

Palmero, Federico Martín; Francos, Marcos Fernández; Laxe, Fernando Gonzalez

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## Spanish regions and sustainable development: measurement of advances from rio to johannesburg through multidimensional synthetic indexes

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**SPANISH REGIONS AND SUSTAINABLE DEVELOPMENT:  
MEASUREMENT OF ADVANCES FROM RIO TO JOHANNESBURG  
THROUGH MULTIDIMENSIONAL SYNTHETIC INDEXES**

**JEL Classification:** Q2, R1

**Key Words:** Sustainable development, regional analysis, Spain

**Marcos Fernández Francos**

Universidad de A Coruña. Facultad de Sociología. Campus de Elviña, s/n 15071 A CORUÑA. E-mail: cos@ole.es

**Fernando González Laxe**

Universidad de A Coruña. Facultad de Ciencias Económicas y Empresariales. Campus de Elviña, s/n 15071 A CORUÑA. E-mail: laxe@udc.es

**Federico Martín Palmero**

Universidad de A Coruña. Facultad de Ciencias Económicas y Empresariales. Campus de Elviña, s/n 15071 A CORUÑA. E-mail: fgmartin@udc.es

## **1. Introduction**

In the United Nations Conference on Environment and Development (Rio de Janeiro, 1992), the bases for a world sustainable development were set. Ten years later it took place in Johannesburg the World Summit on Sustainable Development, where it was discussed about the fulfilled advances and it favoured actions for century XXI. This document analyses the concern on sustainability in the Spanish regions by means of the creation of a global synthetic index of sustainable development that fulfils three conditions: it is adapted to Pressure-State- Response principles, it adopts the Local Agenda 21 mandates and it fits in the four basic dimensions of sustainability: institutional, environmental, economic and social. Over the calculation of the changes taken place in the aforementioned decade in a set of selected variables – grouped in indicators and sub-indicators and classified according to the four dimensions aforementioned in the sustainable development –, it is proceeded to the estimation of the synthetic index for the Spanish Autonomous Regions, what is useful as an instrument of analysis to make those regions hierarchical according to their degree of adaptation to the sustainability commitment developed in the Summit in Rio.

## **2. Background and objectives**

Parallel to the fact in 1987 it was officially designed for the first time the term sustainable development, it was necessary to create a calculation methodology and alternative systems to the traditional ones so as to measure sustainability.

The OECD began the attempts to standardise the new accounting systems by international organisations, by presenting an initial proposal of sustainability indicators in 1991. In 1998, this organism publishes the first series of indicators for sustainable development composed by 51 variables divided into two categories: environmental and socio-economic (OECD, 1998). The publication of environmental indicators is extended, raising the number of them subject to analysis (OECD, 2001), and the most comprehensive compendium (up to 66 variables) is carried out by the OECD in a very systematised manner in 2002, distinguishing three categories: social, economic and environmental. The said variables are classified by a scheme Pressure – State – Response (PSR), adjusted to the specifications of each sector (OECD, 2002).

United Nations (UN) in 1993, through its Sustainable Development Committee presented proposals for the selection of sustainability indicators, what concluded its practically definitive publication (NU, 1999). Methodologically it means an advance with respect to those of the OECD, as it presents four perfectly defined sustainability dimensions – economic, environmental, institutional and social -, as well as the relation of those indicators with Agenda 21 and its insertion within the PSR framework of the mentioned indicators. (It is summarised in a list of 59 variables).

Using this previously mentioned UN contributions as its base, the European Union (EU) elaborated a first approximation to sustainability measures in 1988, which was presented at the Goteborg Summit and which culminated with the publication of the last proposal (Eurostat, 2001). Increased to 63 variables, it presents a similar structure to that of the UN, with identical dimensions or facets of sustainable development, although they are divided in turn into themes and sub-themes. However, the nature of the indicator within the framework of the PSR principles is not clearly defined, although equivalencies are established between the proposal indicators and, where appropriate, the corresponding ones of the UN and the OECD.

These official contributions allow for very partial comparisons from variable to variable or indicator to indicator – since they do not establish a homogeneous synthetic manner in which to be carried out among the different countries, regions or economies. In this sense, it is fundamental to highlight the contribution made to the World Economic Forum (WEF) by the working groups of the Universities of Yale and Columbia, who have designed the Environmental Sustainability Index (ESI), initially presented in 2001 at the Davos G-8 Summit, and revised and updated the following year (WEF, 2002). It is applied to 142 countries and includes 5 dimensions (environmental systems, reducing stresses over the systems, reducing human vulnerability, social and institutional capacity, and global management), which in turn are composed of 20 indicators, subdivided into 68 variables. Its innovation lies on its methodological contribution and that it permits to create indexes by sustainability dimensions for each country, what facilitates comparisons and decision-making.

As it can be observed from the preceding analysis, at present there is not a methodological and calculus proposal that deals with all the facets of sustainable

development in a complete manner, thus it is necessary an adaptation and reformulation of those proposals for their subsequent practical application to the regional analysis.

On the other hand, as it has been pointed out in the introduction, the aim of this document is based on contrasting the advances appreciated with regard to sustainable development in the Spanish regions during the period between the Rio and Johannesburg Summits. With this purpose, it is necessary firstly to establish systems of comparable measurements and, secondly, to proceed to an adequate selection of the variables to be taken into consideration.

The design and application of the proposed synthetic index are to fulfil a series of conditions and to present a method of analysis that, even within its complexity, can be applied to different spheres. Likewise, it should be constructed on the basis of a duly tested methodology, with future possibilities for development. In short, it would be based on the following premises:

- a) It is essential that the index apply to the four generally accepted facets of sustainability: economic, social, environmental and institutional; and that it is applicable in a global, national, regional or local level.
- b) Each one of the variables should be classified under the scheme or model generally adopted by international organisations (OCDE, UN), Pressure – State - Response (PSR) or its variant DSR (Driving Force – State – Response). The process is not complex if a concrete and previously defined methodology is adopted. In this case, DSR is chosen (Moldan and others, 1997).
- c) Likewise, each variable should adapt to the specific principles of sustainability contained in each chapter of Agenda 21 and, as a result, fit in with the mentioned principles.
- d) The generated synthetic index, as well as the indicators, sub-indicators and variables on which it is composed, must likewise adapt to certain coherence principles (Bermejo 2001, 270; Kane 1999; Anderson 1991, 49-51).
- e) Under the aforementioned assumptions, the synthetic indexes are composed for each of the four components or dimensions, which are divided into different indicators. These come from the calculation of a certain number of sub-indicators, each one of them composed by a series of variables. Lastly, from a

methodological perspective, its calculations are based on the contrasted analysis carried out by the Universities of Yale and Columbia (WEF 2002), with a series of diverse modifications and adaptations.

#### **4. Selection of Variables**

Taking Eurostat initial classification (2001) as a starting point, it was proceeded to build a system of variables for the 17 Spanish regions. Their selection was carried out with the aim to establish which ones, from a hierarchical perspective, have adapted to a greater or lesser extent to the principles of sustainable development during the period between both World Summits. With this purpose they have been divided, in turn, into two categories: static and dynamic ones. The first category includes that series of variables we only know their present values (especially for differences in the calculation methodologies in very previous periods or for the inexistence of them in those dates), and those others that would mean nothing to provide them with a dynamic nature. For instance, the fact that the Gross Domestic Product (GDP) in a region increases more than in another region during the period 1992-2002 is not a sign of sustainability since, in absolute terms, the GDP of the first region could be lesser than the GDP in the second in both years. The dynamic variables include the ones proceeding from similar methodologies and statistical sources, and their measurement during the period under consideration is coherent and adopts a signification.

Under these assumptions, 73 variables were selected (29 dynamic ones and 44 static ones), that were grouped in 30 sub-indicators, concentrated in 14 indicators. Lastly, the indicators were distributed into the four well-known sustainability dimensions into consideration. Table 1 includes the tabulation of the classification and groupings carried out, characterised in the aforementioned categories. The sources and description of the variables are included as Appendix.

#### **5. Calculation Methodology**

Once the variables have been selected, the methodology, which is used to carry out all the calculation operations, is composed of the following stages:

1. The first calculation phase is carried out on the basis of the different values observed and obtained for each of the 78 variables for the 17 Spanish regions.
2. Secondly, z-scores are calculated, that is, the values of the variable, standardised, with the purpose of making them comparable. The calculation may be obtained in two different ways:

$$Zs_i = \frac{Xi - \bar{X}}{\sigma x}, \text{ if the sense of sustainability is direct, or}$$

$$Zs_i = \frac{\bar{X} - Xi}{\sigma x}, \text{ if it is inverse. Where:}$$

$Zs_i$  = Value of the standardised variable.

$\bar{X}$  = Average of distribution.

$Xi$  = Value reached by the variable.

$\sigma x$  = Standard deviation of distribution.

3. Subsequently, the values of the percentiles 97,5 and 2,5 are calculated, in order to avoid the extreme values distorting the calculations. This way, and in a later process, the maximum and minimum values are substituted by the value of the respective percentiles (97,5 and 2,5). Although this process is typical of very large distributions (WEF, 2002, 46), with is not the case under question, with this process the null values of the variables are corrected (in the case they were unknown or not available, or if they were excessively dispersed).

Table 1. Composition by Dimensions, Indicators, Sub-indicators and Variables

| DIMENSION     | INDICATOR                            | SUBINDICATOR                               | NUMBER OF VARIABLES |         |
|---------------|--------------------------------------|--------------------------------------------|---------------------|---------|
|               |                                      |                                            | STATIC              | DYNAMIC |
| ECONOMIC      | Economic Structure                   | Economic Performance                       | 3                   | 1       |
|               |                                      | Trade                                      | 1                   | 1       |
|               |                                      | Financial Status                           | 2                   |         |
|               |                                      | Business combination                       | 3                   | 2       |
|               | Consumption and Production patterns  | Energy use                                 | 2                   |         |
|               |                                      | Generation and disposal of municipal waste | 3                   |         |
|               |                                      | Recycling                                  | 1                   | 1       |
|               |                                      | Vehicles                                   |                     | 1       |
| INSTITUTIONAL | Institutional Capacity               | Access to Internet                         | 1                   |         |
|               |                                      | Communication Infrastructure               | 2                   |         |
|               |                                      | Research and Development                   | 1                   |         |
|               |                                      | Number of local Agendas 21                 | 1                   |         |
|               | Human and natural capital protection | Environment                                | 1                   |         |
|               |                                      | Risks to natural capital                   |                     | 1       |
|               |                                      | Risks to human capital                     |                     | 1       |
|               |                                      |                                            |                     |         |
| ENVIRONMENTAL | Atmosphere                           | Air quality and climate change             |                     | 2       |
|               | Land                                 | Agriculture                                | 2                   | 2       |
|               |                                      | Forests                                    |                     | 2       |
|               | Water                                | Water quantity and quality                 | 4                   |         |
|               | Biodiversity                         | Species protection                         | 3                   |         |
| SOCIAL        | Equity                               | Poverty                                    | 8                   |         |
|               |                                      | Gender equality                            | 2                   |         |
|               | Health                               | Illness                                    |                     | 6       |
|               |                                      | Mortality                                  |                     | 3       |
|               |                                      | Sanitation                                 | 2                   |         |
|               | Education                            | Education level                            | 2                   |         |
|               | Housing                              | Living conditions                          |                     | 1       |
|               | Security                             | Crimes                                     |                     | 1       |
|               |                                      | Traffic accidents                          |                     | 1       |
|               | Population                           | Population change                          |                     | 3       |

4. Once all and each of the calculations of the 73 variables taken into account for the 17 economies have been generated, it is necessary to continue with the later process of calculating the indicators, which complies with the following guidelines:

- a) The value of the standardised variables is corrected for the values reached by the percentiles 9,75 and 2,5.
- b) The value of the standardised variable of each indicator is obtained by calculating the simple average of the variables' z-scores, classified according to the sub-indicators in which each of the former ones are

composed (WEF, 2002, 46). The obtained results are presented in Table 2.

5. The next and final phase of the process entails:

- a) Transforming the values of the standardised variable, as obtained in the previous phase, in such a manner that they can be understood and compared. For this purpose, the z-score of each indicator is converted into the normal standard percentile, with a theoretical value between 0 and 100.
- b) Obtaining the values of the percentiles of each component or dimension (economic, institutional, environmental and social), through the weighted average of the percentiles calculated for the indicators. The results are presented in Table 3.

Table 2 Values of the indicators 1992 – 2002 (Standardised Variable)

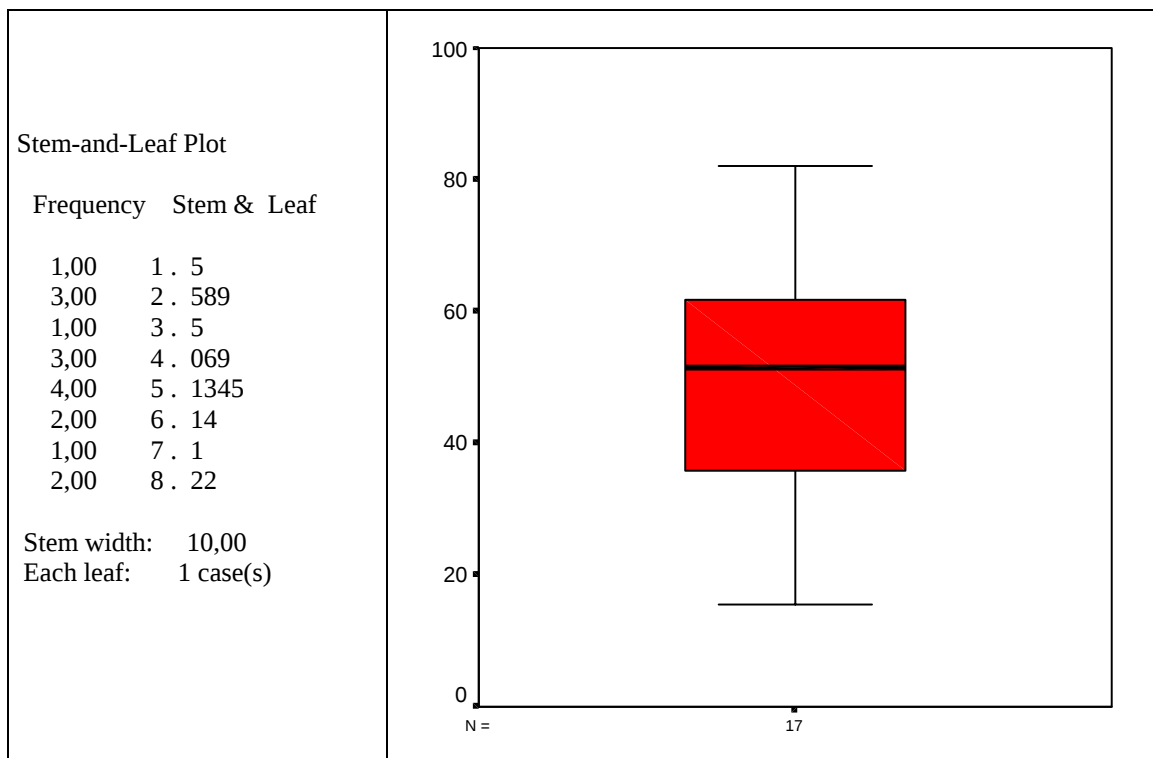
|                    | ECONÓMIC              |                             | INSTITUTIONAL             |                                       | ENVIRONMENTAL |        |        |              | SOCIAL |        |           |         |          |            |
|--------------------|-----------------------|-----------------------------|---------------------------|---------------------------------------|---------------|--------|--------|--------------|--------|--------|-----------|---------|----------|------------|
|                    | ECONOMIC<br>STRUCTURE | CONSUMPTION &<br>PRODUCTION | INSTITUTIONAL<br>CAPACITY | HUMAN & NATURAL<br>CAPITAL PROTECTION | ATMOSPHERE    | LAND   | WATER  | BIODIVERSITY | EQUITY | HEALTH | EDUCATION | HOUSING | SECURITY | POPULATION |
| ANDALUSIA          | -0,201                | -0,109                      | -0,412                    | -0,153                                | -0,096        | 0,046  | -0,467 | 0,279        | -1,146 | 0,034  | -0,730    | 0,264   | 0,205    | -0,349     |
| ARAGON             | 0,195                 | -0,002                      | 0,222                     | 0,590                                 | -0,695        | -0,027 | -0,022 | -0,211       | 0,210  | -0,409 | 0,398     | -0,378  | -0,119   | 0,795      |
| ASTURIAS           | 0,008                 | -0,633                      | -0,054                    | 0,088                                 | 1,110         | 0,561  | 0,418  | 0,426        | -0,217 | 0,337  | 0,073     | 0,318   | 0,095    | 0,635      |
| BALEARIC ISLANDS   | 0,058                 | 0,314                       | -0,009                    | -0,713                                | -0,482        | -0,193 | -0,490 | 0,182        | 0,342  | 0,329  | -0,174    | -0,169  | 0,042    | -1,572     |
| CANARY ISLANDS     | -0,458                | -0,098                      | -0,071                    | -0,752                                | -2,066        | 0,260  | 0,782  | 1,489        | -0,292 | -0,861 | -0,397    | 0,301   | 0,008    | -1,748     |
| CANTABRIA          | -0,083                | -0,276                      | -0,569                    | 0,905                                 | 0,526         | 0,380  | -0,072 | -0,106       | -0,078 | 0,328  | 0,377     | -0,643  | 0,364    | 0,267      |
| CASTILLA-LEON      | -0,129                | -0,327                      | -0,230                    | 0,517                                 | 0,021         | -0,318 | -0,028 | -0,131       | -0,125 | 0,155  | -0,061    | 0,279   | 1,811    | 0,555      |
| CASTILLA LA MANCHA | 0,163                 | 0,050                       | -1,136                    | -0,315                                | 0,348         | -0,349 | -0,517 | -0,658       | -0,106 | -0,153 | -1,525    | 0,236   | -1,511   | 0,749      |
| CATALONIA          | -0,198                | 0,004                       | 1,402                     | 0,323                                 | -0,941        | 0,308  | -0,222 | -0,402       | 0,011  | -0,113 | 0,246     | 1,311   | -0,763   | -0,062     |
| VALENCIA           | -0,239                | -0,139                      | -0,006                    | 0,171                                 | -1,252        | -0,186 | -0,648 | -0,093       | -0,020 | -0,110 | -0,370    | -0,534  | 0,272    | -0,500     |
| EXTREMADURA        | 0,020                 | 0,259                       | -1,316                    | 0,357                                 | 0,902         | 0,297  | -0,145 | 0,512        | -0,844 | 0,307  | -1,440    | 2,762   | -0,346   | 0,057      |
| GALICIA            | -0,189                | 0,535                       | -0,404                    | -0,661                                | -0,250        | 0,176  | 0,880  | -1,232       | -0,558 | 0,543  | -1,013    | 0,132   | -0,262   | 0,195      |
| MADRID             | 0,190                 | 0,102                       | 1,858                     | -0,779                                | 0,065         | -0,212 | 0,362  | 1,103        | 0,674  | 0,143  | 1,991     | 0,247   | 1,519    | -0,402     |
| MURCIA             | -0,453                | 0,132                       | -0,204                    | 0,410                                 | 1,037         | -0,656 | 0,260  | -0,093       | -0,242 | -0,631 | -0,591    | 0,199   | -0,247   | -0,023     |
| NAVARRA            | 0,601                 | -0,075                      | 0,461                     | 0,276                                 | 0,188         | -0,217 | -0,167 | -0,764       | 1,220  | 0,122  | 1,371     | -1,545  | -0,753   | 0,114      |
| BASQUE COUNTRY     | 0,472                 | -0,097                      | 1,192                     | -0,830                                | 0,772         | 0,065  | 0,379  | -0,826       | 0,344  | 0,170  | 1,406     | -1,495  | 0,173    | 0,504      |
| LA RIOJA           | 0,243                 | 0,361                       | -0,721                    | 0,565                                 | 0,811         | 0,067  | -0,303 | 0,526        | 0,829  | -0,191 | 0,438     | -1,284  | -0,490   | 0,783      |

Table 3 Values reached by dimensions (1992 – 2002)

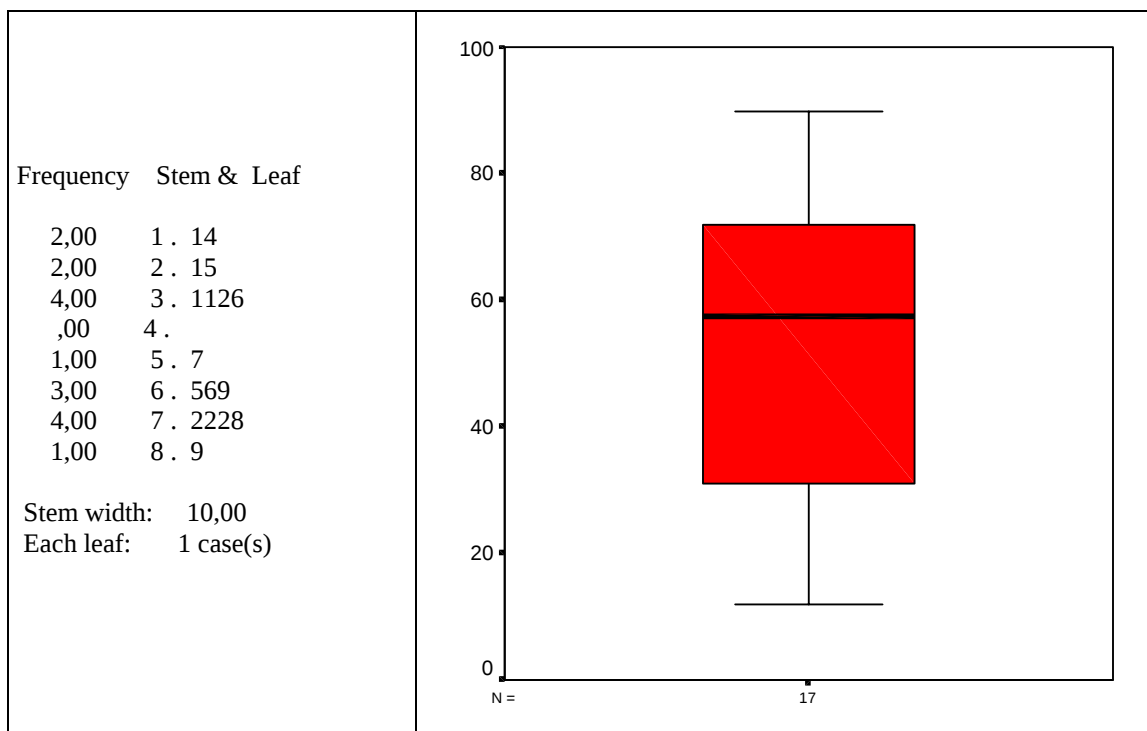
|                    | DIMENSION     |          |               |        |
|--------------------|---------------|----------|---------------|--------|
|                    | INSTITUTIONAL | ECONOMIC | ENVIRONMENTAL | SOCIAL |
| ANDALUSIA          | 29,7          | 21,1     | 43,7          | 28,0   |
| ARAGON             | 82,0          | 69,3     | 42,9          | 48,0   |
| ASTURIAS           | 51,5          | 31,0     | 91,7          | 66,4   |
| BALEARIC ISLANDS   | 46,1          | 72,0     | 31,6          | 68,0   |
| CANARY ISLANDS     | 35,9          | 11,9     | 75,0          | 14,8   |
| CANTABRIA          | 49,2          | 31,8     | 68,7          | 66,0   |
| CASTILLA-LEÓN      | 53,9          | 25,6     | 33,3          | 57,8   |
| CASTILLA LA MANCHA | 15,6          | 66,3     | 16,2          | 35,7   |
| CATALONIA          | 82,0          | 36,9     | 50,0          | 43,9   |
| VALENCIA           | 61,7          | 14,9     | 27,1          | 42,7   |
| EXTREMADURA        | 25,8          | 65,7     | 72,0          | 39,6   |
| GALICIA            | 28,9          | 57,4     | 58,3          | 53,0   |
| MADRID             | 64,8          | 72,6     | 55,4          | 67,0   |
| MURCIA             | 55,4          | 32,4     | 40,8          | 17,0   |
| NAVARRA            | 71,8          | 78,6     | 27,5          | 60,3   |
| BASQUE COUNTRY     | 54,7          | 72,3     | 55,4          | 65,5   |
| LA RIOJA           | 40,6          | 89,9     | 60,0          | 57,1   |

## 6. Coherency Tests

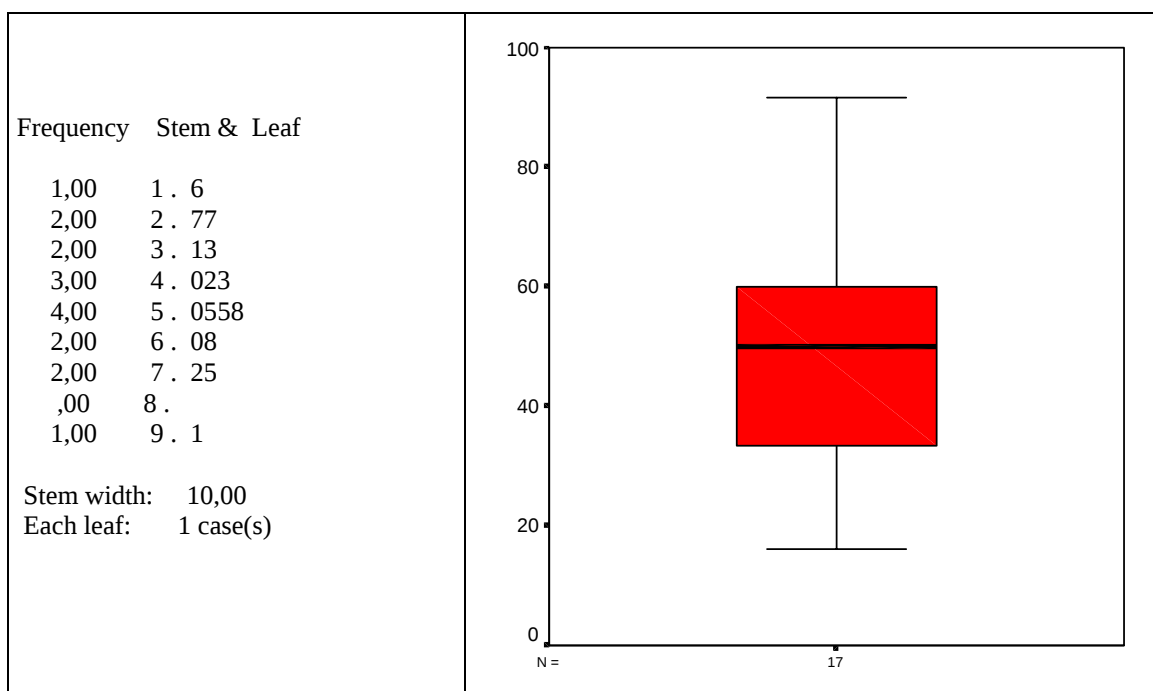
In order to establish whether the obtained results are significant and coherent, it is necessary to ascertain if the values of the percentiles calculated for the four dimensions are representative of a normal distribution. For this purpose, the statistical programme SPSS was used and the calculations were specifically carried out on Box-plot. In this diagram, the box is limited in its upper part by the third quartile, and in its lower part by the first quartile. The horizontal line included inside the box represents the median. The dashes represent the values of the highest and lowest variable. If there is one that is situated less than one and a half times the interquartile range from the lower or upper limits of the box, the programme marks it with 0, and with X if is situated more than one a half times. Once the calculations have been carried out for the values reached in the four indexes of sustainability for the considered dimensions or facets, the obtained results (Figures 1 to 4) prove the coherency, the goodness and the representative nature of the indexes, given that no isolated or extreme value exists.



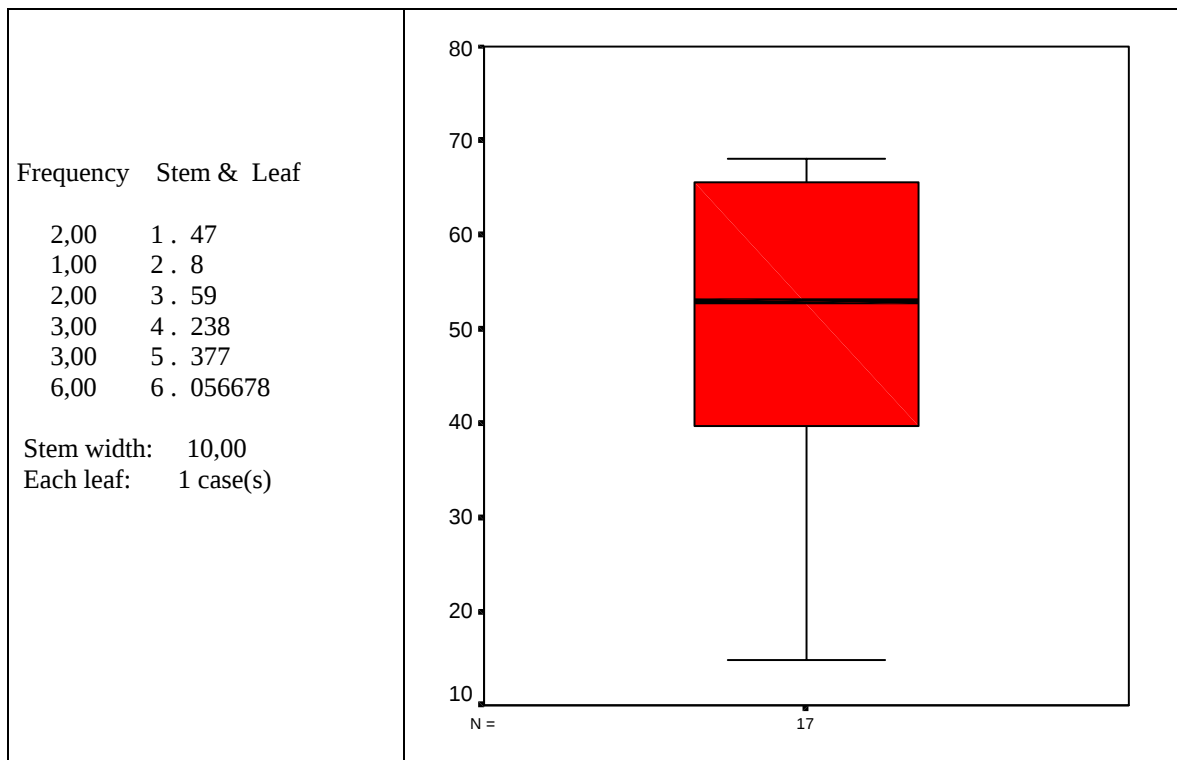
**Fig. 1** Box – plot Diagram (Institutional Dimension)



**Fig. 2** Box – plot Diagram (Economic Dimension)



**Fig. 3** Box – plot Diagram (Environmental Dimension)



**Fig. 4** Box – plot Diagram (Social Dimension)

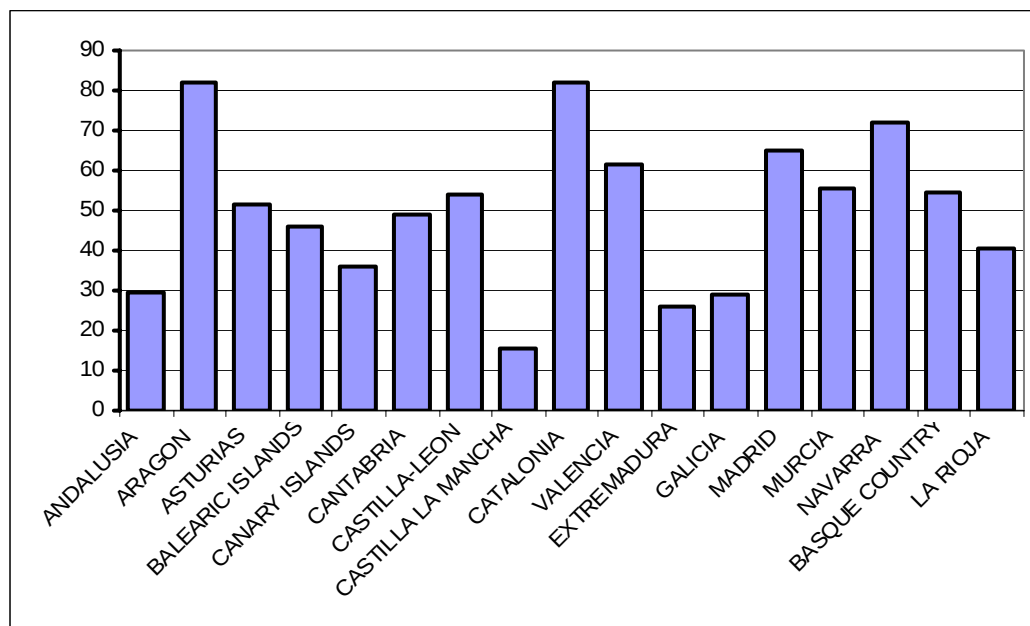
## 7. Result analysis

Once obtained the values reached by indicators and by the four facets of sustainability under consideration, it is possible to carry out an exhaustive analysis of them, what it is raised below for each one of the dimensions into consideration.

### 7.1. *Institutional*

Catalonia and Aragon reach the highest values for this dimension of sustainable development (Figure 5). Nevertheless, by analysing their components, the reasons are very different: Catalonia adopts very high values in Institutional Capacity (communication infrastructures, I+D expenses, and number of Local Agendas 21) and in Human and Natural Capital Protection. In Aragon the opposite happens: the latter indicator is higher, whereas it has relatively lower results in the first. On the other hand, Navarra (third in the top) presents a certainly equilibrated value in the indicators that compose this sustainability dimension.

With regard to the regions less inclined to the institutional action in public action to sustainability, they stand – in this order - Andalusia, Galicia, Extremadura and Castilla La Mancha in the last place. Likewise, Cantabria and La Rioja are also less given to the institutional action. It should be highlighted they are regions with limited public expenditure on Research and Development and on the development of Local Agendas 21, together with the decentralisation of decision-making, either for being regions made up by an only province, or for singular political peculiarities.



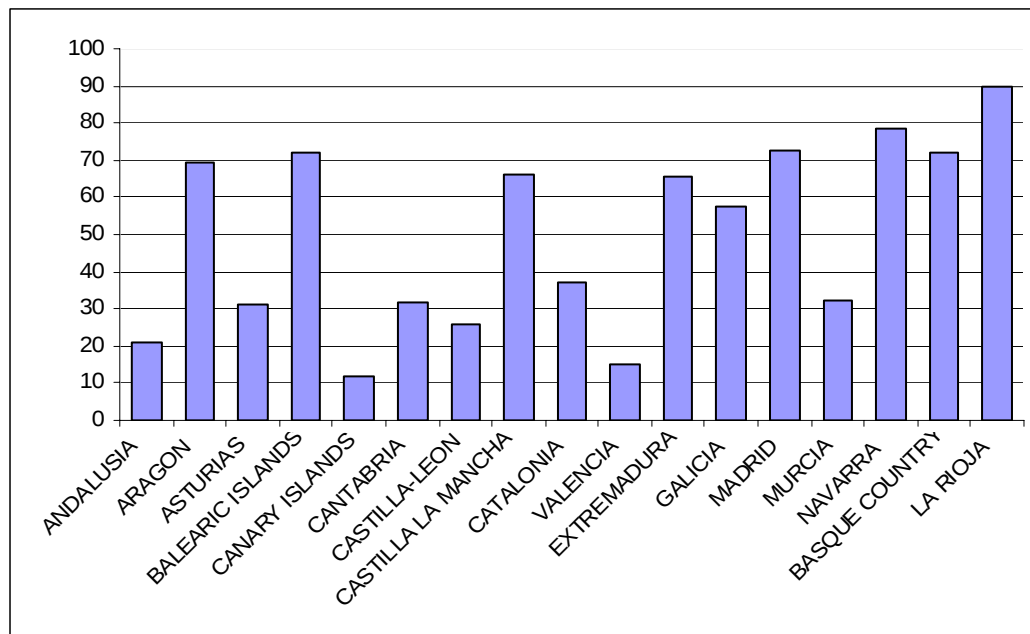
**Fig. 5:** Values per areas: Institutional Dimension

It should be noted that in these four regions the indicators that form this institutional component are all negative (values lower than the average), with the exception of Extremadura, whose relatively positive position in Human and Natural Capital Protection does not compensate the last place in Institutional Capacity.

## 7.2. Economic

In this component of sustainable development La Rioja stands out, with the highest hierarchy according to some positive and equilibrated values of the indicators of Economic Structure and Consumption and Production Patterns (Figure 6). Next, seven regions with very similar values stand: Navarra, Basque Country, Madrid, Balearic Islands, Aragon, Castilla La Mancha, and Extremadura. The explanation of the fact that

these two latter regions (less developed in traditional measurement terms) stand among the most sustainable ones within the economic dimension is they present average values of the indicator of Economic Structure and, especially Extremadura, positive ones in Consumption and Production Patterns, what is a consequence, in turn, of very satisfactory energy demands and its very low rate of generation of waste.

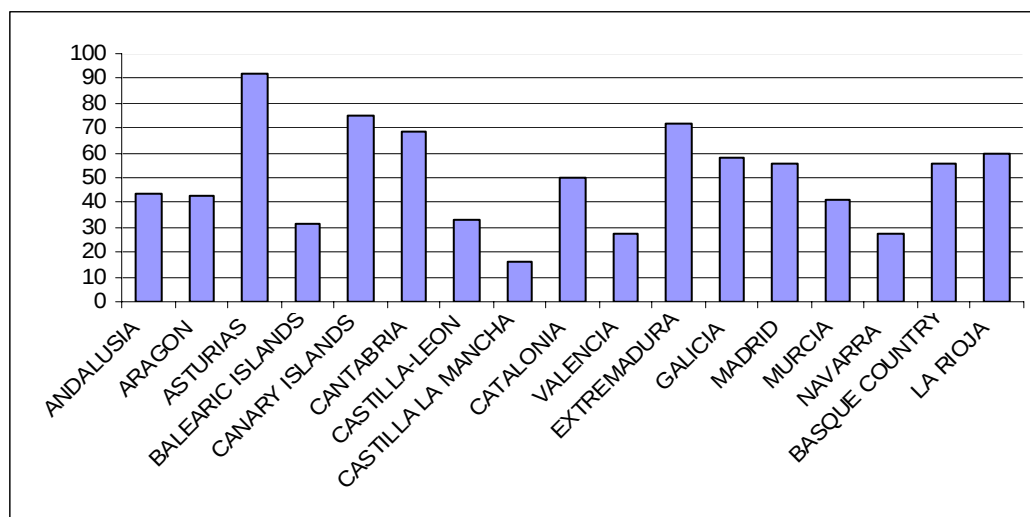


**Fig. 6:** Values per areas: Economic Dimension

The Spanish regions with the lowest values in this dimension are, in descending order, Murcia, Andalusia, Valencia and Canary Islands. The first one presents economic structures very linked to own markets, with high national demand; for its part, Andalusia has lower values than the average in the two indicators that constitute this facet of sustainability. A similar case is the one of Valencia, which, particularly in the indicator of Economic Structure, presents especially negative values in public deficit, official help to development and leading companies in clean technologies. As regards to Production and Consumption Patterns, it is in the lowest positions in recycling rates. For its special configuration and dependence on the tertiary sector, the Canary Islands stand out for the negative values in gross energy demand, lack of companies with clean technology, high generation of domestic waste, absence of any kind of recycling and very high concentration of companies and vehicles.

### 7.3. Environmental

Asturias stands in the first position by far in this dimension of sustainable development (Figure 7). This region presents very positive and quite higher than the average values in all the considered indicators: Atmosphere, Land, Water and Biodiversity. It should be noted, especially, the excellent position in the first of the indicators with respect to the remaining Spanish regions. The variation from 1990 to 1999 of the pressure indexes over the climatic change is the most positive in Spain and the one of air contamination the second one, only surpassed by Murcia. Three regions (the Canary Islands, Extremadura and Cantabria) stand immediately after Asturias.

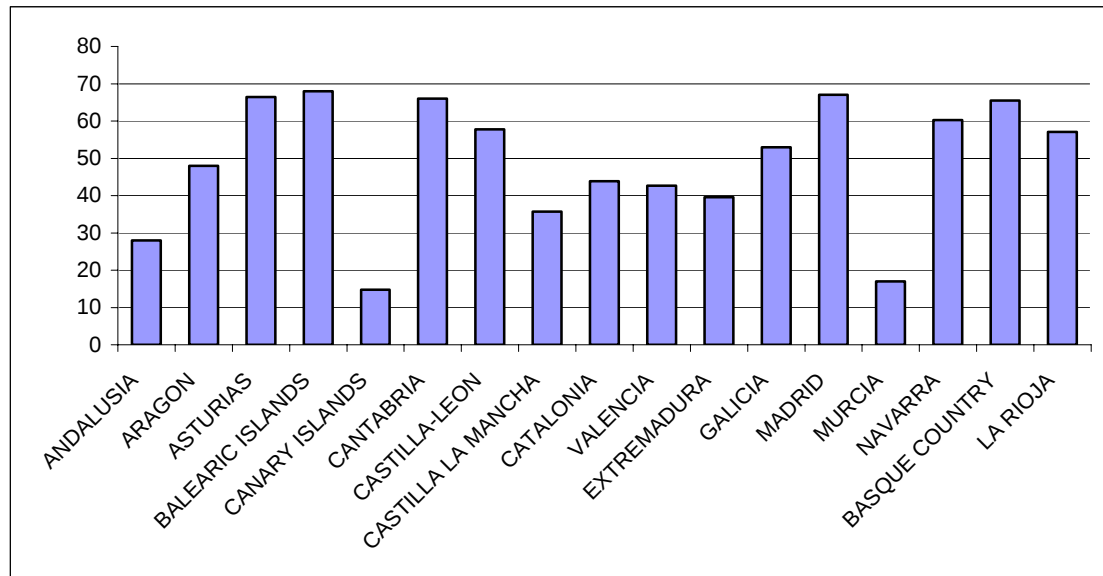


**Fig. 7:** Values per areas: Environmental Dimension.

With regard to the regions with worse results in this sustainability dimension, Valencia and Castilla La Mancha stand in the first positions. The first one, due to the worse behaviour in the indicator of Atmosphere (the evolution of the variables since 1990 to 1990 is especially negative), Land (intensive use of fertilisers), and Biodiversity (limited protected area). On the other hand, Castilla La Mancha presents low values in the indicators of Agriculture (intensive agricultural use of land and limited ecological agriculture), Water (excessive consumption and very high in subterranean waters, and relative lack of drains), and Biodiversity in practically all the variables that compose this indicator.

#### 7.4. Social

The Spanish regions in this last dimension present, on the whole, a more homogeneous organisation into a hierarchy, especially for the highest values. Therefore, Asturias, the Balearic Islands, Cantabria, Madrid, Navarra and the Basque Country stand in the interval of percentiles 60 – 70.



**Fig. 8:** Values per areas: Social Dimension.

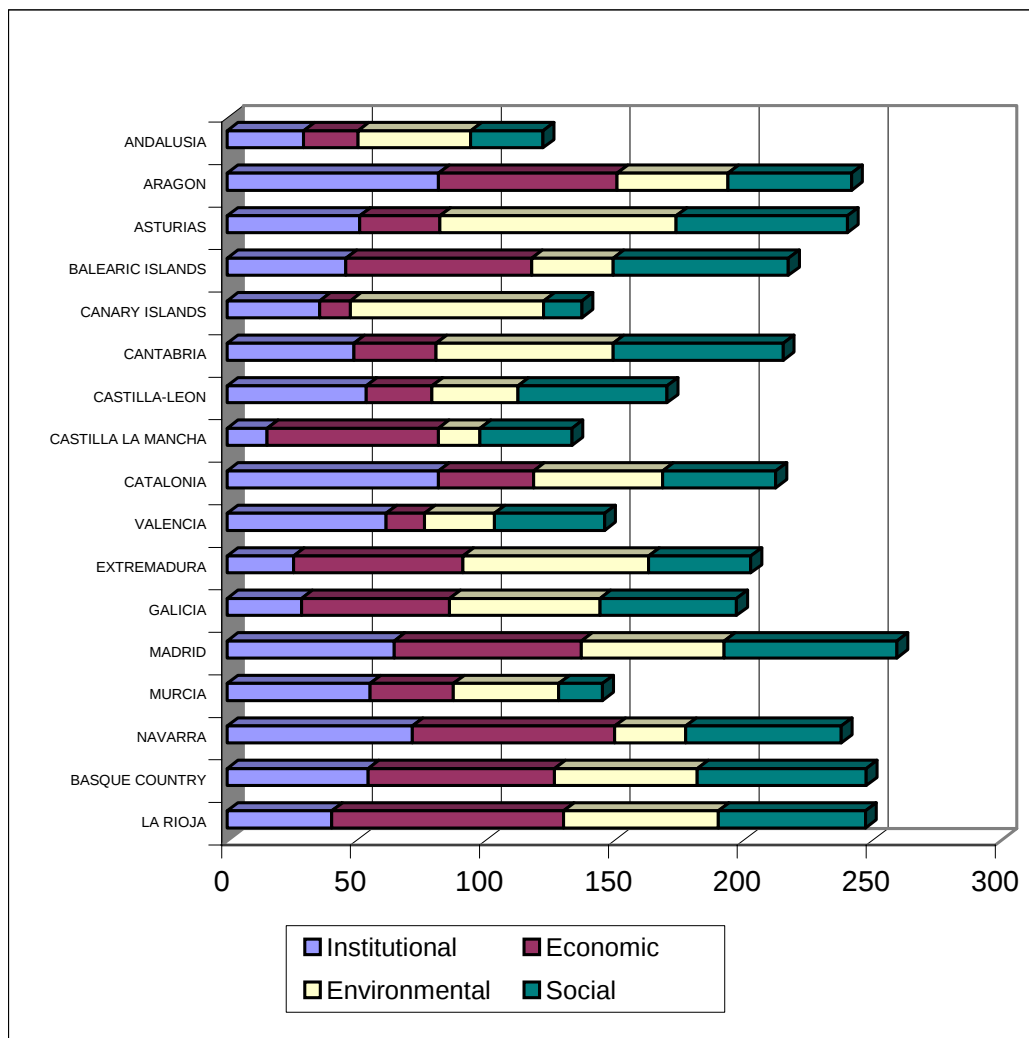
In the opposite side, the Spanish regions with lower values are Murcia and the Canary Islands. This last region presents especially negative results in the indicators of Equity, Health, Education and very particularly in Population.

On analysing the results of this social dimension by indicators, as regards to Health, the Canary Islands, Murcia and Aragon present the lowest average values, whereas Galicia, Cantabria, Asturias and the Balearic Islands have the highest values. In reference to the indicator of Education, this one presents greater dispersion and disparity, with very lower values than the average in Castilla La Mancha, Extremadura and Galicia, and very high values in Madrid, the Basque Country and Navarra. The indicator of Housing shows very different values in the different regions; on the one hand, the variations are negative in Navarra, the Basque Country and La Rioja, regions that had already committed to active housing policies in the last decade, and, on the other hand, it can be observed a positive growth in Extremadura and Catalonia; the first one because of the urban renovation, and the second one due to the adaptation to population increases. In

the indicator of Equity, that contains measures such as income distribution, and poverty measurement, Andalusia, Extremadura and Galicia, regions with the lowest income level, present the most negative values.

## 8. Conclusions: convergence of Spanish regions and sustainability

In short, it should be pointed out that, in the institutional dimension, Aragon and Catalonia have the highest index, and Castilla La Mancha has the lowest one. La Rioja presents an unbeatable position in Consumption and Production Patterns and Economic Structure, compatible with the sustainability (economic dimension), and the Canary Islands stand in the last position in this facet of sustainable development. Castilla La Mancha is the one with the worst results in the environmental dimension, whereas Asturias obtains the best results in this component. In the social dimension of sustainability, the Balearic Islands stand in the top position, and the Canary Islands in the last place.



**Fig. 9:** Sustainable development and convergence of Spanish regions.

As it was stated in the introduction of the present document, the purpose was to find out if the Spanish regions, during the period 1992-2002 had fitted in with the principles of sustainable development brought about by the Rio Summit. Through a lineal accumulation of the values of the percentiles obtained for each dimension, it is possible to establish a classification by which it can be observed what regions converge in a greater or lesser measure to sustainability. From these results (Figure 9), it can be observed Madrid is the region that – in relative terms – converges more during the mentioned period towards sustainable development by virtue of the values that adopt the variables, both evolutionary and dynamic. Next it would stand La Rioja, the Basque Country, Aragon, Asturias and Navarra. In the opposite side, Andalusia, Castilla La Mancha, the Canary Islands, Valencia and Murcia stand.

### Appendix. Variable Description and Sources

| SUBINDICATOR         | C | Nº  | VARIABLE                                            | DEFINITION                                                            | SOURCE                                           |
|----------------------|---|-----|-----------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------|
| Economic Performance | E | E1  | Per capita GDP at prices market                     | Euro per capita                                                       | INE (2001B, 2003F)                               |
|                      | E | E2  | Gross Fixed Capital Formation                       | % of GDP                                                              | FUNDACIÓN DE CAJAS DE AHORRO CONFEDERADAS (2002) |
|                      | E | E3  | Added value                                         | % of GDP                                                              | INE (2001B, 2003F)                               |
|                      | D | E4  | Inflation rate                                      | Variation % 1992 – 2001                                               | INE (2001C, 2003H)                               |
| Trade                | E | E5  | Net goods trade position                            | % of GDP                                                              | MINISTERIO DE ECONOMÍA (2002); INE (2001B)       |
|                      | D | E6  | Net foreign investment position                     | % of GDP<br>(Variation 1998 – 2000)                                   | PELEGRIN (2003)<br>INE (2001B)                   |
| Financial Status     | E | E7  | Public Deficit                                      | % of GDP                                                              | FUNDACIÓN ENCUESTRO (2003)<br>INE (2001B)        |
|                      | E | E8  | Official Development Assistant                      | % of GDP                                                              | INTERMON OXFAM (2002)                            |
| Business combination | D | E9  | Territorial distribution of companies               | Number of Companies/Kilometro <sup>2</sup><br>(Variation 1995 – 2002) | FUNDACIÓN ENCUESTRO (2003)<br>INE (2001A)        |
|                      | D | E10 | Companies per capita                                | Number of companies per 100 inhabitants<br>(Variation 1995 – 2002)    | INE (2001A)<br>FUNDACIÓN ENCUESTRO (2003)        |
|                      | E | E11 | Companies investment on clean technology            | Thousands € per company                                               | INE (2003A)                                      |
|                      | E | E12 | Rate of companies with ISO 14000 rules              | Number of rules per every 10000 companies                             | FUNGESMA (2003)                                  |
|                      | E | E13 | Rate of companies with eco-management and eco-audit | Rate per each 10000 premises devoted to this activity                 | FUNGESMA (2003)                                  |

|                                       |   |     |                                                |                                                           |                                         |
|---------------------------------------|---|-----|------------------------------------------------|-----------------------------------------------------------|-----------------------------------------|
| Energy use                            | E | E14 | Gross energy demand                            | KWh/ per capita                                           | DERSA (2003)<br>INE (2003F)             |
|                                       | E | E15 | Business expenditure on energy                 | Miles de € per company                                    | DERSA 2003<br>INE (2003F)               |
| Generation and disposal of waste      | E | E16 | Municipal waste collected                      | Kilo per capita/year                                      | FUNGESMA (2003)                         |
|                                       | E | E17 | Non-hazardous industrial waste generated       | Ton per capita/year                                       | INE (2003B, 2003F)                      |
|                                       | E | E18 | Hazardous waste generated                      | Ton per capita/year                                       | INE (2003B, 2003F)                      |
| Recycling                             | E | E19 | Paper recycling                                | Recovered kilos per capita                                | FUNDACIÓN ENCuentRO (2003)              |
|                                       | D | E20 | Glass recycling                                | Recovered kilos per capita<br>(% Variation 1995 - 1999)   | FUNDACIÓN ENCuentRO (2003)              |
| Vehicles                              | D | E21 | Vehicles per land area                         | Vehicles per km <sup>2</sup><br>(% Variation 1992 – 2001) | FUNDACIÓN ENCuentRO (2003); INE (2001A) |
| Access to Internet                    | E | IN1 | Access to Internet Availability                | % households                                              | INE (2003C)                             |
| Communication Infrastructure          | E | IN2 | Telephone fixed lines in service               | % households                                              | INE (2003C)                             |
|                                       | E | IN3 | Cellular phones in service                     | % people                                                  | INE (2003H)                             |
| Research and Development R&D          | E | IN4 | Total expenditures on Research and Development | % of GDP                                                  | INE (2002)                              |
| Strategies of Sustainable Development | E | IN5 | Number of Local Agendas 21                     | % Population adhered to Agenda 21                         | GONZÁLEZ LAXE y MARTÍN PALMERO (2002)   |
| Environment                           | E | IN6 | Expenditures on Environment Protection         | Expenditure per capita                                    | PALACIOS (2001)                         |

|                                     |   |     |                                                       |                                                       |                                                                    |
|-------------------------------------|---|-----|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------|
| Risks to Natural Capital            | D | IN7 | Forest fires                                          | 0/00 of affected land area<br>(Variation 1991 - 2000) | INE (2001A, 2001D)                                                 |
| Risks to Human Capital              | D | IN8 | Evolution of work accidents                           | % Variation 1990-2001                                 | FUNDACIÓN ENCUENTRO<br>(2003)                                      |
| Air Quality and Climate Change      | D | M1  | Pressure index of climate change                      | CCI per capita<br>(Variation 1990 – 1999)             | LASSO DE LA VEGA Y OTROS<br>(2001)                                 |
|                                     | D | M2  | Pressure index of air quality                         | PI per capita<br>(Variation 1990 – 1999)              | LASSO DE LA VEGA Y OTROS<br>(2001)                                 |
| Agriculture                         | E | M3  | Agricultural use of land                              | % of total land area                                  | INE (2001A)                                                        |
|                                     | E | M4  | Ecological agriculture                                | % agricultural area                                   | FUNGESMA (2003)<br>INE (2001A)                                     |
|                                     | D | M5  | Pesticides                                            | Kg. per hectare<br>(% Variation 1988 – 2000)          | JUNTA DE ANDALUCÍA (2002)<br>INE (1994)                            |
|                                     | D | M6  | Fertilisers                                           | Kg. per hectare<br>(% Variation 1989 – 2002)          | INE(1994)<br>ANFFE(2002)                                           |
| Forests                             | D | M7  | Variation of forest area land<br>(1993 – 2000)        | %                                                     | MINISTERIO DE AGRICULTURA,<br>PESCA Y ALIMENTACIÓN (1995,<br>2002) |
|                                     | D | M8  | Variation of timber-yielding forests<br>(1993 – 2000) | %                                                     | MINISTERIO DE AGRICULTURA,<br>PESCA Y ALIMENTACIÓN (1995,<br>2002) |
| Water quantity and quality          | E | M9  | Underground water consumption                         | % of total                                            | INE (2003G)                                                        |
|                                     | E | M10 | Households with running water                         | % of total                                            | INE (2003G)                                                        |
|                                     | E | M11 | Households with sewer systems                         | % of households                                       | INE (2003G)                                                        |
|                                     | E | M12 | Water consumption per inhabitant                      | Litre average                                         | INE (2003G)                                                        |
| Species and Ecosystem<br>Protection | E | M13 | Protected area                                        | % area land                                           | JUNTA DE ANDALUCÍA<br>(2001)                                       |
|                                     | E | M14 | ZEPA Areas                                            | % area land                                           | FUNGESMA (2002)                                                    |
|                                     | E | M15 | IBA Areas                                             | % area land                                           | FUNGESMA (2002)                                                    |

|                 |   |     |                                                  |                                                          |                                                 |
|-----------------|---|-----|--------------------------------------------------|----------------------------------------------------------|-------------------------------------------------|
| Poverty         | E | S1  | Poverty                                          | Poverty index                                            | GOERLICH y PINILLA (2003)                       |
|                 | E | S2  | Unemployment rate                                | % of population on active                                | INE (2003D)                                     |
|                 | E | S3  | Youth unemployment                               | % of total between ages 26 and 24                        | INE (2003D)                                     |
|                 | E | S4  | Middle-age unemployment                          | % older than 55 of population on active                  | INE (2003D)                                     |
|                 | E | S5  | Long lasting unemployment                        | Thousands of unemployed people for more than six months  | INE (2003D)                                     |
|                 | E | S6  | Contributory pensions                            | Average pension                                          | MINISTERIO DE TRABAJO Y ASUNTOS SOCIALES (2003) |
|                 | E | S7  | Non-contributory pensions                        | % of population                                          | MINISTERIO DE TRABAJO Y ASUNTOS SOCIALES (2003) |
|                 | E | S8  | Unemployed people receiving unemployment benefit | % of total                                               | MINISTERIO DE TRABAJO Y ASUNTOS SOCIALES (2003) |
| Gender equality | E | S9  | Wages males/females                              | % female over male                                       | INE (2003E)                                     |
|                 | E | S10 | Unemployment males/females                       | % female over male                                       | INE (2003E)                                     |
| Illness         | D | S11 | Cancer mortality (males)                         | Deaths per 100.000 inhabitants (% variation 1988 – 1999) | INE (1992, 2001A)                               |
|                 | D | S12 | Cancer mortality (females)                       | Deaths per 100.000 inhabitants (% variation 1988 – 1999) | INE (1992, 2001A)                               |
|                 | D | S13 | Circulatory diseases mortality (males)           | Deaths per 100.000 inhabitants (% variation 1988 – 1999) | INE (1992, 2001A)                               |
|                 | D | S14 | Circulatory diseases mortality (females)         | Deaths per 100.000 inhabitants (% variation 1988 – 1999) | INE (1992, 2001A)                               |
|                 | D | S15 | Respiratory diseases mortality (hombres)         | Deaths per 100.000 inhabitants (% variation 1988 – 1999) | INE (1992, 2001A)                               |
|                 | D | S16 | Respiratory diseases mortality (females)         | Deaths per 100.000 inhabitants (variation 1988 – 1999)   | INE (1992, 2001A)                               |

|                    |   |     |                                          |                                                                                            |                                           |
|--------------------|---|-----|------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------|
| Mortality          | D | S17 | Infant mortality rates                   | 0/00 de living born<br>(% Variation 1990 – 2000)                                           | FUNDACIÓN ENCUENTRO<br>(2003)             |
|                    | D | S18 | Life expectancy at birth<br>(females)    | Years (% Variación 1990 – 1999)                                                            | INE (1993A, 2003F)                        |
|                    | D | S19 | Life expectancy at birth<br>(males)      | Years (% Variation 1990 – 1999)                                                            | INE (1993A, 2003F)                        |
| Sanitation         | E | S20 | Total expenditures on health<br>services | % of GDP                                                                                   | FUNDACIÓN ENCUENTRO<br>(2003)             |
|                    | E | S21 | Specialised health workers               | Specialists per million inhabitants                                                        | MINISTERIO DE SANIDAD Y<br>CONSUMO (2001) |
| Education Level    | E | S22 | Lower education levels                   | % between ages 25 and 65 with<br>primary or minimum level<br>(% variation 1992 – 2001)     | INE (2003J)                               |
|                    | E | S23 | Higher education levels                  | % between ages 25 and 65 with<br>secondary and higher studies<br>(% variation 1992 – 2001) | INE (2003J)                               |
| Living Conditions  | D | S24 | Rooms per household                      | Rooms per household<br>(% variation 1991 – 2001)                                           | INE (2003J)                               |
| Crimes             | D | S25 | Committed crimes                         | Crimes per 100 inhabitants<br>(% variation 1992 – 2001)                                    | INE (1996, 2003I)                         |
| Traffic Accidents  | D | S26 | Traffic accidents                        | Deaths per million inhabitants<br>(% variation 1991 – 2000)                                | INE (1992, 2001A)                         |
| Population changes | D | S27 | Population growth rate                   | Annual rate per 1000 inhabitants<br>(1990 – 2002)                                          | FUNDACIÓN ENCUENTRO<br>(2003)             |
|                    | D | S28 | Population Density                       | Inhabitants per km <sup>2</sup><br>(% variation 1992 – 2002)                               | FUNDACIÓN ENCUENTRO<br>(2003)             |
|                    | D | S29 | Immigration                              | Rate per 1000 inhabitants<br>(% variation 1992 – 2001)                                     | INE (1993B, 2003J)                        |

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