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The Economic Theory and the Portuguese Manufactured Industry

THE ECONOMIC THEORY AND THE PORTUGUESE MANUFACTURED INDUSTRY

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Abstract

This work aims to compare the Keynesian theory, namely by the Verdoorn Law, the neoclassical theory, by the absolute convergence, and the geographic concentration, by the Rybczynski equation, explanations about the different manufactured industry of the Portuguese regions (NUTs II), for the period 1986-1994. The Verdoorn Law, is tested with the alternative specifications of Kaldor (1966. The absolute convergence is tested for the productivity. To analyze the geographic concentration, with Rybczynski equation, is tested the importance which the natural advantages and local resources are in the manufacturing industry location, in relation with the "spillovers" effects and industrial policies.

Keywords: Verdoorn law; convergence theories; geographic concentration; panel data; manufactured industries; Portuguese regions.

JEL classification: O18, C23, R11, L60.

1. Introduction

Verdoorn law was rediscovered in 1966 and 1967 by Kaldor and since then this law became famous and used in different works. The conclusions obtained by these works are different, because some of them rejecting the Law of Verdoorn and other supporting its validity. 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) (Martinho, 2011a). The last relationship is preferred by Kaldor and because that is known as Kaldor model. Kaldor prefer this model, because avoid relations spurious that we maybe can find in the Verdoorn model, taking into account that the productivity is a quotient between the product and the employment. We expect find increasing returns to scale, when the Verdoorn coefficient approaches the unity and the Kaldor coefficient approaches zero. We can obtain each coefficient, making the difference between the unity and the other coefficient. Usually, the Verdoorn coefficient approaches the 0,45.

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

Taking into account the work of Kim (1999), we seek, also, 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). 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. (Martinho, 2011b). The Rybczynski equation is a very simple model, but has been used by several researchers. Anyway, some authors are critics of this model, because, statistically can be questionable using the difference between the R square adjusted and the unity as measure of the spillover effects and industrial plocies.

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.

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):

$$\Delta \ln P_{it} = c + b \ln P_{i,t-1} + \nu_{it} \quad (3)$$

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). 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, forestry and fisheries (represented by "Agriculture") and production of natural resources and energy (symbolized by "Energy"). The overall regression is then used as follows:

$$\ln Y_{it} = \alpha + \beta_1 \ln Labor_{it} + \beta_2 \ln Agriculture_{it} + \beta_3 \ln Energy_{it} + \beta_4 \ln Construction_{it} + \varepsilon \quad (4)$$

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 (Martinho, 2011b).

The availability of data in this period is a problem and avoids us to do more fine and disaggregated analysis, what had been important. Because, there are some effects that we only can catch with more detailed analysis. When we speak about sectoral and local economic dynamics these questions must be taken into account. But we think the results presented here are a good contribute for the economic Portuguese context and must be improved by other research.

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 1986 to 1994, corresponding to the five regions of mainland Portugal (NUTS II), and for the several manufactured industries in those regions. The data are relative, also, to regional gross value added of agriculture, fisheries and forestry, natural resources and energy and construction and public works. These data were obtained from Eurostat (Eurostat Regio of Statistics 2000).

6. Empirical evidence of the Verdoorn's law

The results in Table 1, obtained in the estimations carried out with the equations of Verdoorn and Kaldor for each of the manufacturing industries, enable us to present the conclusions referred following (Martinho, 2011a).

Manufacturing industries that have, respectively, higher increasing returns to scale, because the Verdoorn and Kaldor coefficient, are the industry of transport equipment, the food industry, industrial minerals, the metal industry, the several industry, the textile industry, the chemical industry and industry equipment and electrical goods. The paper industry has excessively high values. Note that, as expected, the transportation equipment industry and the food industry have the best economies of scale (they are modernized industries) and the textile industry has the lowest economies of scale (industry still very traditional, labor intensive, and in small units).

The constant coefficient is statistically significant only for the metal industry, mineral industry, transport industry and paper industry, sign that in these industries the Verdoorn and Kaldor models do not catch all the effects. The biggest results for the constant are for the metal industry.

Generally the results for the Verdoorn coefficients are statistically better than those for the Kaldor coefficient.

Taking into account the R^2 adjusted results, the biggest values are those for the metal industry, chemical industry and several industry, what allow us to say that the case of the metal industry is a

particular situation. Because, for this industry we have a constant value high and a R^2 adjusted high too.

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

Metal Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn $p_i = a + bq_i$	-4.019* (-2.502)	0.693* (9.915)	1.955	0.898	29
Kaldor $e_i = c + dq_i$	4.019* (2.502)	0.307* (4.385)	1.955	0.788	29
Mineral Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	-0.056* (-4.296)	0.744* (4.545)	1.978	0.352	38
Kaldor	0.056* (4.296)	0.256 (1.566)	1.978	0.061	38
Chemical Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	0.002 (0.127)	0.418* (6.502)	1.825	0.554	34
Kaldor	-0.002 (-0.127)	0.582* (9.052)	1.825	0.707	34
Electrical Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	0.004 (0.208)	-0.126 (-1.274)	1.762	0.128	32
Kaldor	-0.004 (-0.208)	1.126* (11.418)	1.762	0.796	32
Transport Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	-0.055* (-2.595)	0.819* (5.644)	2.006	0.456	38
Kaldor	0.055* (2.595)	0.181 (1.251)	2.006	0.040	38
Food Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	0.006 (0.692)	0.766* (6.497)	2.191	0.526	38
Kaldor	-0.006 (-0.692)	0.234** (1.984)	2.191	0.094	38
Textile Industry					

	Constant	Coefficient	DW	R^2	G.L.
Verdoorn	-0.008 (-0.466)	0.435* (3.557)	2.117	0.271	34
Kaldor	0.008 (0.466)	0.565* (4.626)	2.117	0.386	34
Paper Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	-0.062* (-3.981)	1.114* (12.172)	1.837	0.796	38
Kaldor	0.062* (3.981)	-0.114 (-1.249)	1.837	0.039	38
Several Industry					
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**
Verdoorn	-1.212 (-0.756)	0.550* (8.168)	2.185	0.529	37
Kaldor	1.212 (0.756)	0.450* (6.693)	2.185	0.983	37

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 presents the results for the absolute convergence of output per worker, in the estimations obtained for each of the manufactured industry of NUTS II, from 1986 to 1994 (Martinho, 2011c).

The convergence results obtained are statistically satisfactory for all manufacturing industries of NUTS II. We present only the results of the estimation method with the variables dummies (for each region), because are the more satisfactory and because the Hausman test values.

We can see that the values of the variables dummies are very similar for each industry, sign that there are not big differences between the several regions, what is expected taking into account the dimension of the NUTs II. Anyway, the major effects catch by these variables is for the chemical industry, transport equipment industry, textile industry and several industries. This means that the local effects are bigger in these industries.

The industries with strong signs of convergence are the transport equipment industry and several industries. These are two results not expected, taking into account the results for the Verdoorn Law. This means that the increasing returns for these two industries are not enough to avoid them convergence. For the others industries the results are more acceptable. Anyway, taking into account the results for the variables dummies these results are more comprehensive. In another words,

despite the high increasing returns for these industries, taking into account the values for the Verdoorn coefficient, the values of the results for the dummies variables say that the local effects are high for these industries, in the same line of what we saw about the constant results for the Verdoorn and Kaldor models. So, we can say that there are other factors that affect the spatial distribution of the manufactured industries, beyond the economic dynamics.

Analyzing the R^2 adjusted, the biggest results are that for the transport equipment industry, textile industry and the several industries.

Table 2: Analysis of convergence in productivity for each of the manufacturing industries at the five NUTS II of Portugal, for the period 1986 to 1994

Metals industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		2.171** (1.769)	2.143** (1.753)	2.161** (1.733)	2.752** (1.988)	---	-0.239** (-1.869)	-0.273	1.759	0.198	27
MInerals industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		1.884* (2.051)	1.970* (2.112)	2.004* (2.104)	1.926* (2.042)	1.731** (1.930)	-0.208* (-2.129)	-0.233	2.172	0.189	34
Chemical industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		6.104* (3.750)	6.348* (3.778)	6.381* (3.774)	6.664* (3.778)	6.254* (3.777)	-0.621* (-3.769)	-0.970	1.959	0.325	30
Electric goods industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		3.634* (2.363)	3.552* (2.360)	3.673* (2.362)	3.636* (2.376)	3.429* (2.324)	-0.381* (-2.355)	-0.480	1.259	0.167	34
Transport equipments industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		8.061* (4.948)	8.526* (5.007)	8.614* (4.986)	8.696* (4.998)	8.077* (4.961)	-0.871* (-5.014)	-2.048	2.049	0.429	34
Food industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		2.841* (2.555)	2.777* (2.525)	2.899* (2.508)	2.617* (2.471)	2.593* (2.470)	-0.274* (-2.469)	-0.320	1.786	0.198	34
Textile industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		5.556* (4.288)	5.487* (4.276)	5.506* (4.272)	5.561* (4.253)	5.350* (4.431)	-0.595* (-4.298)	-0.904	1.816	0.431	30
Paper industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		3.703* (2.803)	3.847* (2.840)	3.837* (2.813)	3.684* (2.812)	3.521* (2.782)	-0.382* (-2.852)	-0.481	1.516	0.196	34
Several industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
LSDV		7.802* (5.036)	7.719* (5.022)	7.876* (5.033)	7.548* (5.023)	7.660* (5.018)	-0.847* (-5.032)	-1.877	2.024	0.428	34

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, chemicals, equipment and electrical goods, textile and several products. On the other hand, there is an increased dependence on natural and local resources in industries as the mineral products, equipment and electric goods, textile and several products. 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 (Martinho, 2011b).

The results for the constant part and for the variables dummies are high, in the same line of we said before. The values for the variables dummies, of each industry, are more or less similar for the different regions, sign the differences between the NUT II are not significant. In this model the dummies variables are not statistically significant for the transport equipment industry. In another way, the relationship, for this industry, with the labor is weak, but the relationship with the proxy for the capital is strong, what is expected.

The relationship with the agriculture is only statistically significant for the mineral and chemical industries, what is not a relevant result. There are a positive relationship with the energy in the mineral industry and a negative relationship for the several industries. Capital is important for the mineral, transport equipment and textile industries. Have a negative effect for the metal industry.

Table 3: Results of estimations for the years 1986-1994

$$\ln Y_{it} = \alpha + \beta_1 \ln Labor_{it} + \beta_2 \ln Agriculture_{it} + \beta_3 \ln Energy_{it} + \beta_4 \ln Construction_{it} + \varepsilon$$

	IMT (2)	**IMI (1)**	**IPQ (1)**	**IEE (1)**	**IET (1)**	**IAL (2)**	**ITE (1)**	**IPA (1)**	**IPD (2)**
α	10.010 (0.810)					34.31(*) (3.356)			83.250(*) (5.412)
Dummy1		18.753(*) (5.442)	-13.467(*) (-3.134)	14.333(*) (2.811)	9.183 (1.603)		15.175(*) (3.652)	17.850(*) (3.162)	
Dummy2		19.334(*) (5.733)	-12.679(*) (-2.930)	13.993(*) (2.802)	10.084(**) (1.766)		14.904(*) (3.597)	17.532(*) (3.100)	
Dummy3		19.324(*) (5.634)	-13.134(*) (-3.108)	14.314(*) (2.804)	10.155(**) (1.797)		14.640(*) (3.534)	18.586(*) (3.313)	
Dummy4		18.619(*) (5.655)	-11.256(*) (-2.599)	14.022(*) (2.857)	9.384 (1.627)		15.067(*) (3.647)	15.001(*) (2.654)	
Dummy5		17.860(*) (5.629)	-11.060(*) (-2.682)	12.629(*) (2.653)	7.604 (1.377)		13.206(*) (3.344)	13.696(*) (2.574)	

β_1	1.420(*) (4.965)	0.517(*) (4.651)	1.098(*) (8.056)	0.817(*) (7.695)	0.397(*) (2.455)	0.378(*) (2.000)	0.809(*) (5.962)	-0.071 (-0.230)	0.862(*) (10.995)
β_2	0.844 (1.353)	-0.358(*) (-2.420)	0.709(*) (2.628)	-0.085 (-0.480)	-0.314 (-0.955)	-0.026 (-0.130)	-0.484(**) (-1.952)	-0.171 (-0.505)	-0.148 (-0.780)
β_3	0.431 (1.468)	-0.242(*) (-3.422)	0.120 (0.721)	-0.084 (-0.876)	0.147 (0.844)	-0.067 (-0.706)	-0.229(**) (-1.738)	-0.165 (-0.904)	-0.524(*) (-5.289)
β_4	-1.459(*) (-4.033)	0.359(*) (2.629)	0.260 (1.185)	0.061 (0.318)	0.433(*) (2.066)	0.166 (0.853)	0.529(*) (2.702)	0.427 (1.596)	-0.085 (-0.461)
R² adjusted	0.822	0.993	0.987	0.996	0.986	0.968	0.997	0.983	0.999
Hausman test	(c)	115.873(b)(*)	26.702(b)(*)	34.002(b)(*)	9.710(b)(*)	(c)	34.595(b)(*)	26.591(b)(*)	1.083(a)

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; IAL, 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

With the Keynesian theory, it appears that those with, respectively, higher dynamics are the transport equipment industry, food industry, minerals industrial, metals industry, the several industries, the textile industry, chemical industry and equipment and electrical goods industry. The paper industry has excessively high values.

About the neoclassical theory there is a curious result for the equipment transport industry and several industries, because present strong evidences of absolute convergence and we know that these industries are a dynamic sectors.

About the geographic concentration, of referring that the location of the Portuguese manufacturing industry is still mostly explained by specific factors of locations. The industrial policies of modernization and innovation are not relevant, especially those that have come from the European Union, what is more preoccupant. The relation expected between some industries and some local resources are not found, as for example the relation between the food industry and the agricultural sector.

So, we can say that the strong increasing returns to scale in the same industries (like the transport equipment industry) are not enough to avoid the convergence of these industries. On the other hand, although, the strong increasing returns to scale in the some industries, the location of the manufactured industries in Portugal is mostly explained by the specific factors of the locations, like the capital for the transport equipment industry.

The results found here say many things, in the period considered, about the Portuguese economic situation in general and about the Portuguese manufactured industry in particular. Maybe, this results explain many of the context we saw in the periods following and what we see today about the economic crisis in Portugal.

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