UNIVERSITÀ DEGLI STUDI DI NAPOLI
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HOW MUCH SPECIALIZATION MATTERS IN EUROPEAN GROWTH: AN APPLICATION OF CART ANALYSIS TO EMU REGIONS

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HOW MUCH SPECIALIZATION MATTERS IN EUROPEAN GROWTH: AN APPLICATION OF CART ANALYSIS TO EMU REGIONS[♦]

Rita De Siano[*] and Marcella D'Uva[**]

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Indice

1. *Introduction*

The main consequence for the countries joining the European Monetary Union (EMU) is the loss of an independent monetary policy, that is the abandon of domestic interest rates and nominal exchange rates as policy instruments aimed at macroeconomic stabilization. According to most of the contributes to the "New Optimum Currency Areas" theory, costs of this renounce are closely linked to the similarities among countries' industrial structures, crucial in determining the size of responses to external shocks.

Caporale (1993) evidences the importance of knowing the nature of economic shocks in order to evaluate the potential costs and benefits of joining the EMU. When the shock arises in a sector producing homogeneous goods, hence characterized by weak trade barriers, it could be uniformly transmitted in the whole area through the international exchanges. On the opposite, when the disturbance is originated in a non-homogeneous sector, there appears to be an inverse correlation between the existence of trade barriers and the resulting symmetry of its effects.

Researchers dealing with EMU issues formed controversial opinions on the nature of the shocks affecting Union members. Some of them (Emerson (1991); Manasse, Helg, Monacelli, Rovelli, (1995); Frankel, Rose, (1996)) conclude that the exchange trade following the monetary integration may induce an increasing homogeneity industrial structures, even if countries did not show *a priori* synchronized business cycles. As a consequence of the increasing symmetry, both on the demand and the supply side, monetary union may become more desirable and sustainable.

On the other hand, there are economists (Kenen (1969), Krugman (1993)) thinking that monetary integration may increase the probability of asymmetric shocks as a consequence of a higher specialization of the domestic production structures. Each country may specialize in those productions where it shows comparative advantages; of course, this may contribute to change the nature of the shocks which, being initially sector specific, are transformed into country specific.

This work is based on the idea that costs related to European Monetary Integration should be evaluated at a region level rather than at a country level since Monetary Union cancels the relevance of national borders. Looking at the uniformity of the economic structure inside the union, different areas than those based on geographical and political criteria may be obtained. Once the idea of individual countries has disappeared and new core groups may come out, exhibiting no links with the old administrative borders, adjustment problems become pertinent to regional economics and no more to international economics.

In our opinion, evidences from the theory together with methods suggested by empirical analyses should be applied to the regional economic system. Indeed, greater differences in the productive structure may be found among the regions with no regard to the nations which they belong to. Particularly, the empirical evidence on the European regional growth during the last 15-20 years shows the following stylized facts:

i) it is possible to identify different groups of regional economies with an internal high level of homogeneity;

ii) together with a high *intra*-group homogeneity data display an increasing *inter*-groups differentiation.

Given the evidences mentioned above, the objectives of this work are first of all the identification and description of groups of regional economies at NUTS2 level[1] of ten countries (Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherland, Portugal and Spain), among those joining the Euro-zone, according to the productive structures they show before the entrance in the European Monetary Union and, secondly, the analysis of the regional specialization evolution that followed the monetary integration process. In a short period analysis the existence of groups of regions, showing a higher internal homogeneity, may determine asymmetric responses to economic shocks. Based on this eventuality a long term dynamic analysis could be used to verify the existence of multiple equilibria in regional growth processes and the contribution of shocks to diverging growth rate levels. Therefore, the final objective of this work will be the estimation of the per-capita Gdp growth rate of each group in order to verify the convergence/divergence of the considered regions. This investigation may involve considerable implications for economic policies, particularly those dealing with evaluation process of the central policies' impact on regional economic activities.

The procedure of groups' identification generally is carried out using the tools supplied by multivariate statistical analyses, as for example the traditional duster analysis. In our work we apply a classification and segmentation methodology, the Classification And Regression Tree analysis (CART), which has been used up to now mainly in marketing and financial sectors and, by academic researches, in the medical field. In spite of this recently, there has been a growing interest by applied economists (Durlauf and Johnson, 1995, Johnson and Takeyama, 2001) in the potentialities of this method, as CART analysis shows a higher explanatory power if compared to the cluster methodology. The main difference between the two methodologies is the fact that the CART is able to select endogenously the "optimal" predictors (split variables) of the outcome variable of interest (dependent variable in the regression process), preserving a sufficient number of degrees of freedom for further analyses.

The paper is organised as follows: section 2 describes the methodology, section 3 displays the data used in the empirical analysis, section 4 shows the estimates and the results of CART method, section 5 concludes. Besides, Appendix 1 lists the groups of regions after the Classification and Regression Tree and Appendix 2 shows a graphical representation of the grown tree.

2. *Methodology*

Hence, the empirical analysis is based on the CART methodology (Classification And Regression Tree), first described by Breiman *et all.* (1984), which provides binary recursive

[1] Nomenclature of statistical territorial units according to the Eurostat classification of the administrative regions.

partitionings using non-parametric approaches. The main result of this procedure is the construction of homogeneus groups of individuals, named "nodes", using as splitting variables those predictors which minimize the "impurity" (heterogeneity) within the group. Differently from others partitioning methodology CART allows to classify individuals without any information on the underlying distribution of the predictor variables. In other words there is no need to determine whether these variables are normally distributed and make transformations if they are not.

The term "binary" implies that the algorithm used by this technique splits the dataset always into two subsets based on a single best predictor variable. This procedure may be applied over and over again in a "recursive" way. The outcome is a tree with branches and terminal nodes, constructed to be as much homogeneous as possible, where the predicted value of the dependent variable is equal to the average value of the node. Each node (parent node) may be splitted into two sub-groups defined as child nodes.

Tree building starts from a "root node" containing the individuals of the whole sample (learning dataset). The first step is aimed at finding the splitter (then best among all the possible splitting variables) that seeks to maximize the average "purity" of the two child nodes, that is to minimize the variance explained in each node. Different measures of purity, called "splitting criteria", can be chosen in order to group the individuals. The most common are the Gini, the Twoing and the Power-modified Twoing splitting rules where the first, performing tipically best, is generally preferred in dealing with quantitative variables. The heterogeneity index of Gini is given by the following expression:

$$G = 1 - \sum_{i=1}^{r} f_i^2$$

where f_i^2 is the relative frequency of the i-th modality of a phenomenon which may assume *r* modality. The range of G is the interval [0,1] where G=0 denotes maximum homogeneity and G=1 maximum heterogeneity. Gini tries to divide classes of modality by focusing on one class at a time: separating the most "important" class in each node (with a higher frequency) until the final tree contains only pure child nodes. The regression is conducted using the least square method which allows to minimize the *intra*-group variability of the dependent variable. The process is stopped when there is only one observation in each child node, when splitting becomes impossible because observations contained in the node have an identical distribution of predictor variables and finally when a limit on the number of levels in the maximal tree is given exogenously. With the exclusion of the last case, it is necessary to "prune" the tree because the maximal tree generally overfits the original dataset.

In order to prune (to generate a sequence of smaller and simpler trees) the method of minimizing a measure of error-complexity $R_\alpha(T)$ can be used. This method is indicated by the following expression:

$$R_\alpha(T) = \hat{R}(T) + \alpha\left|\tilde{T}\right|$$

where $\hat{R}(T)$ is an estimate of the variance within the node, α is a sequence of complexity parameters (nodes are pruned away as α increases) and $\tilde{T}$ indicates the set of all the terminal nodes of the tree. Beginning at the last level the child nodes are pruned away if resulting change in the predicted misclassification cost is less than α times the change in tree complexity.

In our analysis, in order to chose the best tree, we select the Standard Error rule which generates the smallest tree within a single standard error of the minimal cost tree. Testing and selection of the optimal tree are integral parts of the CART algorithm.

The reason why we decided to apply this methodology is deeply linked to the presence of several key advantages. First of all, unlike other methodologies, CART allows to perform a regression together with a classification analyses on the same "learning" dataset. Besides, CART does not require specification of a functional form for the predictor variables and an *a priori* selection of the splitting variables and results to be extremely robust to the effects of occurring outliers. Finally, CART's embedded test disciplines ensure that the patterns found will hold up when applied to new data.

3. *The data*

In what follows we build a dataset containing indicators of the regional specialization which will be used in the CART process. Regional database nowadays available (EUROSTAT) contains information on the added value and number of workers for each branch of economic activity.

The study covers the period 1986-2000 and refers to 123 regions belonging to ten of the Euro-area countries so divided: 9 regions for Belgium, 20 for France, 29 for Germany, 11 for Greece, 20 for Italy, 12 for Nederland, 15 for Spain, 5 for Portugal[2]. Eurostat Nuts2 classifications during the considered period takes Ireland and Luxembourg as two single regions.

The dependent variable used in the regression tree analysis is the growth rate of per-capita GDP relative to the whole period (1986-2000). Control variables used to group regions are represented by the following measures:

- per-capita output at the beginning of the sample period (GDP86);
- Balassa indices of specialization relative to agriculture, industry and services sectors (Bal01, Bal02, Bal03);
- Krugman specialization index (KRUG);
- an indicator of the penetration of the high-tech sector (IHT);
- an indicator of market power of each region (potmer).

[2] Our sample excludes those regions for which there is a lack of data as for example some belonging to Eastern Germany regions and some of the French colonies.

Balassa indices are given by the following expression:

$$BALASSA_{sr} = \frac{\dfrac{E_{sr}}{\sum_r E_{sr}}}{\dfrac{\sum_s E_{sr}}{\sum_s \sum_r E_{sr}}}$$

where E stands for employment[3] and the subscripts s and r denote sectors and regions respectively. This measure takes values between zero and infinity and increases as regional specialization in a particular sector increases.

Krugman index represents a measure of similarity of regional production structures with respect to the whole sample average:

$$KRUG = \frac{1}{2} \sum_s \left| E_r^s - \overline{E}^s \right|$$

where the difference between E_r^s, the share of employment in a sector in region *r,* and $\overline{E}^s$, the sample average share, is summed over all sectors. This specialization index takes the value 0 if a region has a production structure which is identical to the whole sample average and takes the value 1 if the region's structure is completely different.

The indicator measuring the penetration of the High-Tech sector is given by the number of patents over the annual Government expenditure for patents.

Average values of all the annual indices written above have been used in our regression tree analysis.

The Market Potential Index[4] of a particular region is based on its own Gdp and the Gdp of the surrounding regions. Gdp figures are adjusted to reflect the increased cost of accessing markets as distance increase. Thus the Gdp of a neighbouring region is discounted less heavily than the Gdp of a more distant region because the trade costs of tapping in to the Gdp of the latter are lower. Specifically, the formula for the market potential index of region i (MP_i) is defined as:

$$MP_i = \frac{GDP_i}{\sqrt{D_{ii}}} + \sum_{j=1}^{N} \frac{GDP_i}{W_j \cdot \sqrt{D_{ij}}}$$

[3] Employed persons by sectors as given by the Community labour force survey in the Eurostat regional database.

[4] The data on Market Potential Index were taken from Pricewaterhouse Coopers European Economic Outlook (september 1999).

Dij is the distance between the principal cities of regions *i* and *j*; this distance is square rooted reflecting the fact that a region twice as far away as another region is not twice as costly to access. N is the number of neighbouring regions and W is a weight used to discount neighbours that are overseas.

4. *CART's estimates and results*

The application of CART analysis to the dataset presented in the previous section has been finalized to the construction of a tree presenting terminal nodes including those regions which showed a more homogeneus behaviour of the per-capita Gdp growth rate.

First we used all the splitting variables (predictors) in order to evaluate the relative importance of each of them in the grouping process. The regression splitting rule we used was the least squares method. The main result was the evidence of a higher weight of variables such as GDP86 and Balassa indices compared to the other indicators.

The second step was to grow a tree (Figure 1, Appendix 2) using only GDP86 and the three Balassa indices as predictor variables, and again the least squares method as regression splitting rule. Once more Gdp revealed to be the most significant predictor variables, followed by Bal02, Bal03 and Bal01, respectively. The resulting tree presents 13 homogeneous terminal nodes (ordered according to the level of per-capita Gdp), each of one shows a particular specialization together with a different output level. A list of the regions included in each group is contained in Appendix 1.

In what follows we detail the characteristics of each group:

- *Group 1*. This group includes twelve regions and presents a predicted value of per-capita Gdp growth rate equal to 0,705. With exclusion of Noord-Holland, Zuid-Holland, Utrecht and Lazio, these regions show the minimum value of the initial per-capita Gdp (GDP86<7400 in terms of purchasing power parities) and the highest level of specialization in agricultural sector (Bal01>2,85). All regions present a low level of industrial specialization (Bal02<0,6185) and the lowest level of services specialization (Bal03<0,7), except for Noord-Holland, Zuid-Holland, Corse and Lazio which show a rather high value of Bal03. After all, the common factor of regions belonging to this group is a low level of industrial specialization.

- *Group 2*. This group includes seven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,533. In this group the initial level of per-capita Gdp is higher than that in group 1 (GDP86<9000 except for Liguria and Provence with 11200< GDP86≤13814). Regions generally showed a higher level of specialization in agriculture and services than in industry (Bal01<1,4; 0,61<Bal02≤0,76; Bal03>1,08).

- *Group 3*. This group includes seven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,399. The group is characterized by a high specialization in agricultural sector and a low level of initial Gdp (GDP86<8000 except for Aquitaine). The specialization in the services sector is rather high (1,01<Bal03≤1,08, except for Thessalia and Extremadura) while the level of Bal02 is low (0,61<Bal02≤0,76).

- *Group 4*. This group includes eleven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,929. This group, as the previous one, shows a high specialization in the agricoltural sector, a low level of initial per-capita Gdp but a lower specialization in the services sector (Bal03<0.9 except for Attiki that presents a higher level of Bal03 probably due to the turistic activity). Bal02 values are close to the European average (0.93).

- *Group 5*. This group includes ten regions and presents a predicted value of per-capita Gdp growth rate equal to 0,574. Regions belonging to this group show a medium initial per-capita Gdp (7436< GDP86≤11181) and a higher specialization in agriculture (Bal01>0,95). The specialization in the industrial sector seems to be rather low (Bal02<0,9) while that in the services is close to the European average (Bal03≤ 1,08).

- *Group 6*. This group includes eleven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,659. This group shows a medium value of initial per-capita Gdp (7436< GDP86≤11181), a level of agricultural specialization little above the European average (Bal01>1.07), a higher level of Bal02 than the European average (0,93<Bal02≤1,031) and a medium level of services specialization (Bal03≤1,08). As a result, regions included in group seem to be specialized in all the sectors considered in this study.

- *Group 7*. This group includes seven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,408. Regions belonging to this group display again a medium level of initial per-capita Gdp (7436< GDP86≤11181), an average level of Bal01 (Bal01>0,7) except for Nord-Pas-de-Calais and Lorraine, a Bal02 level above the European average (1,031<Bal02≤1,15) and a medium specialization in services sector (Bal03≤1,08).

- *Group 8*. This group includes twelve regions and presents a predicted value of per-capita Gdp growth rate equal to 0,728. This group presents the same levels of initial per-capita Gdp and Bal03 as the previous one and the highest level of industrial specialization (Bal02>1,155) with respect to all the other groups. It includes regions which are either considerably or slightly specialized in the agricultural sector.

- *Group 9*. This group includes eleven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,917. Regions of this group show a level of initial Gdp rather high (7436< GDP86≤2100.5) and a level of agricultural specialization generally below the European average (Bal01<0,7) except for Oost-Vlaanderen and West-Vlaanderen. They present a medium level of Bal02 and a medium level of Bal03 (Bal03<1,048).

- *Group 10*. This group includes thirteen regions and presents a predicted value of per-capita Gdp growth rate equal to 0,654. This group includes regions with a high level of initial per-capita Gdp (12100,5<GDP86≤13819), a slight specialization in agriculture (Bal01<0,75) except for Trentino (1,2<Bal01≤1,5) and medium values of Bal02 (around 0,93) and Bal03 (Bal03≤1,08).

- *Group 11*. This group includes seven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,886. Regions belonging to this group display a specialization which increases in the services sector (Bal03>1,08) and decreases in agriculture (Bal01<0,9) as the initial Gdp levels increase (7436< GDP86<13819). Registred levels of industrial activity are around the European average.
- *Group 12*. This group includes eight regions and presents a predicted value of per-capita Gdp growth rate equal to 0,916. This group gives an evidence of a positive correlation between initial wealth (13819< GDP86≤15969) and industrial specialization. Among these regions there are some which are the most specialized in industrial activity (Bal02>1,144) and, except for Antwerpen, they show a high specialization in the services sector, too.
- *Group 13*. This group includes seven regions and presents a predicted value of per-capita Gdp growth rate equal to 0,853. Regions included in this group are the richest among European regions (GDP86>15969) and show a very low specialization in agricultural sector (Bal01<0,62). This group presents a high specialization in the services sector (except for Stuttgart which, together with Darmstadt, is specialized in industrial sector) and generally a low level of Bal02.

As regards the High Technology Index (IHT) a further empirical analysis showed the presence of increasing levels as we go through the groups starting from the first up to the last one. Besides, regions belonging to the last groups show a market power considerably higher than those belonging to the former ones.

The chief evidence of this study is the absence of a catching up process among the considered regions. As matter of fact, groups characterized by different levels of initial per-capita Gdp show different predicted values of Gdp growth rate in the sense that richer regions display higher values than poorer regions. This trend leads us to hypothesize the existence of long term multiple equilibria and a consequent increasing divergence of output levels.

Regions showing a higher estimation of per-capita Gdp growth rate are those characterized by a more considerable specialization in industrial sectors (groups 9 and 12). This outcome may confirm the consideration that industry is a leading sector of the economic activity. A further result is the identification of a second "core" of regions (groups 11 and 13). more specialized in the services sector with a predicted output growth rate slightly lower than that of the first "core" The last outcomes may be well explained if one keeps in mind that the last 20 years have been characterized above all by a quick and increasing development of High-Tech productions. The process, generated in the United States, subsequently spread all over the Continental Europe countries.

In our investigation a particular mention must be given to the fourth group of regions, which, despite of a low initial level of output, showed estimates of Gdp growth rate values analogous to that of the most developed groups. The high level of specialization in the agricultural sector, together with an average industrial specialization, did not prevent these regions from experimenting a sizeable development.

5. *Conclusions*

What has been emphasized in our work is the application of a new classification technique, namely the Classification And Regression Tree analysis (CART), to the economic data relative to regions belonging to some of the countries joining the European Monetary Union. This methodology allowed us to generate groups of regions which showed the minimum *intra*-group heterogeneity of per-capita Gdp growth rate (dependent variable). Control variables, that is those variables and the respective splitting values which seemed to behave best in grouping, have been chosen endogenously among all the available predictors.

The first result has been the identification of 13 homogeneous terminal nodes (ordered according to the predicted level of per-capita GDP) showing each a particular level of specialization in the sectors considered (agriculture, industry, services) and different output levels.

The empirical evidence shows a variety of combinations between Gross domestic product growth rate and sector specialization. In addition to groups of poorer regions, more specialized in the agricultural activity, and richer ones, more specialized in the industrial sector, there are several groups which show a set of different trade-off between these predictor variables. A new element of this study is the identification of a group of regions, appearing to be the richest of our sample, which show a very high level of specialization in the services sector, result that could be a consequence of the period chosen for our empirical investigation.

The main outcome of this work is the absence of a catching up process among the considered regions. The existence of rich regions displaying values of Gdp growth rate higher than those of poorer regions may support the hypothesis of long term multiple equilibria and a consequent increasing divergence of output levels.

6. *References*

Baldwin, (1989), "The growth effects of 1992" *Economic policy*, October.

Barrios S., Brülhart M., Elliot R.J.R. (2001): Sensier M.: "A Tale of Two Cycles: Co-fluctuation between UK regions and Euro Zone " *Working Paper no.003*, Centre for Growth and Business Cycle Research, School of Economic Studies, University of Manchester.

Breiman L., Friedman J.L., Olshen R.A and Stone .C.J.(1984): "*Classification and Regression Trees"*, Wadsworth , Belmont, CA.

Brülhart, M.(2001): "Evolving Geographical Specialisation of European Manufacturing Industries", *DEEP Working Papers* no.00.08, University of Lausanne.

Caporale G.M.(1993): "Is Europe an Optimun Currency Area?" *CEPR, Discussion Papers* No.915, February.

D'Uva M., De Siano R., Messina G. (1999), "Aree Valutarie Ottimali: Literature Review", *Istituto Universitario Navale Working Paper no. 2/99.*

Durlauf S.N., Johnson P.A. (1995):"Multiple regimes and cross-country growth behaviour", *Journal of Applied Econometrics*, vol.10, pp.365-384.

Emerson, (1991):"Aspects of the economics of EMU", *European Economic Review*, no.35.

Frankel, J.A.; Rose A.K.(1996): "The endogeneity of the Optimum Currency Area criteria *", NBER Working Papers Series*, n.5700, August.

Hallet M. (2000): "Regional Specialisation and Concentration in the EU, Directorate -General for Economic and Financial Affairs*, European Commission, Economic Papers* no.141.

Johnson P.A., Takeyama L.N.(2001):"Initial conditions and economic growth in the US states", *European Economic Review* no.45, pp.919-927.

Kenen , P.B.,(1969): "The theory of Optimum Currency Areas: an Eclectic View", in "*Monetary problems of the International Economy."* by Mundell, R. A., and Swaboda, A.K., University of Chicago Press, pp.41-60.

Krugman P.,(1993): "Lessons of Massachusetts for EMU" in Torres F.,Giavazzi F."*Adjustment and growth in the European Monetary Union*" , Cambridge University Press.

Lewis R.J.(2000): "An Introduction to Classification and Regression Tree (CART) Analysis", presented at the *2000 Annual Meeting of the Society for Academic Emergency Medicine* in San Francisco, California.

Manasse -Helg-Monacelli-Rovelli (1995): "How much (A)Simmetry in Europe? Evidence from industrial sectors", *European Economic Review*, vol.39, n.5.

Midelfart-Knarvik K.H., Overman H.G., Redding S.J. and Venables A.J.(2000): "The location of European Industry", Report prepared for the Directorate-General for Economic and Financial affairs, *European Commission, Economic Papers* no.142.

Mundell R(1961) : "A Theory of Optimum Currency Areas", American Economic Review, no.51, pp.657 - 665.

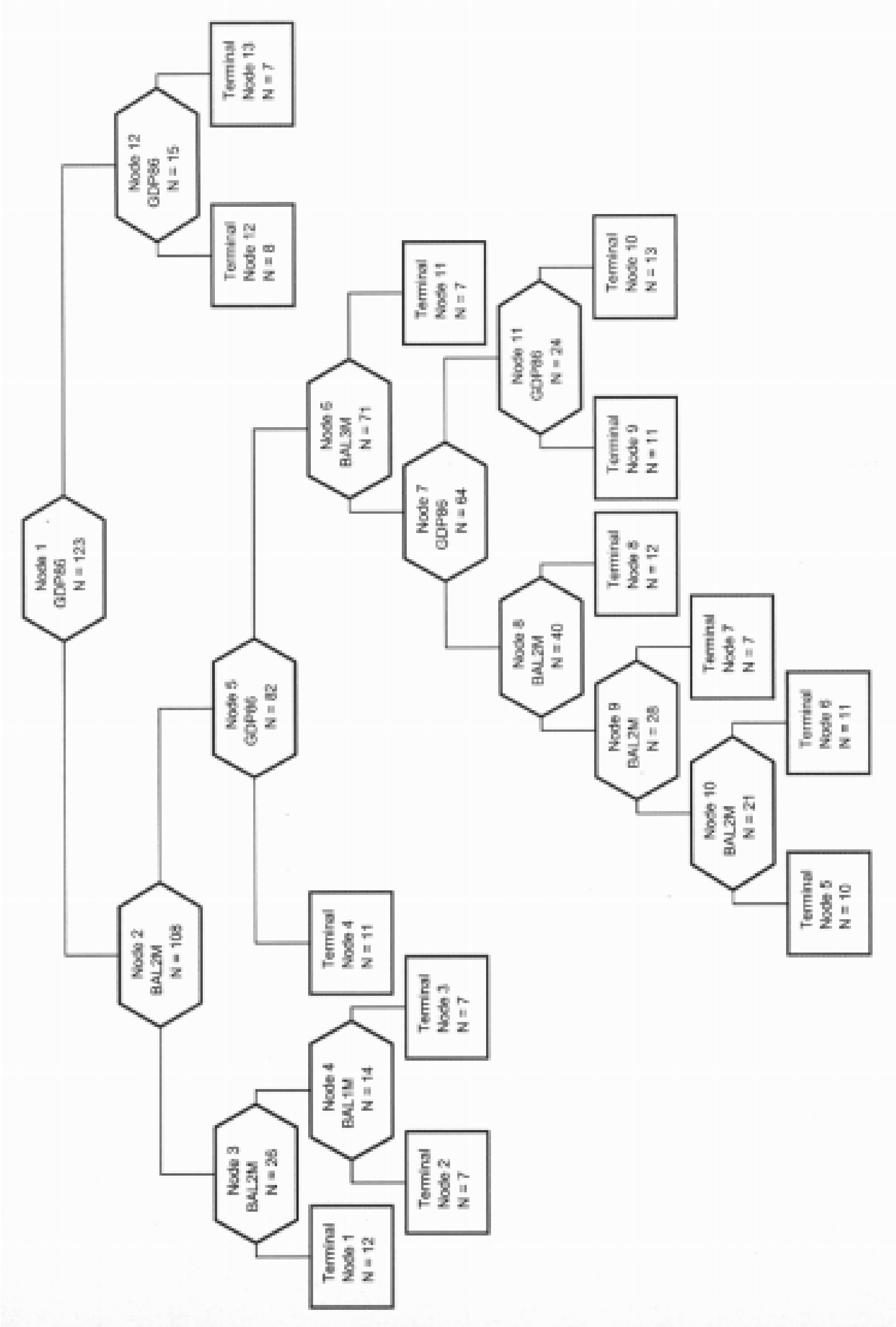
Appendix 1

Groups of regions

1. Corse (FR), Anatoliki Macedonia, Thraki (GR), Ipeiros (GR), Dytiki Ellada (GR), Peloponnisos (GR), Kriti (GR), Lazio (I), Calabria (I), Utrecht (NL), Noord-Holland (NL), Zuid-Holland (NL), Algarve (PT).
2. Luxembourg (B), Namur (B), Languedoc-Roussillon (F), Provence-Alpes-Côte d'Azur (F), Notio Aicaio (GR), Liguria (I), Flevoland (NL).
3. Andalucia (E), Extremadura (E), Aquitaine (F), Thessalia (GR), Campania (I), Sicilia (I), Sardegna (I).
4. Galicia (E), Castilla y León (E), Castilla-la Mancha (E), Kentriki Makedonia (GR), Ditiki Makedonia (GR), Attiki (GR), Ireland (IE), Norte (PT), Centro (PT), Alentejo (PT).
5. Molise (I), Puglia (I), Friesland (NL), Drenthe (NL), Sterea Ellada (GR), Auvergne (F), Midi-Pirénées (F), Poitou- Charentes (F), Bretagne (F), Basse- Normandie (F).
6. Umbria (I), Abruzzo (I), Overijssel (NL), Limburg (NL), Noord-Brabant (NL), Pays-de-la Loire (F), Bourgone (F), Murcia (E), Cantabria (E), Principado de Asturias (E), Lüneburg (D).
7. Weser-Ems (D), Trier (D), Aragón (E), Comunidad-Valenciana (E), Picardie (F), Nord-Pas-de-Calais (F), Lorraine (F).
8. Limburg (B), Niederbayern (D), Oberpfalz (D), Unterfranken (D), Gießen (D), Münster (D), Koblenz (D), Pais Vasco (E), Comunidad Foral de Navarra (E), La Rioja (E), Cataluña (E), Franche-Comté (F).
9. Marche (I), Centre (F), Saarland (D), Arnsberg (D), Detmold (D), Hannover (D), Braunschweig (D), Kassel (D), Schwaben (D), Oost-Vlaanderen (B), West-Vlaanderen (B).
10. Freiburg (D), Tübingen (D), Düsseldorf (D), Köln (D), Rheinhessen- Pfalz (D), Haute- Normandie (F), Alsace (F), Rhône-Alpes (F), Piemonte (I), Trentino (I), Veneto (I), Friuli Venezia Giulia (I), Toscana (I).
11. Hainaut (B), Liége (B), Schleswig-Holstein (D), Comunidad de Madrid (E), Gelderland (NL), Zeeland (NL), Lisboa e Vale do Tejo (PT).
12. Antwerpen (B), Karlsruhe (D), Oberbayern (D), Mittelfranken (D), Valle D'Aosta (I), Lombardia (I), Emilia Romagna (I), Luxembourg (LU).
13. Région Bruxelles-capitale/ Brussels hoofdstad gewest (B), Stuttgart (D), Bremen (D), Hamburg (D), Darmstadt (D), Île de France (F), Groningen (NL).

Appendix 2

FIGURE 1: TREE RESULTING BY THE CART ANALYSIS



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