.342	14
GLS	2.075 (1.299)						-0.211 (-1.283)	-0.237	1.976	0.084	18
Transport equipments industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	2.429* (2.264)						-0.237* (-2.179)	-0.270	1.837	0.209	18
LSDV		8.626* (10.922)	8.647* (10.973)	9.051* (10.924)	8.537* (10.917)	8.356* (10.866)	-0.867* (-10.811)	-2.017	2.000	0.896	14
GLS	3.507* (3.025)						-0.346* (-2.947)	-0.425	1.649	0.326	18
Food industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.873 (1.619)						-0.082 (-1.453)	-0.086	2.921	0.105	18
LSDV		-0.516 (-0.300)	-0.521 (-0.308)	-0.532 (-0.304)	-0.425 (-0.259)	-0.435 (-0.268)	0.060 (0.341)	0.058	2.230	0.208	14
GLS	1.027* (4.163)						-0.098* (-3.800)	-0.103	2.251	0.445	18
Textile industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.788** (2.048)						-0.080** (-1.882)	-0.083	1.902	0.165	18
LSDV		0.514 (0.261)	0.525 (0.270)	0.515 (0.262)	0.522 (0.272)	0.541 (0.301)	-0.051 (-0.239)	-0.052	1.919	0.167	14
GLS	0.802* (20.052)						-0.081* (-18.461)	-0.085	1.719	0.950	18
Paper industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.735 (1.524)						-0.073 (-1.471)	-0.076	2.341	0.107	18
LSDV		5.201 (1.479)	5.454 (1.462)	5.410 (1.467)	5.053 (1.470)	4.970 (1.486)	-0.533 (-1.465)	-0.761	1.939	0.227	14
GLS	0.654* (3.329)						-0.064* (-3.198)	-0.066	2.185	0.362	18
Several industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	-0.338 (-0.463)						0.042 (0.531)	0.041	2.651	0.015	18
LSDV		3.734** (1.949)	3.883** (1.962)	3.940** (1.966)	3.817** (1.967)	3.647** (1.934)	-0.402** (-1.930)	-0.514	2.905	0.303	14
GLS	-0.904* (-3.791)						0.102* (4.003)	0.097	1.922	0.471	18

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.

8. EMPIRICAL EVIDENCE OF GEOGRAPHIC CONCENTRATION

In the results presented in the following table, there is a strong positive relationship between gross value added and labor in particular in the industries of metals, minerals, textile, paper and several products. On the other hand, there is an increased dependence on natural and local resources in the different industries. We found that the location of manufacturing industry is yet mostly explained by specific factors of locations and poorly explained by "spillovers" effects and industrial policies.

Table 3: Results of estimations for the whole period 1995-1999

$$\ln Y_{it} = \alpha + \beta_1 \ln Labor_{it} + \beta_2 \ln Agriculture_{it} + \beta_3 \ln Florestry_{it} + \beta_4 \ln Extraction1_{it} + \beta_5 \ln Extraction2_{it} + \beta_6 \ln Energy_{it} + \beta_7 \ln Construction_{it} + \beta_8 \ln Capital_{it} + \varepsilon$$

	IMT (2)	IMI (2)	IPQ (2)	IEE (2)	IET (2)	IAL (1)	ITE (1)	IPA (1)	IPD (1)
α	3.476 (0.365)	3.151 (0.403)	-126.876 (-1.572)	64.626$^{(*)}$ (4.362)	17.203 (0.395)				
Dummy1									
Dummy2									
Dummy3									
Dummy4						-3.137 (-1.740)	-1.212 (-2.826)	0.687 (0.663)	-0.497 (-0.590)
Dummy5									
β_1	1.294$^{(*)}$ (7.664)	1.251$^{(*)}$ (13.829)	1.800 (1.339)	-0.073 (-0.321)	0.684 (0.640)	0.072 (0.332)	0.747$^{(*)}$ (11.372)	1.320$^{(*)}$ (2.887)	0.585$^{(**)}$ (2.141)
β_2	0.136 (0.778)	-0.078 (-0.452)	3.558$^{(*)}$ (2.929)	-1.334$^{(*)}$ (-4.651)	-0.482 (-0.703)	0.795$^{(**)}$ (2.996)	0.408$^{(**)}$ (3.914)	-0.638 (-1.666)	-0.114 (-0.411)
β_3	-0.356 (-1.730)	-0.267 (-1.682)	2.306 (1.209)	-1.242$^{(*)}$ (-3.769)	-0.639 (-0.521)	0.822$^{(**)}$ (3.502)	0.498$^{(*)}$ (6.317)	0.376$^{(*)}$ (4.689)	0.258$^{(**)}$ (2.227)
β_4	-0.161$^{(**)}$ (-2.024)	-0.064 (-1.073)	0.568 (0.911)	-0.175 (-1.475)	-0.147 (-0.423)	0.180$^{(**)}$ (3.164)	0.107$^{(*)}$ (5.271)	0.036 (0.532)	-0.084 (-1.025)
β_5	0.606$^{(*)}$ (4.819)	0.411$^{(*)}$ (3.386)	2.198$^{(*)}$ (2.755)	-1.039$^{(*)}$ (-4.951)	0.120 (0.180)	0.011 (0.057)	-0.273$^{(**)}$ (-3.729)	-0.384 (-1.462)	0.163 (0.509)
β_6	-0.215 (-1.802)	-0.042 (-0.437)	-3.058$^{(*)}$ (-3.196)	0.257 (1.338)	0.404 (0.540)	-0.352 (-1.599)	-0.562$^{(*)}$ (-6.689)	-0.046 (-0.265)	-0.214 (-1.035)
β_7	-0.237 (-1.247)	-0.182 (-1.371)	0.330 (0.273)	0.995$^{(*)}$ (3.153)	0.134 (0.146)	-0.185 (-0.655)	0.139 (1.560)	0.553 (1.848)	0.470 (1.265)
β_8	-0.036 (-1.538)	0.038$^{(**)}$ (2.043)	0.407$^{(**)}$ (2.105)	0.087$^{(**)}$ (2.351)	0.101 (0.964)	0.004 (0.143)	0.072$^{(*)}$ (7.404)	-0.036 (-0.997)	-0.017 (-0.387)
Sum of the elasticities	1.031	1.067	8.109	-2.524	0.175	1.347	1.136	1.181	1.047
R^2 adjusted	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
Residual part	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Durbin-Watson	2.343	2.282	1.988	2.221	2.191	2.021	3.074	2.747	2.400
Hausman test	(c)	(c)	(c)	(c)	(c)	(c)	16.063$^{(b)(*)}$	33381.450$^{(b)(*)}$	197.160$^{(b)(*)}$

For each of the industries, the first values correspond to the coefficients of each of the variables and values in brackets represent t-statistic of each; (1) Estimation with variables "dummies"; (2) Estimation with random effects; (*) coefficient statistically significant at 5% (**) Coefficient statistically significant at 10%; IMT, metals industries; IMI, industrial mineral;, IPQ, the chemicals industries; IEE, equipment and electrical goods industries; EIT, transport equipment industry; ITB, food industry; ITE, textiles industries; IPA, paper industry; IPD, manufacturing of various products; (a) accepted the hypothesis of random effects; (b) reject the hypothesis of random effects; (c) Amount not statistically acceptable.

9. CONCLUSIONS

The results of the estimations made in this period, notes that the manufactured industry provides greater increasing returns to scale.

The signs of absolute convergence are different from one manufactured industries to another, but there is a curious results for the equipment transport industry, because present strong evidence of absolute convergence and we know that this industry is a dynamic sector. In another hand we have the textile industry that we expect find strong signs of absolute convergence, because we know this is a sector with weak dynamics, but we do not see these evidences.

Of referring that the location of the Portuguese manufacturing industry is still mostly explained by specific factors of locations and the industrial policies of modernization and innovation are not relevant, especially those that have come from the European Union, what is more worrying.

So, we can that the strong increasing returns to scale in the same industries are not enough to avoid the convergence of this industries. On other hand the surprising signs of convergence in some industries are because the location of the manufactured industries in Portugal is mostly explained by the specific factors of the locations.

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