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TECHNOLOGICAL DEVELOPMENT AND REGIONAL COHESION IN THE LESS FAVOURED REGIONS: THE CASE OF CASTILLA Y LEON.

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ABSTRACT

One of the main objectives in the European Union is to improve the economic and social cohesion among its territories. In this context, a major focus is placed on the less favoured regions. Among the multiple instruments which can be implemented to attain the previous objective, those aimed to finance Research and Technological Development projects (RTD) in these regions are becoming more and more relevant. Such particular policy is founded on the idea that regional competitiveness, and therefore, each region's ability to enjoy a sustainable and sustained growth, relies primarily on the RTD efforts which can be undertaken by the different regional economic actors.

Several European Union reports confirm that inter-regional disparities in technological development, the so-called 'RTD gap', are still much wider than the regional differences in economic and social terms, the so-called 'cohesion gap'. That fact stresses the need for regional policy to increasingly concentrate its efforts on the promotion of technological innovation in the productive systems of less developed areas.

In this paper, we will focus on the relationships between the RTD efforts carried out in the less favoured regions, within the framework of multiple level of government economic policies, and the achievements in the realm of regional cohesion. In order to do so, first, we will try to observe the evolution of inter-regional disparities in income per capita and the evolution of some RTD indicators for the Spanish regions, with particular reference to Castilla y León. Secondly, we will try to characterise these regions from the technological point of view, identifying typologies that facilitate the definition of their needs and weaknesses, and help to conduct the policy-maker action. Our analysis will be developed for the period 1987 to 1994, which the latest data available in Eurostat for regional RTD activities.

KEY WORDS: RTD activities, regional cohesion, technological disparities.

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I. INTRODUCTION.

Competitiveness has become a kind of economic religion of the late 20th century. Enterprises see it as the key to increase profits and market share. Governments pursue it as a way to fix their economies. However, its meaning differs depending on the point of view. Business can consider it as "the ability to produce goods and services which meet the test of international markets, while at the same time maintaining high and sustainable levels of income". Authorities, in a more general sense, define it as the ability of companies, industries, regions, nations and supranational regions to generate, while being expose to international competition, relatively high income and employment levels (European Commission, 1998a), in other words, the improving of the Gross Domestic Product (GDP) *per head*.

It is generally accepted that regional competitiveness is a key factor of regional development. The first one is associated with four main factors: the structure of economic activity, the level of innovation, the degree of accessibility and the education level of the work force. Research and Technological Development is one of the important underlying features that benefit these factors[1].

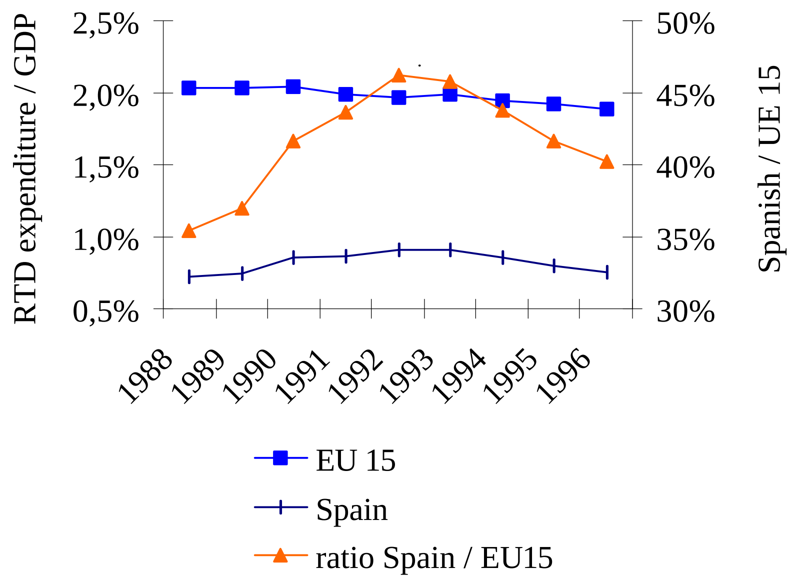
The regional technology policy and its link to growth has evolved considerably during the last two decades or so. In the early 1980s, the "linear view" of the process of innovation[2] was dominant, so the expenditure on *Research and Technological Development* (RTD) was expected to produce economic development automatically. In the latter part of the 1980's, the necessity of adapting scientific results to business needs appeared, but the supply side policy was maintained and less developed regions were unable to improve their economic status through RTD. Nowadays, innovation, whether led by demand or by technology, is conceived as a complex interaction linking potential users with new developments in science and technology, in a specific socio-economic context. Therefore, policy action recognises that "technological progress is not translated into economic benefits and jobs by governments, countries, or sectors, but by innovative firms" (OECD, 1996) and, also, that "innovation and technology development are the result of a complex set of relationships among actors

[1] Some of the main factors underlying competitiveness are Research and Technological Development, Small and Medium Enterprises, Foreign Direct Investment, Infrastructure and Human Capital, and Institutions and Social Capital (European Commission, 1998a, p.35).

[2] The process innovation is consider as a pipeline. That is, government puts public money into basic research at universities and national laboratories at one end, and after a while, new technology and commercial applications appear at the other.

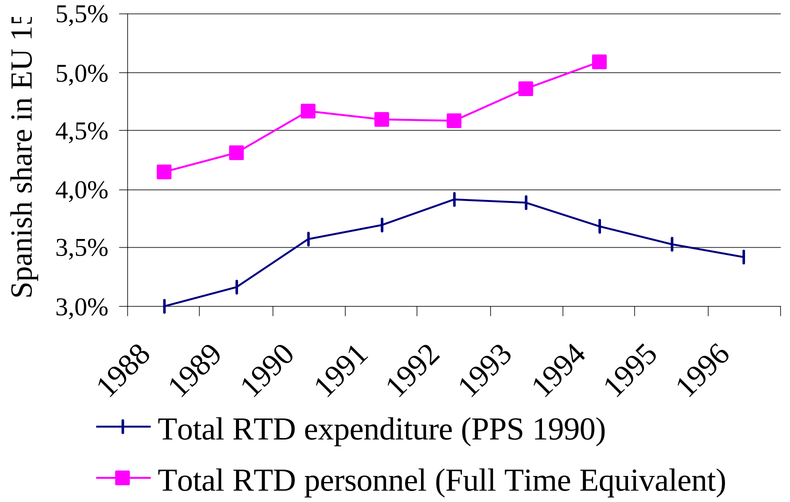
in the system, which includes enterprises, universities and government research institutes. For policy-makers, an understanding of the national innovation system can help identify leverage points for enhancing innovative

Figure 2. Spanish role in European RTD



Source: European Commission (1997a)

Figure1. Spanish role in European RTD



Source: European Commission (1997a)

Table 1. GDP per head (PPS, EUR15=100)

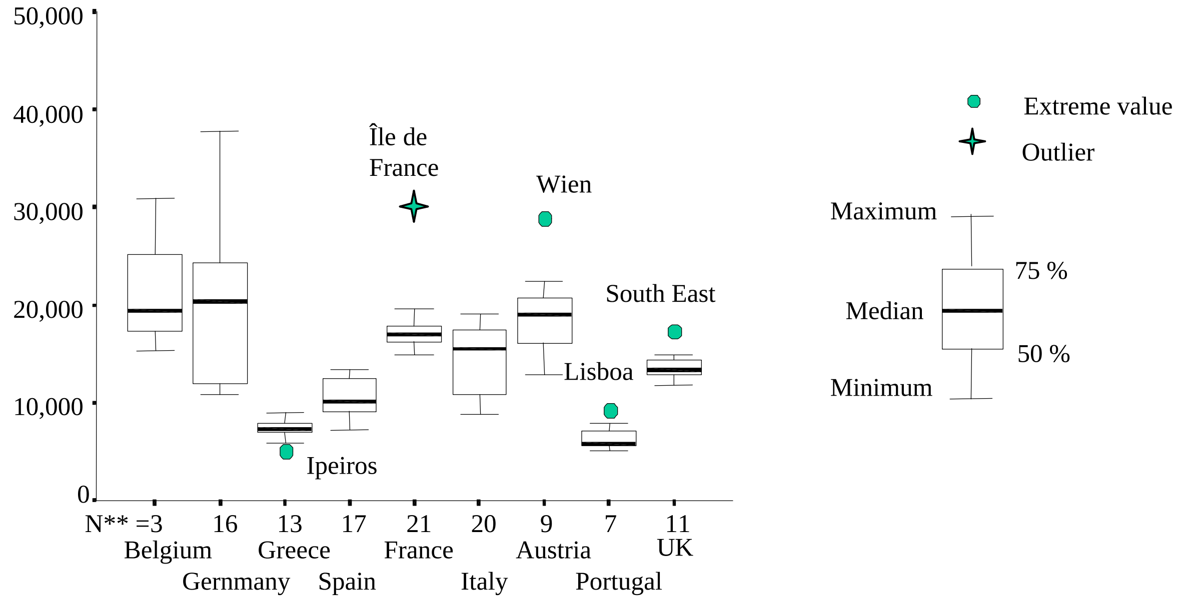
	B	DK	D*	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
1986	102.8	112.1	:	59.2	69.8	109.8	60.8	100.4	137.3	101.8	103.2	55.1	99.7	111.5	98.6
1996	112.1	119.2	108.3	67.5	78.7	103.9	96.5	102.7	168.5	106.8	112.3	70.5	96.9	101.2	99.8

* data including new landers, without them the data is 116.1 and 118.5.
Source: European Commission (1998a).

With regards to the RTD regional dimension in the context of the European economies, there are two questions that can be taken into consideration: the relative position of regions in their countries and the dispersion of the regional data. The first question reveals very big differences between regions and countries, regardless of the measure used. As shown by a box-whisker plot (Figure 3), the median of the *Gross Expenditure on RTD* (GERD) by GDP oscillates between less than 0.5 % to almost 2%. The structure of the distribution, once the outlier and extreme values[3] have been remove, shows the degree of cohesion of the magnitude in two ways: the box gathers the values of the second and third quartile and the whisker the range of the magnitude for the considered regions.

[3] The outliers are these values whose distance to the box is between 1,5 and 3 times the length of the box, and the extreme values are those which are more than 3 time further from the edge of the box.

(GDP per head, ECUs)



** Number of regions considered in each country.
Source: European Commission (1997a)

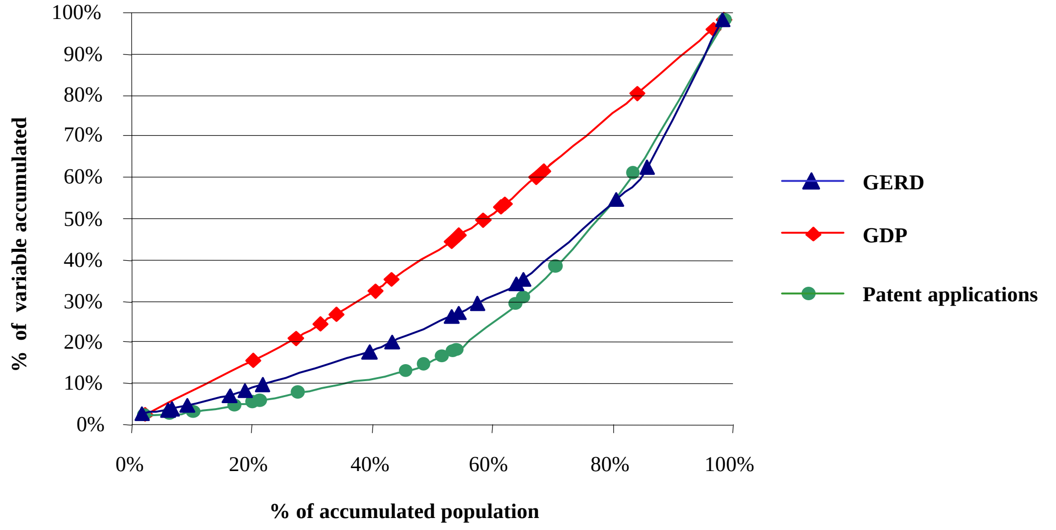
Source:

*Belgium, Spain, France, Italy and UK in 1994; Germany, Greece and Austria in 1993; Portugal in 1992.
** Number of regions considered in each country.
Source: European Commission (1997a)

important divergence in this field. The median oscillates between 7,000 and 20,000 Ecus. But the technological and economic setting is not the same: Belgium and Germany have more divergence in economic cohesion, while France, Austria and the United Kingdom have more technological disparity.
In both cases, Spain is at the bottom of the Figures, accompanied in the technological one by Greece, Italy, Portugal and even by Austria, but in the economic one, just by Portugal and slightly by Italy or Germany.
The Spanish regional situation, with an average of GERD/GDP of 0.85%, presents regions with a high capacity adjoining regions with a low RTD potential. The extent of concentration of the technology resources in just a few regions can be appreciated in Figure 5. In this Figure, some Lorenz curves for regions accumulate different variables, arranged by regional intensity by population of the variables. Two of the best three regions (Madrid and Cataluña) control almost 60% of the expenditure and have no more than 35% of the population. And the eight less technologically developed regions concentrate more that 40% of the population and just a 16% of the expenditure. Even worse is for patent applications, with 55% of applications concentrated on just 20% of the population. The GDP is more equally distributed as the curve is closer to the diagonal.

This regional context has improved slightly during the last decade (1987-1994). In terms of technological cohesion can be highlighted some decentralisation from Madrid, although the disparity stays in similar levels and the median has increased a little (Figure 6). The second area, socio-economic cohesion, is presented in Figure 7 and it is evident that the median is clearly increasing until 1992, and that the distance between the edges is does not grow that fast. So, for that period, it is possible to identify a small progress, and for the two years following, although the median falls, the whisker distance also falls. In any case, the regional disparities in both fields are still recognised as being a big challenge to be solved by Spanish policy-makers. In order to meet this challenge, the Spanish government pretends that RTD appropriations reaches the objective of 1.2 % of GDP by the year 2003. Also, it is preparin a new law which will foster innovation in the industrial sector. Finally, referring to Castilla y León, it is placed in the 5th, the 6th and the 11th position out of 17 regions, if GERD/GDP, RTD personnel by 1,000 labour force or patent applications by 1,000 labour force are considered (Table 2). These indicators put it in a relatively good position in terms of human and financial resources (RTD inputs), but in a bad position in result of patents (RTD output). Besides, the ratios calculated are much smaller

Figure 5. Regional technological concentration (17 Spanish regions)



Navarra	49	1,594	8	204	524	0.75%	7.81	0.038	0.240	12,460
La Rioja	8	173	:	100	261	0.25%	1.73	:	0.080	12,061
Aragón	85	2,086	8.7	474	1,184	0.62%	4.40	0.019	0.179	11,632
Madrid	1,279	27,217	82.3	1,955	5,001	1.96%	13.92	0.041	0.654	13,057
Castilla y León	**163**	**4,247**	**8.6**	**975**	**2,522**	**0.67%**	**4.36**	**0.009**	**0.167**	**9,671**
Castilla-La Mancha	29	680	3.8	603	1,680	0.20%	1.13	0.007	0.048	8,657
Extremadura	30	1,009	1	400	1,069	0.39%	2.52	0.003	0.075	7,233
Cataluña	691	14,080	155.2	2,603	6,070	0.89%	5.41	0.059	0.265	12,773
Comunidad Valenciana	218	5,148	35.5	1,598	3,893	0.56%	3.22	0.022	0.136	10,070
Baleares	12	250	3.2	294	722	0.12%	0.85	0.011	0.041	13,489
Andalucía	284	7,333	10.7	2,589	7,065	0.52%	2.83	0.004	0.110	7,715
Murcia	46	1,346	1	417	1,071	0.47%	3.23	0.002	0.110	9,193
Canarias	84	1,850	2	611	1,535	0.53%	3.03	0.003	0.137	10,233

Source: European Commission (1998).

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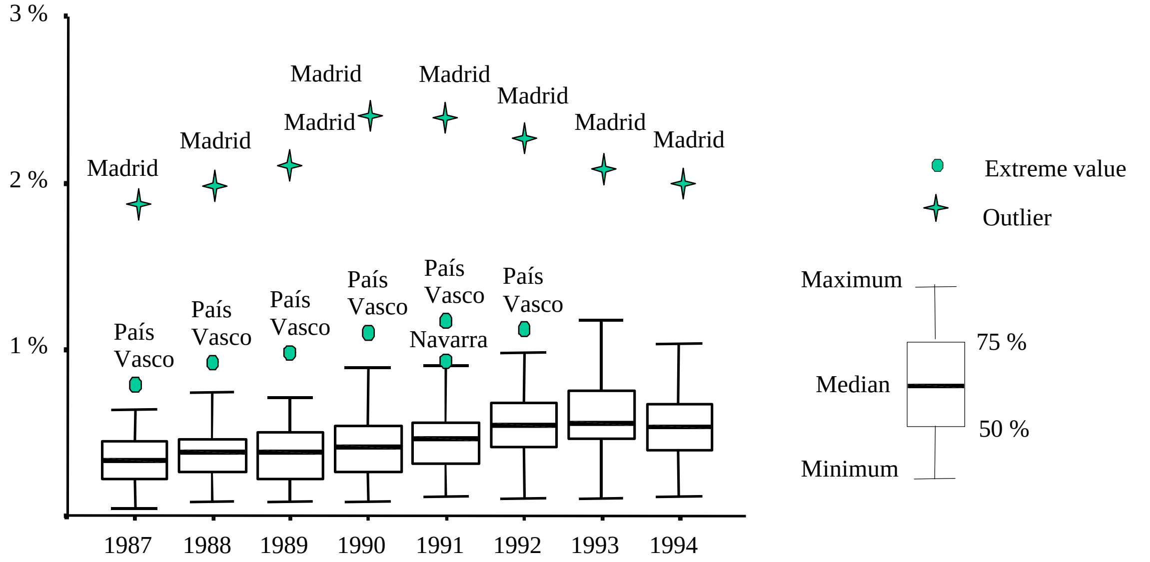
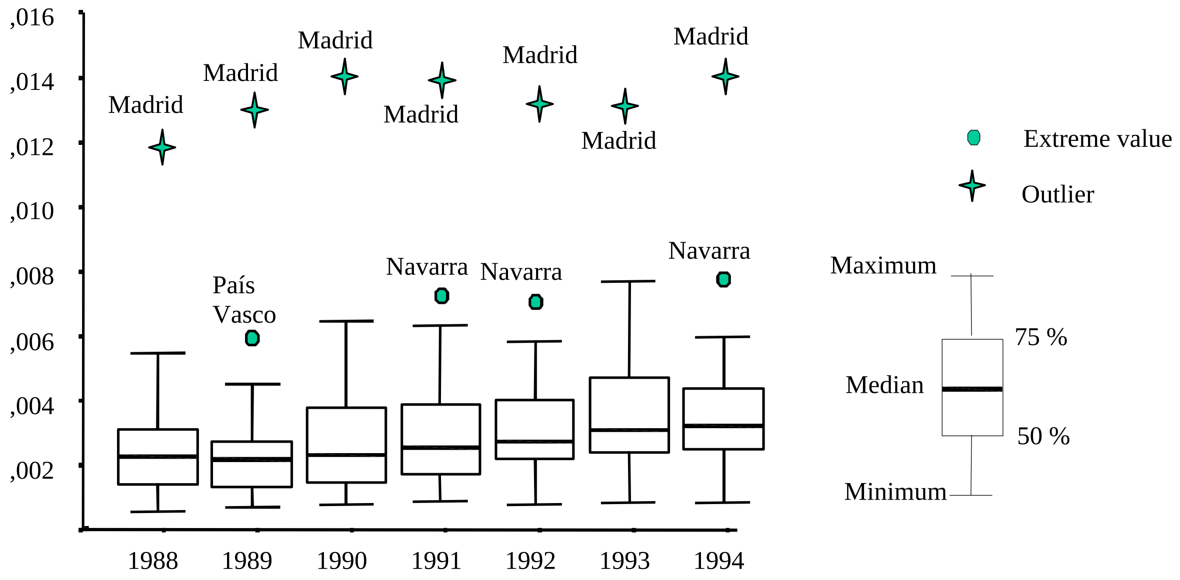


Source: European Commission (1997a)



Source: European Commission (1997a)

IV. THE RTD PROFILE OF THE SPANISH REGIONS

In RTD field, the main statistic information available is referred to the financial and human resources applied, which can be classified in different categories (Business Enterprise, Government and Higher Education) and also its results, in form of patent applications[4].

The regional distribution of these variables is not homogeneous and the analysis of the particular distribution can shed some light on the sources of disparities in technological activities and on the technological regional bases. In this part, we will try to characterise the regions from the technological point of view, identifying typologies of regions that facilitate the definition of their needs and weaknesses, and help to conduct the policy-maker action. This analysis should also be interpreted within a systemic approach of innovation, that suggests that science, technology, and socio-economic variables tend to evolve in an interrelated matter.

Cluster Analysis is the most appropriate technique to construct such a typology, but it should be applied after using Principal Components analysis of the involved variables (Everitt, 1991). So, two steps can be identified in this analysis.

In the first step, Principal Component Analysis is used with the main purpose of describing the variation of a set of multivariate data in terms of a smaller set of uncorrelated main components, which are a linear combination of the original variables. The new variables are derived in decreasing order of importance so that, the first principal component was the variable that much more explains the variation on the original data. These components can be used to summarise the data with little loss of information, thus providing a reduction in the dimensionality of the data, and simplifying later analysis.

In the second step, Cluster Analysis pretends to find a classification in which the items of interest are placed into a small number of homogeneous groups or clusters mutually exclusive. As prior analysis provides low-dimensional plots of the available data, it helps to identify clusters of similar regions. There are many different methods of cluster analysis. One of the most widely used is an agglomerative hierarchical clustering technique. They all operate proceeding sequentially from a initial stage in which each object is considered to be a single member “cluster”, to the final stage in which there is a single group containing all the objects. At each stage in the procedure, the number of groups is reduced by one by joining together the two groups considered to be most similar or the closest to each other. A useful visualisation of this hierarchical structure is a tree diagram, more commonly known as a "dendrogram".

In our analysis, this procedure has been done twice, once for the first year of the examined period (1989) and another time for the last one (1994), in an attempt to identify trends or changes in the evolution. The RTD variables for the Spanish regions which will be used in our analysis are shown in Table 3.

Table 3. RTD variables

BE	RTD expenditure by Business enterprise sector /GDP
GOE	RTD expenditure by Government sector / GDP
HEE	RTD expenditure by Higher Education sector / GDP
BP	RTD personnel in Business enterprise sector / 1,000 Labour force
GOP	RTD personnel in Government sector / 1,000 Labour force
HEP	RTD personnel in Higher Education sector / 1,000 Labour force
PA	European patent applications / MIO labour force

In our point of view, the distinction between sectors is relevant as the consecution of economic results from RTD activities by businesses is not simple. Links are required among all the involved agents. It is widely admitted that the last two sectors, which are referred as the public sector, have more problems to achieve it than the first one. Besides, less developed areas have a bigger weight on public sector in comparison with other regions, what makes more difficult to obtain economics output from their technological efforts. This makes

[4] There are other interesting measures of RTD activity such as: Scientific Publications, Technical Publications and also studies related with Technologic Balance of Payments. However, the last one cannot be used for regional analysis purposes and for the others, we have not enough available data for Spanish regions.

more relevant for government to be aware of the importance of facilitating adequate relationships among the different agents which participate in the innovation process.

III.1 REGIONAL SITUATION AND TYPOLOGY FOR THE YEAR 1989.

The outcome of the principal component analysis based for the year 1989 is shown in Table 4. The first two principal components are retained, as both have their eigenvalues greater than unity, and they account for nearly 85% of the total variation of the original variables (Everitt, 1991). In other words, the resu1ts suggest that the first two component scores for each region might act as an adequate summary of the original seven scores in any further analysis data.

Table 4. Principal Components.1989.

Principal components	Eigenvalues	% Explained variance	% Cumulative explained variance
PC1	4.737	67.7 %	67.7 %
PC2	1.202	17.2 %	84.9 %
PC3	0.826	11.8 %	96.7 %
PC4	0.192	2.7 %	99.4 %
PC5	0.031	0.4 %	99.8 %
PC6	0.007	0.1 %	99.9 %
PC7	0.004	0.06 %	100 %

The coefficients defining the two principal components of these data are given in Table 5. They represent the correlations between observed variables and derived components. The first component (PC1) appears to measure overall RTD expenditure, human resources and patenting as might be expected since all correlations between PC1 and the variables are positive. The second component (PC2) contrasts Public RTD with Business RTD. Regions particularly poor at Business RTD and patenting tend to have high positive scores on this component, and those with poor governmental or higher education RTD, and which are strong in terms of patents have high negative scores.

Table 5. Correlation between original variables and derived components.1989.

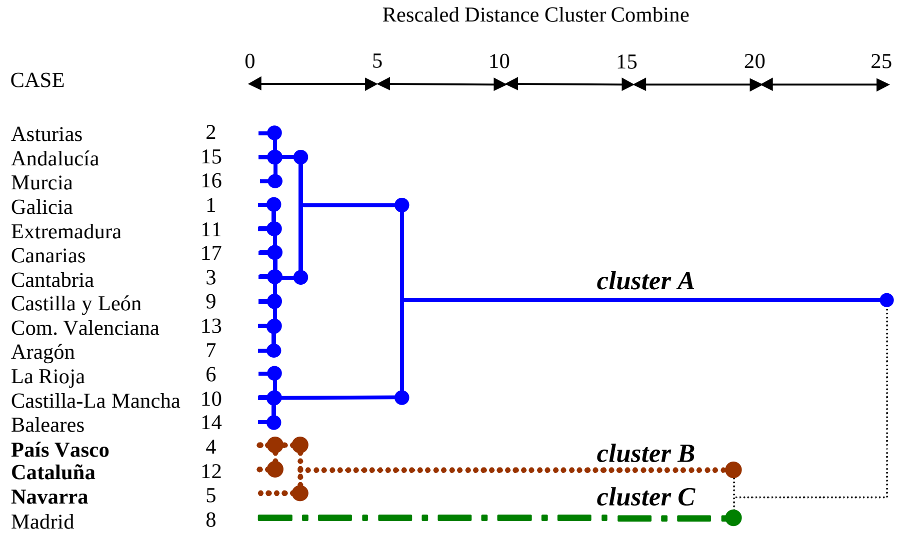
	Original Variables	Principal Components	
		PC1	**PC2**
	BE	0,918	(-0,324)
	GOE	0,837	0,306
	HEE	0,670	0,510
	BP	0,889	(-0,415)
	GOP	0,857	0,226
	HEP	0,882	0,302
	PA	0,665	(-0,640)
Financial Input			
Human Input			
OUTPUT			

Once the principal components have been defined, the 17 Spanish regions are grouped according to their similarities with respect to the values of their principal components. Euclidean distance was picked among the different possibilities for defining intergroup distance or similarity. Using that measure clusters were merged so as to produce the smallest increase in the sum-of-squared error terms at each step using the Ward's hierarchical clustering procedure (Everitt, 1991, pp.125).

Following the Ward's procedure, a hierarchical structure is generated as it is present in the dendrogram of Figure 9. This represents the clustering process, the horizontal distance shows the dissimilarity between elements, the shorter the distance the greater the similarity. In this case, three clusters can be identified, as these groups join each other too far in distance to be considered similar regions.

Each of them can be interpreted by studying the average values for their principal components which are calculated in Table 6 and the information obtained from the Principal component which are synthesised in Table 7. The conclusions for them are as follows:

Figure 9. Dendrogram.1989



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Principal Component	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
PC1	(-0,353)	0,409	0,433	0,688	3,295	0
PC2	0,381	0,517	(-1,866)	0,148	0,645	0

Table 1.

Table 2. Interpretation of Principal Components for1989

Principal Component	**Characteristics**	
	PC > 0	**PC < 0**
PC1	High overall RTD High patenting	Low overall RTD Low patenting
PC2	Public RTD	Business RTD

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• The first cluster, which we have named "C", is composed just by Madrid. This is characterised by the high level of all the RTD indicators, it has the greatest value for PC1. Besides the PC2 is high which can be explained by the very important role of its public RTD. Both features are typical of central locations within a country, as it is recognised by the Second European Report on R&D Indicators: "central locations within member states are the main beneficiaries of national R&D infrastructure and dominate the European technological space" (European Commission, 1998b). Madrid stands 62% and 21% of government and higher education expenditure and 60% and 21% of government and higher education personnel dedicated to RTD.

- The second, Cluster "B", is formed by 3 regions: País Vasco, Cataluña y Navarra. This group is the second in importance of RTD, and the second principal component is high and negative. From this, it can be interpreted that the business RTD activity is the cause of their good situation, especially in the case of Navarra. As reference, 85%, 84%, 71% of the GERD belonged to Business sector in Navarra, País Vasco and Cataluña and 87%, 72% and 61% of the personnel is account as business sector personnel, respectively. As País Vasco y Cataluña get the highest values of PC1 after Madrid, which is related with RTD resources and patents, so this cluster must have still some relevant RTD activity.

- Finally, Cluster "A" groups the rest of the Spanish regions (all the European considered Objective #1 regions belong to this cluster). Almost all of them present negative values for the PC1 which can be the result of a poor technological position. Besides, most of them have a significant value of PC2 which is linked with the fact of a small presence of private sector and good results in term of patents.

III.2 REGIONAL SITUATION AND TYPOLOGY FOR THE YEAR 1994.

After this first configuration of the Spanish regional technological landscape, one question that arises is to know to which extent this situation goes on, some years later, or if the groups have been modified in any way. Doing the same procedure, but based on the 1994 data, some interesting differences are detected. The first one is that Principal Component analysis clearly indicates that there are three major components. These components (Table 8) have eigenvalues greater than unity and explain nearly 93% of the total variation of the original variables.

Table 8. Principal Components.1994.

Principal Components	**Eigenvalues**	**% Explained variance**	**% Cumulative explained variance**
PC1'	3.977	56.8 %	56.8 %
PC2'	1.449	20.7 %	77.5 %
PC3'	1.080	15.4 %	92.9 %
PC4'	0.297	4.2 %	97.1 %
PC5'	0.181	2.6 %	99.7 %
PC6'	0.013	0.2 %	99.9 %
PC7'	0.003	0.04 %	100 %

The correlation between variables and major components appears in Table 9, which permits us to determine what are the main features of each of them. As in the analysis done for 1989, the first component measures overall RTD. The second component contrasts higher ºeducation RTD with Business RTD. Besides, the coefficient for patenting is negative and appears low negative correlation between second component and governmental RTD. Regions with high levels at higher education RTD and poor at patenting tend to have high positive values on this component, and regions with a strong Business RTD and patenting become negative. Finally, the third component contrasts higher education and Business RTD with governmental RTD. The results on patenting are better in this cluster. Regions with lower government RTD and higher number of patents tend to have high positive scores on this component, and those which are stronger at governmental RTD and poorer at patenting have high negative scores.

Table 9. Correlations between original variables and derived components.1994.

Original Variables	**Principal Components**		
	PC1'	**PC2'**	**PC3'**

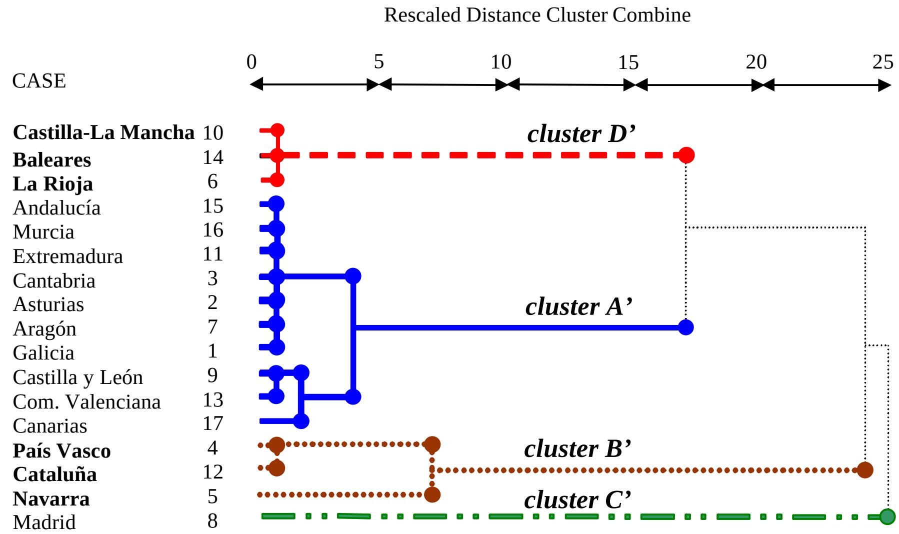
BE	0.915	(-0.243)	0.231
GOE	0.802	(-0.015)	(-0.590)
HEE	0.324	0.891	0.020
BP	0.914	(-0.219)	0.286
GOP	0.792	(-0.087)	(-0.595)
HEP	0.590	0.691	0.219
PA	0.762	(-0.253)	0.441

In comparison with Principal Components Analysis accomplished for 1989, there is a great difference concerning the public expenditure in RTD, especially that undertaken by higher education, and not that much for government effort. This fact is reflected in the third component that is added, which can be seen as an alteration of the content of the old second principal component.

The cluster analysis, based on the extracted components from 1994 data, gives four clusters. As the dendrogram of Figure 10 shows, the regions integrated in each one of them are substantially the same as in 1989 case, though a new group (D') appears, which is a desegregation of the old cluster A.

The previous dendrogram and the information that was extracted from the principal component analysis, which is summarised in Table 10, permit the definition of these clusters and the regions that belong to them.

Figure 10. Dendrogram 1994.



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Principal Component	Cluster A' ($N_{A'}$=10) Mean	Standard Deviation	Cluster B' ($N_{B'}$=3) Mean	Standard deviation	Cluster C' ($N_{C'}$=1) Mean	Standard deviation	Cluster D' ($N_{D'}$=3) Mean	Standard deviation
PC1'	(-0,301)	0,231	0,766	0,085	3,248	0	(-0,844)	0,273
PC2'	0,557	0,524	(-0,278)	1,380	(-0,456)	0	(-1,425)	0,221
PC3'	(-0,264)	0,436	1,799	0,159	(-1,869)	0	(-0,295)	0,189

- Cluster B' is formed by Cataluña, Navarra y el País Vasco. It holds the best technological regions of Spain, after Madrid, which means a significant improvement for Navarra since 1989. In this group, the high scores of the second component show that the governmental activity is relevant, especially in Navarra.

- Cluster A' is made up of 10 regions. Almost all of them present negative values of the PC1', which denotes a low level of resources and patent applications. The agent distribution is mainly defined by a predominance of government (PC3'<0) and higher education (PC2'<0). A smaller importance of governmental activity (PC3'>0) is detected for Castilla y León, although this is not enough to be included in cluster B'.

- The new Cluster D' is formed by La Rioja, Baleares y Castilla-La Mancha. All these regions have negative values in all the components. The interpretation of this cluster pinpoints a quite poor technological performance. These regions suffer from a stagnation in the different variables while the rest of the old cluster A has been able to improve in some way. Two of them get the worst scores of PC1', and similar results emerge from the PC2', which means a slightly higher education activity. Only the government sector maintains a relevant position in a small total activity.

- Within this global analysis of the Spanish regions, a main concern was to identify the specific case of Castilla y León. This region is located in central Spain, but clearly peripheral in Europe. Its socio-economic structure remains characterised by its important weight of agriculture employment, 15.3%, as compared to other sectors (industry, 19.2%, construction 11.1% and services, 54.4%). In income terms, it is a region objective #1, though its path puts it among the regions which are on the verge of surpassing that situation. This is in part due to the loss of population in the region. Technologically, there is some activity, although far below that of European developed areas.

- The behaviour of Castilla y Léon causes it to belong to cluster A in 1989 and to cluster A’ in 1994. The values of its principal components for both years are presented in Table 12.

Table 12. Principal components of Castilla y León.

	1989		**1994**		
	PC1	**PC2**	**PC1'**	**PC2'**	**PC3'**
Castilla y León values	0.004	0.309	(-0.120)	1.193	0.390
Mean	(-0.353)	0.381	(-0.301)	0.556	(-0.264)
Cluster's features of Castilla y León					
Minimum	0.409	0.517	0.231	0.524	0.436
Maximum	(-1.005)	(-0.565)	(-0.667)	(-0.246)	(-0.713)
Standard deviation	0.240	1.143	0.089	1.444	0.390

For the first year, 1989, it is one of the few regions of its group with a positive score in PC1, together with by Cantabria y Aragón, which is a favourable condition. The second component, PC2, presents similar values to the mean value of the cluster. Therefore, the Public sector plays a leading role, steering the technological development of the region.

For 1994, Castilla y León still maintains a good position in its group as it is suggested by the value of PC1'. It is the third region after Aragón and the Comunidad Valenciana. The importance acquired by the higher education sector which grows from 35% to 51% of the total regional expenditure and from 50% to 64% of the RTD personnel must be emphasised. Besides, its having a positive value for PC3' reflects a small share of the government sector in the regional RTD. It is the third region, according to the importance of the government sector activity, after País Vasco and Navarra.

V. CONCLUSIONS.

The Spanish role in the European RTD activity, both in terms of personnel and expenditure, can be considered satisfactory, taking into account that the starting point was far below the European regional average. During the 90's, however, the RTD gap widens between Spain and the EU-15 average.

The latest data indicate that Spanish RTD expenditure just accounts for 40.2 % of the EU-15 average level of GERD/GDP, while, at the same time, its GDP per head (PPS) is 78.7 % of the EU-15 average. The first variable has risen 4.6 points since 1987 and the second has increased 8.9 points since 1986, which implies better results in diminishing the economic cohesion gap than in the technological one.

Technological and economic disparities are both high for the European regions, regardless the measure we can used. As for the Spanish regions are placed within the group of less favoured regions of the EU, also showing significant degree of disparity among them. In the national context, Castilla y León clearly stands as a region with a relative good position in terms of RTD inputs (human and financial resources), but not so good in the regional ranking for RTD outputs, which we have measured in terms patent applications. Nevertheless, regional disparities in the technological and economic field are recognised as a challenge to be solved by Spanish authorities.

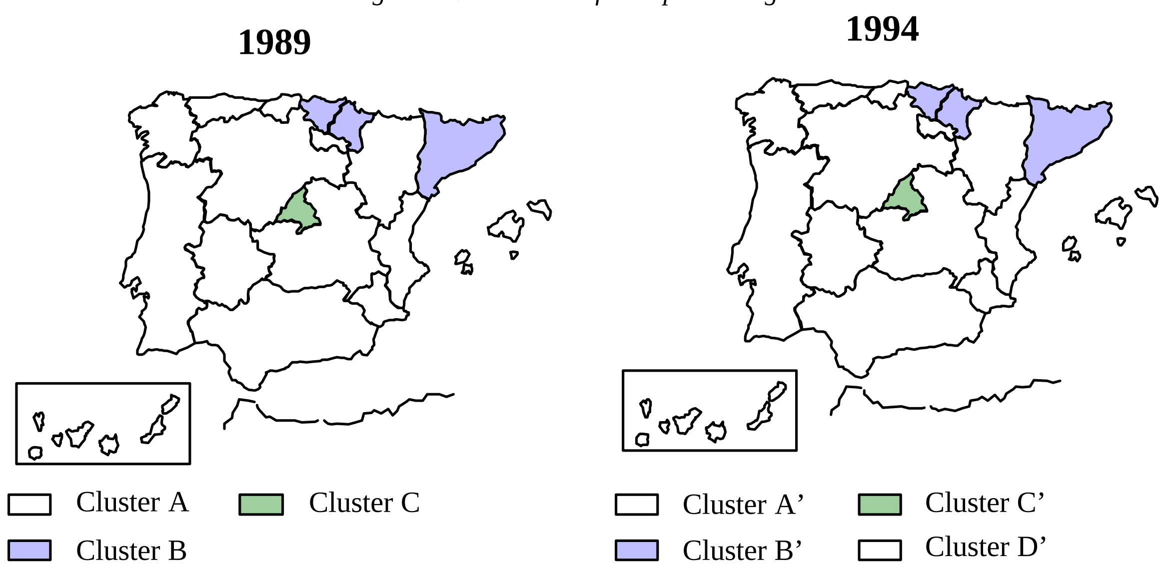
The results of the Principal Component Analysis of the Spanish regions undertaken in 1989 indicate that the variation of the RTD variables considered could be summarised into two components. The first represents the global importance that the RTD inputs reach in the region, as well as its level of RTD output (patents). More specifically, this component includes 67.7% of the variance. The second component differentiates between the regions, according to the relative importance of the RTD activities developed by the Public Sector (Government and Higher Education) versus those undertaken by the Business Sector. This component accounts for 17.7% of the total variance.

In accordance with the above-mentioned findings, and after applying the Cluster Analysis, we can identify three groups of regions with different RTD components. The first group, made up of Madrid, shows high level of overall RTD activities, which are carried out by the Public Sector. The second group includes regions which show a lower overall RTD activity level, being its major characteristic the higher relative importance of these activities which are developed by the Business Sector. The third group includes the remaining regions, among which we can find Castilla y León. This cluster is characterised by a low level of RTD activities, which is fundamentally sustained by the activity of the Public Sector in detriment to the activity of the firms.

In 1994, we observe changes, not only in the components which explain the regional divergences in the RTD variables, but also with respect to the groups that the Cluster Analysis reveals (Figure 12). As for the Principal Components, in 1994, there are three aspects which determine most of the variance (93%). Thus, together with the level of overall RTD activities, we must also consider the differences inside the activity of the Public Sector, making a distinction between those which are developed by the Government and those undertaken by the Universities.

Similarly, the Cluster Analysis shows, for the year 1994, the existence of four groups of regions. The

Figure 12. Evolution of the Spanish regions



European Commission (1998a): "Sixth Periodic Report on the Social and Economic Situation and Development of Regions in the European Union". Brussels.

European Commission (1998b): "Reinforcing Cohesion and Competitiveness through Research, Technological Development and Innovation. COM(1998) 275 fin". Brussels.

Everitt, B.S. y Dunn, G. (1991): "Applied Multivariate Data Analysis". Edward Arnold. London.
OECD (1996): "Technology, Productivity and Job Creation". Paris.
OECD (1997): "National Innovation Systems". Paris.
Visauta Vinacua, B. (1998): "Análisis Estadístico con SPSS (Statistical Package for the Social Science) para Windows: Estadística Multivariante". McGraw-Hill. Madrid.

VIII.ANNEXE

Value of principal components for Spanish regions

1989

	REGIONS	**PC1**	**PC2**
A	Galicia	(-0.538)	0.493
	Asturias	(-0.045)	0.923
	Cantabria	0.001	0.369
	La Rioja	(-1.005)	(-0.548)
	Aragón	0.240	0.529
	Castilla y León	**0.004**	**0.309**
	Castilla-La Mancha	(-0.955)	(-0.565)
	Extremadura	(-0.568)	0.523
	Com.Valenciana	(-0.257)	0.206
	Baleares	(-0.886)	0.029
	Andalucía	(-0.063)	0.937
	Murcia	(-0.101)	1.143
	Canarias	(-0.419)	0.605
	mean	**(-0.353)**	**0.381**
	standard deviation	0.409	0.517

1994

	REGIONS	**PC1**	**PC2**	**PC3**
III.3 **A’**	Galicia	(-0.637)	(-0.246)	(-0.368)
	Asturias	(-0.249)	0.234	(-0.101)
	Cantabria	(-0.297)	0.828	(-0.278)
	Aragón	0.089	0.104	(-0.407)
	Castilla y León	**(-0.120)**	**1.193**	**0.390**
	Extremadura	(-0.667)	0.458	(-0.712)
	Com. Valenciana	(-0.108)	0.874	0.572
	Andalucía	(-0.371)	0.492	(-0.446)
	Murcia	(-0.342)	0.184	(-0.631)
	Canarias	(-0.312)	1.444	(-0.661)
	mean	**(-0.301)**	**0.556**	**(-0.264)**
	standard deviation	0.231	0.524	0.436
III.4 III.5 B’	País Vasco	0.693	(-1.318)	1.879
	Navarra	0.746	1.287	1.903
	Cataluña	0.860	(-0.803)	1.616

	País Vasco	0.895	(-1.723)
	III.6 B		
	Navarra	(-0.358)	(-2.018)
	Cataluña	0.762	(-1.857)
	mean	**0.433**	**(-1.866)**
	standard deviation	0.688	0.148
C	Madrid	3.295	0.645
	mean	**3.295**	**0.645**
	standard deviation	0	0

	mean	**0.766**	**(-0.278)**	**1.799**
	standard deviation	0.085	1.380	0.159
III.7	Madrid	3.248	(-0.456)	(-1.869)
	III.8 C’			
	mean	**3.248**	**(-0.456)**	**(-1.869)**
	standard deviation	0	0	0
D’ III.9	La Rioja	(-0.530)	(-1.663)	(-0.415)
	Castilla-La Mancha	(-1.023)	(-1.385)	(-0.394)
	Baleares	(-0.979)	(-1.227)	(-0.077)
	mean	**(-0.844)**	**(-1.425)**	**(-0.295)**
	standard deviation	0.273	0.221	0.189