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A NON LINEAR MODEL OF THE NEW ECONOMIC GEOGRAPHY FOR PORTUGAL. ANOTHER PERSPECTIVE

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ABSTRACT

With this work we try to present a non 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 non linear way. In a non linear way, of referring, as summary conclusion, that with this work the existence of increasing returns to scale and low transport cost, in the Portuguese regions, was proven and, because this, the existence of agglomeration in Portugal.

Keywords: new economic geography; non 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 non 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.

Although the agglomeration process have appeared more associated with economic geography, it is however noted that it is based, as the polarization, the earlier ideas of (5)Myrdal (1957) and (6)Hirschman (1958), pioneers of the processes of regional growth with characteristics cumulative. The work developed at the level of economic geography, traditional and recent attempt to explain the location of economic activities based on spatial factors. The liberal economic policies, international economic integration and technological progress have created, however, new challenges that promote agglomeration (7)(Jovanovic, 2000). So, have been developed new tools for economic geography, such as increasing returns, productive linkages, the multiple equilibria (with the centripetal forces in favor of agglomeration and centrifugal against agglomeration) and imperfect competition. These contributions have allowed some innovations in modeling the processes of agglomeration, which has become treatable by economists, a large number of issues. In particular the inclusion of increasing returns in the analytical models, which led to the call of increasing returns revolution in economics (Fujita et al., 2000). (8-10)Krugman (1994, 1995 and 1998) has been the central figure in these developments. (11)Fujita (1988),(12) Fujita et al. (1996) and (13)Venables (1996), in turn, have been leaders in the development and exploration of the implications of economic models of location, based on increasing returns. These developments have helped to explain the clustering and "clustering" of companies and industries.

Hanson, in 1998, taking into account the model of Krugman (1991) and the extent of Thomas (1997) this model, had a good theoretical and empirical contribution to empirically examine, with reduced forms, the relationship between increasing returns to scale, costs transportation and geographical concentration of economic activity.

2. THE MODEL

The model of Krugman (1991) describes himself, then, as follows:

$$Y_i = (1 - \mu)\phi_i + \mu\lambda_i w_i, \text{ income equation (1)}$$

$$G_i = \left[\sum_j \lambda_j (w_j e^{-\tau d_{ij}})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \forall i, \text{ index price equation (2)}$$

$$w_i = \left[\sum_j Y_j (G_j e^{-\tau d_{ij}})^{\sigma-1} \right]^{\frac{1}{\sigma}}, \forall i, \text{ nominal wage equation (3)}$$

$$\frac{w_i}{w_j} = \left(\frac{G_i}{G_j} \right)^\mu, \text{ real wage equation (3)}$$

In these equations, Y_i is the income in region i , w_i the wage in region i , ϕ_i is the percentage of agricultural workers in region i , G_i the price index for manufactured goods in the region i and d_{ij} is the distance between each pair of locations. In equilibrium the region i share λ_i employed in sector of manufactured goods which is equal to the fraction of companies located in manufactured goods in region i , n_i/n . Alternatively Thomas (1997) presents the following extension of the model of Krugman (1991):

$$Y_i = \lambda_i L w_i, \forall i, \text{ income equation (5)}$$

$$P_i H_i = (1 - \mu) Y_i, \forall i, \text{ housing price equation (6)}$$

$$G_i = \left[\sum_j \lambda_j (w_j e^{ad_{ij}})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \forall i, \text{ price index equation (7)}$$

$$w_i = \left[\sum_j Y_j (G_j e^{-ad_{ij}})^{\sigma-1} \right]^{\frac{1}{\sigma}}, \forall i \text{ nominal wage equation (8)}$$

$$\frac{w_i}{P_i^{1-\mu} G_i^\mu} = \frac{w_j}{P_j^{1-\mu} G_j^\mu}, \forall i \neq j, \text{ real wage equation (9)}$$

Y_i is the income in region i , w_i the wage in region i , L the total supply of workers for the manufactured goods sector, λ_i the percentage of employees in the sector of manufactured products, P_i the price of housing in region i , the G_i price index for manufactured goods in region i , H_i the supply of housing in the region i and d_{ij} is the distance between each pair of locations.

Recently Fujita et al. (2000) also presented an alternative model:

$$Y_i = \mu \lambda_i w_i + (1 - \mu) \phi_i, \text{ income equation (10)}$$

$$G_i = \left[\sum_j \lambda_j (w_j T_{ji})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \text{ price equation (11)}$$

$$w_i = \left[\sum_j Y_j T_{ij}^{1-\sigma} G_j^{\sigma-1} \right]^{\frac{1}{\sigma}}, \text{ nominal wage equation (12)}$$

$$\omega_i = w_i G_i^{-\mu}, \text{ real wage equation (13)}$$

Y_i is the income in region i , w_i the wage in region i , ϕ_i is the percentage of agricultural workers in the region i , λ_i the percentage of employees in the sector of manufactured products, G_i price index for manufactured goods in region i , and T_{ij} 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.

Note that, as can be seen, the three models are very similar, the main difference is that Thomas (1997) have considered building housing sector (power anti-agglomeration) and have created more than one equation and Fujita et al. (2000) have considered transport costs as variables and not considered as parameters in their models Krugman (1991) and Thomas (1997).

It should be noted also that the equations of the income of the previous models, it is assumed that agricultural workers earn the same wage everywhere, given that agricultural goods are freely transported. Were chosen, on the other hand, units such that there are μ workers in manufacturing and $1 - \mu$ agricultural workers.

It could be argued that as industrial workers who are potential users, then locations with large concentrations also tend to have high demand for manufactured goods. This concentration of consumers and producers to some extent explains the cumulative process that may lead to agglomeration phenomena.

Following procedures of Hanson (1998), substituting equations (1) and (4) in (2) yields the reduced equation (14), substituting equations (5), (6) and (9) in (8) obtain the reduced equation (15) and substituting equations (10) and (13) in (11) yields the reduced equation 16, namely:

$$\log(w_i) = C + \sigma^{-1} \log \left(\sum_j Y_j w_j^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) + v_i, \quad (14)$$

$$\log(w_i) = D + \sigma^{-1} \log \left(\sum_j Y_j^{\frac{\sigma(\mu-1)+1}{\mu}} H_j^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_j^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) + \eta_i, \quad (15)$$

$$\log(w_i) = F + \sigma^{-1} \log \left(\sum_j Y_j w_j^{\frac{\sigma-1}{\mu}} T_{ij}^{-(\sigma-1)} \right) + \psi_i, \quad (16)$$

Thus Hanson (1998) solved the problem of lack of price indices for manufactured products and prices for housing at more disaggregated geographic levels. In the last two equations C, D and F are constants and parameters, and η_i , v_i and ψ_i are error terms.

Furthermore, if the sources of correlation are unobservable factors that are constant over time, then these factors can be controlled using a specification with differentiation in time, which makes the variables expressed in growth rates. Given the dearth of statistical data for the Portuguese regions and the small size of the Portuguese territory, this third alternative to solve the problems of endogeneity seems to be the most viable and as such will be adopted in this work.

Using the differences in the timing of the regression equations, the equation (14) becomes:

$$\Delta \log(w_{it}) = \sigma^{-1} \left[\begin{array}{c} \log \left(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) - \\ \log \left(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) \end{array} \right] + \Delta v_{it}, \quad (17)$$

Equation (15) is also

$$\Delta \log(w_{it}) = \sigma^{-1} \left[\begin{array}{c} \log \left(\sum_j Y_{jt}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) - \\ \log \left(\sum_j Y_{jt-1}^{\frac{\sigma(\mu-1)+1}{\mu}} H_{jt-1}^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_{jt-1}^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) \end{array} \right] + \Delta \eta_{it}, \quad (18)$$

Similarly, equation (16) is as follows

$$\Delta \log(w_{it}) = \sigma^{-1} \left[\begin{array}{c} \log \left(\sum_j Y_{jt} w_{jt}^{\frac{\sigma-1}{\mu}} T_{ijt}^{-(\sigma-1)} \right) - \\ \log \left(\sum_j Y_{jt-1} w_{jt-1}^{\frac{\sigma-1}{\mu}} T_{ijt-1}^{-(\sigma-1)} \right) \end{array} \right] + \Delta \psi_{it} \quad (19)$$

On balance, taking into account the developments of the New Economic Geography, a value $\sigma/(\sigma-1)$ greater than one indicates that the production is subject to increasing returns to scale. This is because, for the New Economic Geography economies of scale arise through the number of varieties of

manufactured goods will be greater the lower the elasticity of substitution σ . Thus, the lower the elasticity of substitution is further away from one the value of $\sigma/(\sigma-1)$ and the greater the increasing returns to scale.

(14) Krugman (1992) shows that if $\sigma(1-\mu) > 1$, then 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 transport costs. If $\sigma(1-\mu) < 1$, then increasing returns are sufficiently strong or the fraction is sufficiently high, such as economic activity is concentrated geographically to any value τ .

3. THE NON LINEAR MODEL

Analysis of the results, obtained in the estimations, it appears that these are slightly different for the reduced equations of the three models considered, with the estimates made with the equation of the Thomas model present statistically better results. Possibly because it is an equation to work harder and thus beyond the centripetal forces of agglomeration, consider also the centrifugal forces of anti-agglomeration by immobile factors. Anyway, the results obtained with the estimates of the three equations confirm some importance, but small, of the transport costs, given the low values of the parameter τ . Looking at the increasing returns to scale, calculating, as noted, the value $\sigma/(\sigma-1)$, it appears that this is always greater than one, reflecting the fact that there were increasing returns in the Portuguese regions in this period. It should be noted also that the parameter values μ are unreasonably high in all three estimations, however, as stated there is a tendency for these values that fall around the unit in most empirical work.

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 the period 1995 to 1999, for the NUTs III and for total manufacturing, from the INE (National Accounts 2003).

5. CONCLUSIONS

Note that the results obtained with the estimates of Thomas model equations are statistically more satisfactory, possibly because they consider in these equations in addition to the centrifugal forces present in the increasing returns, also centrifugal forces, in this work, by the number of employees in the sector agricultural. It should be noted, finally, that transport costs have had some importance in the evolution of the space economy in Portugal, although has been decreasing in recent years, which is understandable given the investments that have been made in terms of infrastructure, especially after our entrance into the European Economic Community in 1986, with the support that has been under structural policies.

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