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A LINEAR MODEL OF THE NEW ECONOMIC GEOGRAPHY FOR PORTUGAL

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ABSTRACT

With this work we try to present a linear model for Portugal based on the new economic geography. We built the model taking into account an analyse about the agglomeration process in Portugal, using the New Economic Geography models, in a linear way. We considered, yet, for this model, the complementarily of clustering models, associated with the New Economic Geography, and polarization associated with the Keynesian tradition.

Keywords: new economic geography; linear models; Portuguese regions.

1. INTRODUCTION

To built the model, we mainly aimed to analyze the process of agglomeration across regions (NUTS II) of Portugal, using linear models of New Economic Geography, in particular, developments considered by (1)Krugman (1991), (2)Thomas (1997), (3)Hanson (1998) and (4)Fujita et al. (2000). We will also try to compare the results obtained by the empirical models developed by each of these authors ((5)Martinho, 2011a).

In a theoretical context, it is intended to explain the complementarily of clustering models, associated with the New Economic Geography, and polarization associated with the Keynesian tradition ((6)Martinho, 2011b).

2. THE BASE MODEL

Taking in to account the procedures referred in Martinho (2011a), we use the Krugman (1991), Thomas (1997) and Fujita et al. (2000) equations, respectively, as following (reduced and linearized):

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

$$\Delta \log(w_{it}) = \sigma^{-1}\left[\begin{array}{l}\log(\sum_j Y_{jt}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}}) - \\ \log(\sum_j Y_{jt-1}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt-1}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt-1}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}})\end{array}\right] + \Delta \eta_{it}\text{ , (2)}$$

$$\Delta \log(w_{it}) = \sigma^{-1}\left[\begin{array}{l}\log(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} T_{ijt}^{-(\sigma-1)}) - \\ \log(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} T_{ijt-1}^{-(\sigma-1)})\end{array}\right] + \Delta \psi_{it}\text{ , (3)}$$

In these equations, Yi is the income in region i, wi the wage in region i and dij is the distance between each pair of locations. Hi the supply of housing in the region i and Tij transport costs between regions i and j. The parameters to be estimated, these models are σ the elasticity of substitution between manufactured goods, μ the share of expenditure on manufactured goods and τ the transport costs to send a unit of manufactured goods in a unit distance. η_i, ν_i and ψ_i are error terms.

3. THE LINEAR MODEL

Considering only the equation of real wages, from the equations of static equilibrium, we obtain, in a reduced form the equation (4) and in a linear form the equation (5), taking in to account the procedures of Martinho (2011b).

$$\omega_r = \left[\sum_s Y_s T_{rs}^{1-\sigma} G_s^{\sigma-1}\right]^{1/\sigma} \left[\sum_s \lambda_s (w_s T_{sr})^{1-\sigma}\right]^{-\mu/(1-\sigma)}, \quad (4)$$

$$\log(\omega_r) = \frac{1}{\sigma}\log\left[\sum_s Y_s T_{rs}^{1-\sigma} G_s^{\sigma-1}\right] - \frac{\mu}{(1-\sigma)}\log\left[\sum_s \lambda_s (w_s T_{sr})^{1-\sigma}\right], \quad (5)$$

3.1. 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:

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{pt} + f_2 \ln T_{rpt} + f_3 \ln G_{pt} + f_4 \ln \lambda_{pt} + f_5 \ln w_{pt} + f_6 \ln T_{prt} + f_7 \ln P_{rt}, \quad (6)$$

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.

3.2. LINEARIZED AND REDUCED EQUATION OF REAL WAGES, WITH THE VARIABLES INDEPENDENT REGIONALLY DISAGGREGATED

Following it is presented 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:

$$\ln \omega_{rt} = f_0 + f_1 \ln Y_{rt} + f_2 \ln T_{rpt} + f_3 \ln G_{rt} + f_4 \ln \lambda_{rt} + f_5 \ln w_{rt} + f_6 \ln T_{prt}, \quad (7)$$

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.

3.3. 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 Armstrong (1995) and 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:

$$\ln\left(\frac{\omega_{rt}}{\omega_{lt}}\right) = a_0 + a_1 \ln Y_{nt} + a_2 \ln T_{rl} + a_3 \ln L_{nt} + a_4 \ln P_{rt} + a_5 \ln RL_{rmt} + a_6 \ln RL_{rgt} + a_7 RL_{rkt} + a_8 \ln RL_{rnt} \quad , (8)$$

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).

4. THE DATA USED

Considering the variables of the model presented previously, and the availability of statistical information, we used the following data at regional level: temporal data from 1987 to 1994 for the five regions (NUTS II) in mainland Portugal and for the various manufacturing industries existing in these regions, from the regional database of Eurostat statistics (Eurostat Regio of Statistics 2000).

5. CONCLUSIONS

O referring, it appears that the explanatory power of the independent variables considered in models of the New Economic Geography, 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, the "backward and forward" linkages and agglomeration economies, represented in the variables Rlrmt and RLrgt, have some importance in the explanation of Portuguese context. This taking into account the mentioned by (7)Marshall (1920) which in modern terminology argued that increasing returns to scale occur in industry, in the face of "spillover" effects, advantages of market expertise and "backward" and "forward" linkages associated with large local markets.

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.

Finally, is important to refer the importance of the transportation costs in explaining the spatial issues, reinforced by the fact that the estimates made with the seven NUTS II Portugal (including Madeira and Açores) present values much worse than when considering only the five NUTS II. What makes sense, since the real wage developments do not follow the increase in transport costs from the continent for these two Portuguese islands.

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