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INNOVATION POLICY IN SPAIN

Technology, innovation and economy in Spain:

National and regional influences

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Technology, Innovation and Economy in Spain. National and regional influences.

The objective of the present work is to analyse and assess the influence of the innovation process in the economic development of Spain, essentially since her incorporation into the European Community in 1985-86. Along this exercise, the existence or not of a system of innovation should be lighted as well as the relevance of the regionalisation of Spain politics to those processes.

This analysis has to be placed into a dual, and significant, context. On one side, the position of Spain in relation to Europe and her policies; regional, innovation, research and development. On the other, the socio-economical characteristics and evolution of Spain along the last fifteen years.

These contexts shall be confronted against the current theoretical framework on the systems of innovation and the economic and regional development.

General overview

In previous work (Muñoz, 1999, Muñoz *et al.* 1998,1999), it has been repeatedly stated that the take off of Spain during the autarchy was apparently independent of the country efforts in R&D and innovation. However, different efforts were made later on to modernise Spain by incorporating in that process political segments of influence in relation with science and technology policies (Sanz-Menéndez, 1997, Muñoz, 1999, Muñoz et al. 1998, 1999).

Such efforts succeeded in launching a scientific community able to compete into the international area by producing knowledge of certain recognition although with uneven distribution between the different fields of cognitive endeavour (see Quintanilla *et al. 1992;* Cami *et al.* 1993, 1997). But they were harbouring the links of such scientific awaken with the process of innovation and its potential impact on production and economic growth (Espinosa de los Monteros *et al*., 1994 a,b; 1995 a,b; 1996 a,b; 1997).

The creation of a European regional policy

The integration of Spain in Europe was decisive for a greater involvement of her economy into an open, competitive arena. The country and the political leaders were in clear bet for improving the macroeconomical indicators in order to reach convergence but, at the same time, they were benefiting of the EC regional policy.

European regional policy. The EC regional policy was created in 1975, as awareness of regional disparities in Europe has been since long established (Bache, 1998). The Treaty of Rome made no specific commitment to the creation of a Community regional policy, though a number of early financial instruments had a regional dimension: the European Social Fund (ESF); the European Coal and Steel Community (ECSC); the European Investment Bank (EIB); and the European Agricultural Guidance and Guarantee Fund (EAGGF). After 1975, the main financial instrument of regional policy was the European Regional Development Fund (ERDF).

This Fund, after a long process of discussions, was formally established in March 1975. This ERDF was aimed to fund up to 50 per cent of the cost of regional development projects in targeted regions. The remaining cost would be provided by domestic sources. The idea underlying this "match-funding" was to foster coordination and complementarity between EC and national initiatives.

Projects funded through ERDF fell under two broad categories: industrial and infrastructure. The national governments proposed that the distribution of the regional fund should take place according to national "quotas", leaving aside "objective" criteria. The fund was endowed with 300 million of account units for its first year and 500 million for the following two. The result was a dispersed rather than concentrated distribution of funding, the ERDF covering the 60 per cent of the geographical area and 40 per cent of the total population. Three countries were net beneficiaries and six net contributors (Table 1).

Table 1. ***National Quotas of ERDF in 1975***

Country	Percentage
Belgium	1.5
Denmark	1.3
France	15.0
Germany	6.4
Italy	40.0
Ireland	6.0*
Luxembourg	0.1
Netherlands	1.7
United Kingdom	28.0

*Ireland received a further 6 million of units of account taken from the others with the exception of Italy.
Source: Preston (1984), taken from Bache (1998)

The major reform took place in 1988, with some reforms occurring in 1979 and 1984, as reflection of a struggle to throw off the many restrictions imposed by the Council of Ministers in the original Fund Regulation (Armstrong 1989, quoted by Bache, 1998,53). The outcomes of the 1979 and 1984 reforms turned out to be a review than the substantial reform the Commission intended and fighted on against the interests of the member countries. The Commission's proposals that were adopted included the creation and development of the non-quota system and programme contracts. These were seeds for the future policy development as resulted in the reform of 1988.

The 1988 reform of the Structural Funds

The context of the reform was provided by two important events: the enlargement of the Community to include Portugal and Spain that took place in 1985, and the greater relevance to the economic and social cohesion given in the Single European Act (1986).

The accession of Spain and Portugal to EC implied a considerable widening of regional disparities, leading to a doubling of the population of the "least favoured regions", - those with per capita GDP of less than 50 per cent of the Community average. This fact prompted an expansion of regional policy within European Community and prompted the introduction of a new type of programme: The Integrated Mediterranean Programmes (IMPs). These programmes were introduced to respond to Greek threats to veto the accession of Spain and Portugal at the European Council held in Dublin in December 1984. In recognition to the Greek arguments that the enlargement would damage Greece economically, the Brussels European Council meeting of March 1985 agreed the IMP initiative to compensate Greece, Italy and France. The IMP initiative was considered as an important step for the reform package of 1988 as it implied greater involvement of the Commision in its management. Article 130D of the Single European Act called for a reform of the three structural funds (ERDF, ESP and EA GGF) through a framework regulation on their tasks, their effectiveness and "on co-ordination of their activities between themselves and with the operations of EIB and other financial instruments" (Bache, 1999,69, quoting the Commission, 1989).

The Council (Brussels, February 1988) agreed the draft regulations prepared by the Commission and that allocations to the three structural funds would double in real terms between 1987 and 1993 with allocations in the final year period up to 14,000 million ECU, around 25 per cent of the EU budget. This represented a huge increase with respect to initial allocations and the operation of the funds were guided by four principles: *concentration, programming, partnership and additionality.*

Following the principle of concentration, the structural fund expenditure was focused on five objectives, three with an explicit regional dimension (Objectives 1,2 and 5b). The bulk of the expenditure was focused on the most disadvantaged regions eligible under Objective 1 and amounted to approximately 65 per cent of the total structural fund allocation.

Objective 1: promoting the development of "less developed regions (those with per capita income of less than, or close to, 75 per cent of the Community average under "special circumstances") (ERDF, ESF and EAGGF -Guidance Section).

Objective 2: converting the regions seriously affected by industrial decline (ERDF, ESF)

Objective 3: combating long-term unemployment (assisting people over 25 unemployed for over a year) (ESF)

Objective 4: assisting the occupational integration of young (people below the age of 25) (ESF)

Objective 5: a) accelerating the adjustment of agricultural structures (EAGGF);

b) promoting the development of rural areas (EAGGF, ESF, ERDF).

The Council decided eligibility for assistance under Objective 1 and the designated areas were listed in the Framework Regulation. Seven Member States qualified for assistance under this objective, including coverage for the whole of Greece, Ireland and Portugal . Elegibility for assistance under Objective 2 was negotiated between the Commission and national governments following proposals of over 900 regions by Member States. Ultimately, 60 regions in nine Member States were eligible. Objective 5b involved relatively small amounts of funding (2,600 million ECU), equal to 7 per cent of Objective 1 allocation. Elegibility was less controversial and covered 5 per cent of the Community population spread across nine Member States (Greece, Ireland and Portugal were the exception).

An indication of the allocation of regional significant Funds is given in Table 2, whereas the allocation of Structural Funds, both by Member State, is shown in Table 3.

The other three principles: programming (multi-annual programmes were supported by the Council following Commission proposals), partnership (policy not only for the regions, but also by the regions) and additionality (a positive step towards the commitment of Member States to support the regions) represented the winning aces of the Commission.

Table 2. *Indicative allocation of Objective Funds of regional significance by Member States for 1989 – 93.*

Country	**Objective 1(%)**	**Objective 2 (%)**	**Objective 5 b (%)**
Belgium		5.0	1.25
Denmark		0.8	0.88
France		17.6	36.82
France (overseas depart.)	2.1		
Germany		8.6	20.14
Greece	16.2		
Ireland	5.4		
Italy (southern)	24.5		
Italy		6.1	14.77
Luxembourg		0.5	0.09
Netherlands		1.9	1.69
Portugal	17.5		
Spain	*32.6*	*19.7*	*10.93*
UK		39.7	13.43
UK (Northern Ireland)	1.7		

Greece, Ireland and Portugal did not receive Objective 2 funding as they were selected as a whole under Objective 1

Source: taken from Bache (1998)

Table 3. *Total allocation of Structural Funds by Member State 1989-93*

Country	**Percentage**
Belgium	1.18
Denmark	0.64
Germany	9.56
France	9.38
Greece	11.96
Ireland	7.08
Italy	17.08
Luxembourg	0.09
Netherlands	1.15
Portugal	13.42
Spain	20.81
UK	7.65

Source: taken from Bache 1998, calculated from Commission data, 1996.

The 1993 Reform

The major principles adopted in 1988 were, in the official literature, either maintained and strengthened, but in reality changes were made to the four guiding principles, in several cases driven by the preferences of national governments.

"The principle of concentration continued to focus aid on the areas of greatest need" (Bache, 1998), but amendments were made to the priority objectives: Objectives 1 and 2 were not changed in 1993, while Objectives 3 and 4 were merged to create a new Objective 5 aimed at "facilitating the integration of those threatened with exclusion from the labour market". The new Objective 4 was designed to put into force the adaptation of workers to industrial changes and to changes in production systems Objective 5 a maintained its initial goal but a new fund was added to assist the fisheries sector. Objective 5 b changed slightly and Objective 6 was added to promote "developing sparsely populated Nordic areas".

A number of regions were included under Objective 1 for the first time in 1993 from Germany (five new German Länder), UK (Merseyside, the Highlands and Islands), Belgium (Hamant), France (Nord –Pas de Calais) and Netherlands (Flevoland), even though their GDP per capita was higher than the 75 per cent of the Community average.

This levered the coverage of Objective 1 funding to 26.6 per cent of the European Community population, accounting for 68 per cent of all structural funding. Objective 2 regions received 11.1 per cent of all structural fund allocations. Table 4 illustrates the distribution by Member State of the regional significant Objectives 1.2 and 5 b funds and the total allocation along the period 1994-99 compared to the allocations for 1989-93 which are indicated in brackets.

Table 4. *Allocation of Regional Objectives Funds and total allocation (1994-1999). Distribution by Member State and comparison with 1989-93 period.*

Percentage

	Objective 1	**Objective 2**	**Objective 3**	**Total**
Austria	0.17(0.00)	0.17(0.00)	5.87(0.00)	1.04(0.00)
Belgium	0.78(0.00)	2.22(4.47)	1.12(1.48)	1.31(1.18)
Denmark	--	0.78(0.41)	0.79(0.94)	0.54(0.64)
Finland	--	1.17(0.00)	2.77(0.00)	1.09(0.00)
France	2.33(2.18)	24.55(19.98)	33.60(39.16)	9.65(9.38)
Germany	14.51(6.84)	10.2(9.48)	17.89(22.89)	14.12(9.56)
Greece	14.87(17.18)	--	--	10.12(11.96)
Ireland	5.98(10.18)	--	--	4.07(7.08)
Italy	15.81(19.41)	9.52(6.31)	13.13(16.13)	14.29(17.08)
Luxembourg	--	0.11(0.19)	0.90(0.13)	0.06(0.09)
Netherlands	0.16(0.00)	4.33(1.01)	2.19(1.48)	1.59(1.15)
Portugal	14.87(19.28)	--	--	10.12(13.42)
Spain	*27.98(23.21)*	*15.73(24.57)*	*9.70(11.87)*	*22.91(20.81)*
Sweden	--	1.02(0.00)	1.97(0.00)	0.85(0.00)
UK	2.51(1.81)	29.83(32.87)	1.97(5.91)	8.26(7.65)

Allocation for 1989-93 differed from the indicative allocations (Table 2) as calculated from the Commission (taken from Bache, 1998).

Cohesion Fund

The Spanish government, worried that it would become a net contributor to Community funds by 1993, argued for a new compensatory mechanism during the negotiations over the Maastricht Treaty. A new Cohesion Fund to compensate for ongoing regional disparities was established by the Council faced with the threat of veto from the Spanish government. The Cohesion Fund estimated allocations of approximately 16,000 million ECU over the period 1993-1999. The Cohesion Fund differed in some of its principles from the structural funds. It was aimed to finance projects instead of programmes and only those concerned with environment and transport infrastructure. The Cohesion Fund was targeted to Member States with a GDP of less than 90 per cent of the Community average, not to regions. It would support up to 85 per cent of the costs of the project – a higher rate than with any of the structural funds. As with those funds, the Cohesion Fund was subject to indicative allocations (Greece, 16-20 per cent; Spain 52-58 per cent; Portugal 16-20 per cent, and Ireland 7-10 per cent).

The establishment of the Cohesion Fund has led to a new distribution of the share of the Structural Intervention of the European Commission which is depicted in Table 5.

Table 5. *Extent of Structural Intervention (including all the initiatives and funds) from 1994-99 (allocations for 1989-93 in brackets).*

	% share of EU support	***EU support as % national GDP***
Austria	1.13(0.00)	0.19(0.00)
Belgium	1.25(1.18)	0.18(0.11)
Denmark	0.50(0.59)	0.11(0.08)
Germany	12.97(11.46)	0.21(0.13)
Greece	10.58(12.51)	3.67(2.65)
Spain	*25.30(20.57)*	*1.74(0.75)*
Finland	1.19(0.00)	0.40(0.00)
France	8.92(9.46)	0.22(0.14)
Ireland	4.42(6.68)	2.82(2.66)
Italy	12.92(16.90)	0.42(0.27)
Netherlands	1.56(1.11)	0.15(0.07)
Portugal	10.53(12.90)	3.98(3.07)
Sweden	0.93(0.00)	0.37(0.00)

Source: taken from Bache, 1998.

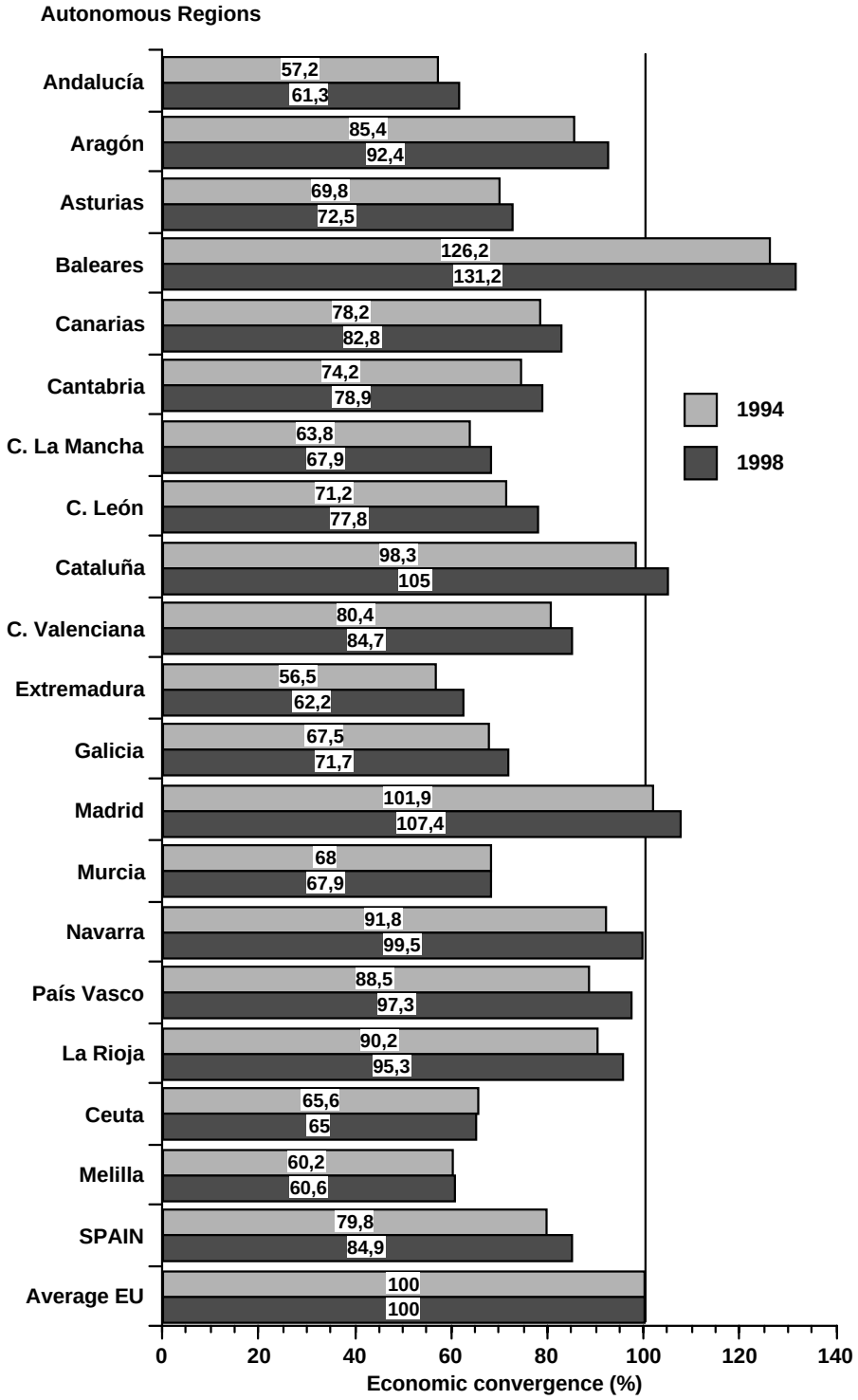
Incorporation of Spain into Europe: a crucial factor for convergence.

At the onset of integration of Spain into the European Community, a high percentage of the Autonomous Regions of Spain were supported by the Structural Frame. Most of the regions were eligible as Objective 1 since their per capita GDP was lower than 75 per cent of Community average, others like the Basque Country or even parts of Madrid were objective 2. The only exceptions were Cataluña, Navarra, La Rioja and Baleares.

It is obvious that not all the structural funds have been addressed to innovation objectives and to foster research activities but it has to be recognised that a very important part of them have been driven to improve the infrastructure of transport, communications and technical and scientific laboratories, a crucial steps to build instruments that may foster the competivity of the productive sectors.

Along the process of convergence, the Spanish regions have experienced ups and downs with regard to the criteria of economic convergence. The current situation as it is shown in fig. 1 represents important leaps ahead for most of the regions as compared to 1994.

Figure 1. Economic convergence of Autonomous Regions with the EU (per capita income).



Source. Fundación de las Cajas de Ahorros Confederadas, 1999.

Socio-economical map of Spain and the Autonomous Regions

The CONVERGE project has clearly stated that the concept of "convergence" holds some ambiguities as it was used to refer the nominal criteria underlying the implementation of the single European currency. The interest of the COVERGE project is to explore the "real convergence" and refers to the analysis of the regions in living standards, employment opportunities and social conditions.

The case of Spain appears as paradigmatic to illustrate the ambiguities of the concept of "nominal convergence" and to explore the data and eventually the causalities underlying the issues related to value the "real convergence".

Characteristics of Spanish economy

Since its incorporation into the European Union in 1985-86, Spanish economy has followed a positive path, although it also accused the crisis of the early nineties, suffering of even less growth and more unemployment than the other Member States. However after this leap back, the economy of Spain has been growing at a higher rate than the average of the EU. In 1998, The Gross Domestic Product of Spain grew 4.60 per cent (4.67 per cent excluding the agrarian sector).

This pace of growth has been accompanied by a containment of the rate of inflation (remaining around 2-2.2 per cent) and by a significant decrease in the rate of unemployment, one of the most critical variables in the development of Spain during the last third of the century. Another important feature of the political and economical evolution of Spain along this period is the increasing relevance of the regionalisation. This was one important trend emerging from the democratic transition and has been constituting and still represents one of the major political issues at stake in Spain. The regionalisation is also extremely significant to light the lack of homogeneity existing in terms of macroeconomical indicators between the Spanish regions. This process adds value in assessing the relative of these macroeconomical indicators when they are not analysed in depth and with the sufficient level of disaggregation. Disparities between

regions with regard to growth, per capita GDP, distribution of employment by sectors are salient characteristics of the socio-economical map of Spain.

The aim of the present section is to provide some data which support the above assertion and to draw some conclusions that may frame the further discussion on the innovation and technology influences on the real situation.

Table 5 records the whole GDP growth in the different regions of Spain or excluding the agrarian sector; this second indicator is helpful to identify the agrarian specialisation of some Spanish region and to determine the relevance of this factor in the economic growth. The regions are classified in three groups: the first corresponding to those regions that grew over Spain average; The second to those regions growing around average and the third to those regions that show growth below average.

Table 6. *GDP growth (1998) of Spanish Autonomous Regions both including and non-including agrarian sector as compared to Spain average (4.60 per cent; excluding agrarian sector 4.67)* .

Over average	**GDP growth % Total**	**Non-agrarian Sector**
Baleares	5.64	5.71
Canarias	4.83	5.01
País Vasco	5.38	5.38
Navarra	5.05	5.00
Castilla-León	4.93	4.60*
Extremadura	4.83	4.11*
Aragón	4.72	4.90
Castilla – La Mancha	4.71	4.50*
Cataluña	4.66	4.70

Average	**GDP growth % Total**	**Non-agrarian Sector**
Andalucia	4.55	4.99
Madrid	4.51	4.52
Cantabría	4.51	4.63
Valenciana	4.36	4.55

Below average		
La Rioja	4.27	4.04
Murcia	3.93	3.94
Galicia	3.99	4.15
Melilla	3.93	3.94
Ceuta	3.83	3.85
Asturias	2.46	2.54

* Denotes regions with overaverage growth essentially supported by the agrarian sector.

Source: FUNCAS (Fundación de las Cajas de Ahorro Confederadas)

Some conclusions can be drawn

a) There are strong differences in the growth rate between regions. Baleares runs far first, followed quite closely by País Vasco, as their rate are around one point higher than the average of Spain. The difference between the better and the poorer amounts to more than three percentage points.
b) The extremely good positions of regions like Extremadura, Castilla–León and Castilla–La Mancha are noteworthy. It is important to stress the fact that these regions rely strongly on the agrarian sector for their excellent performance. Productive growth of this sector in Extremadura and Castilla-León surpassed 8 per cent.
c) A series of regions (Navarra, Cataluña, Madrid and País Vasco) show a well balanced situation with respect to the growth dependence on sectors (differences between the two columns amount to less than 10 per cent).

d) Other regions (Aragón, Canarias and to some extent surprisingly Andalucía and Comunidad Valenciana) are stemming their growth from the non-agrarian sector. This is surprising in the case of Andalucía and Com. Valenciana that have been primarily agrarian communities. As a matter fact, the growth productivity from the agrarian sector in Comunidad Valenciana was the lowest of Spain along 1998 (less than 1 per cent). The last two regions are likely evolving towards balanced economies.

e) Among the slow developing regions, the relative good position of Galicia in the data excluding the agrarian sector is worth mention, essentially because Galicia economy is still largely dependent on the agrarian sector. The situation is just opposite in the case of La Rioja, a community with strong agrofood sector. The per capita income confirms the grouping of the Spanish regions into three blocks corresponding to overaverage, average and below average, though some members of the groups have changed their position, a new indication of the marked heterogeneity existing in the socio-economical mapping of Spain.

The list and distribution by blocks is as follows.

Overaverage

Baleares	138.15
La Rioja	117.08
Aragón	115.03
Madrid	111.66
Cataluña	110.94
País Vasco	108.35

Below average

Castilla-La Mancha	90.32
Murcia	87.70
Extremadura	87.07
Ceuta	84.68
Andalucía	81.51
Melilla	77.27

Around average

Canarias
Cantabria
Comunidad Valenciana
Galicia
Asturias
Navarra
Castilla-León

The distribution of employment by sectors in the whole of Spain as compared to that by the different regions points out to the same line of arguments; diversity and specialisation are the marked characteristics revealed by this indicator.

Results are illustrated in Table 7 (Spain) and in Table 8 where only the results of the two extreme groups (over and below average) are shown.

Table 7. *Distribution of employment by sectors in Spain*

Sector	**%**
Agriculture	7.9
Industry	20.6
Building	9.9
Services for sales	37.5
Services not for sales	24.2
Total	100.0

Table 8. *Distribution of employment by sectors in the Autonomous Regions of Spain. Year 1998*

Sector	**Agriculture %**	**Industry %**	**Building %**	**Services for sale %**	**Services not for sale %**
Overaverage	Galicia 20.0	La Rioja 33.7	Castilla-La Mancha 14.7	Baleares 53.1	Madrid 29.1
	Extremadura 16.6	Navarra 30.4	Extremadura 13.3	Canarias 47.2	Extremadura 27.7
	Castilla-León 13.0	País Vasco 29.3	Baleares 12.2	Madrid 44.2	Andalucía 27.3
	Castilla-La Mancha 12.4	Cataluña 29.2	Asturias 12.0	Andalucía 35-40	Cantabria 27.0
	Murcia 12.3		Cantabria 10.9	Com. Valenciana 35-40	
	Andalucia 12.0			Cataluña 35-40	
	Cantabria 9.9			País Vasco 35-40	
Below average	Cataluña 3.3	Baleares 11.3	Navarra 8.1	Navarra 29.2	Murcia 21.9
	País Vasco 2.6	Extremadura 9.9	País Vasco 8.1	La Rioja 27.2	Com.Valenciana 21.3
	Baleares 2.3	Canarias 9.0	Madrid 8.0		Baleares 21.2
	Madrid 1.1		Aragón 7.3		Cataluña 21.0
					La Rioja 18.8

Source: Survey on Active Population (1998). INE

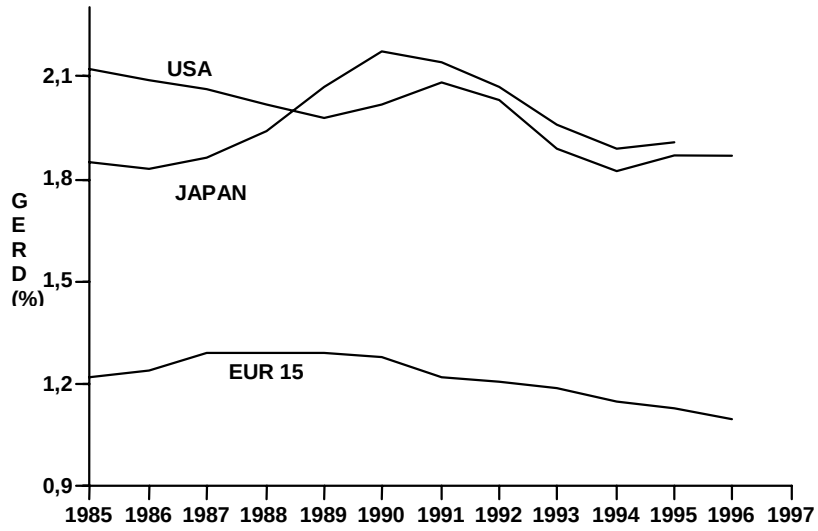
Technology and Innovation in the European context

It is now assumed that the development and marketing of new products and services, as requisites to maintain and increase the competitivity of countries and regions, seems to be tightly linked to significant inputs in R&D and innovation activities.

The countries producing goods with high salary levels need the strategic production (and use) of knowledge as a means to become (or remain) competitive.

Europe has been well aware of her deficits in R&D and innovation activities as compared to United States and Japan. Traditional input indicators such as the percentage of GDP devoted to R&D (GERD) has been a first criterion for comparison of the scientific and technological capabilities of Europe in relation to the other two big regions of the world. The GERD has been declining in the three regions along the nineties with Europe largely lagging behind. The differences remained vertically constant along the last decade. (fig.2).

Figure 2. Contribution of business sector to R&D expenditure (GERD) in the three main regions of the world.



Source: Data bases EUROSTAT COMPET, OCDE; evaluations IFO.

The most relevant fact is that the decline in the GERD figures of Europe and Japan were essentially due to a decrease in the expenditure of the business sector (table 9) while in the United States this value remained practically constant around 72 per cent.

Table 9. *Percentage of business sector in GERD. Evolution during six year period.*

Region	**Share of business sector in GERD**	
	1990-1992	1994-1996
EU – 15	63.2	60.6
USA	72.1	71.8
JAPAN	74.7	71.1

Source: *La competitivité de l' índustrie européenne. Rapport 1998*

The number of patents issued is another indicator which gives an approximative assessment of the economic potential of R&D outputs. According to this indicator expressed in world patents by million of inhabitants, Japan outweighed the United States by a factor of two to three and Europe by a factor of four. The gap between USA and Europe is increasing during the last years.

National Systems of Innovation (NSI)

The concept of National Systems of Innovation has been gaining support as an explanatory variable of the size, role, and performance of innovation within the economy of each country or region. This concept counts on the interplay between a series of actors whose actions and interactions are influenced by a set of factors: The financial system, firms management, the legal frame, the regulations, the skills of human resources, their mobility, the social relations and the negotiations practices.

The idea of National Systems of Innovation relies in a view based on the complexity of the socio-economical activities. Several schemes have been depicted to give an image of the concept. Fig.3 provides an example of the complexity of the elements that integrate the National Systems of Innovation and of their interactions. In spite of the comprehensive character of this scheme, there may be still some drawbacks in it. In any case, it serves to give ground to the idea that the National Systems of Innovation should present important differences depending on critical factors such as the organisation of the university research system, the characteristics of the public research centres and the nature and type of firms existing in each economical sector. I would like to stress the idea of divergence between NSI as more plausible than that of convergence.

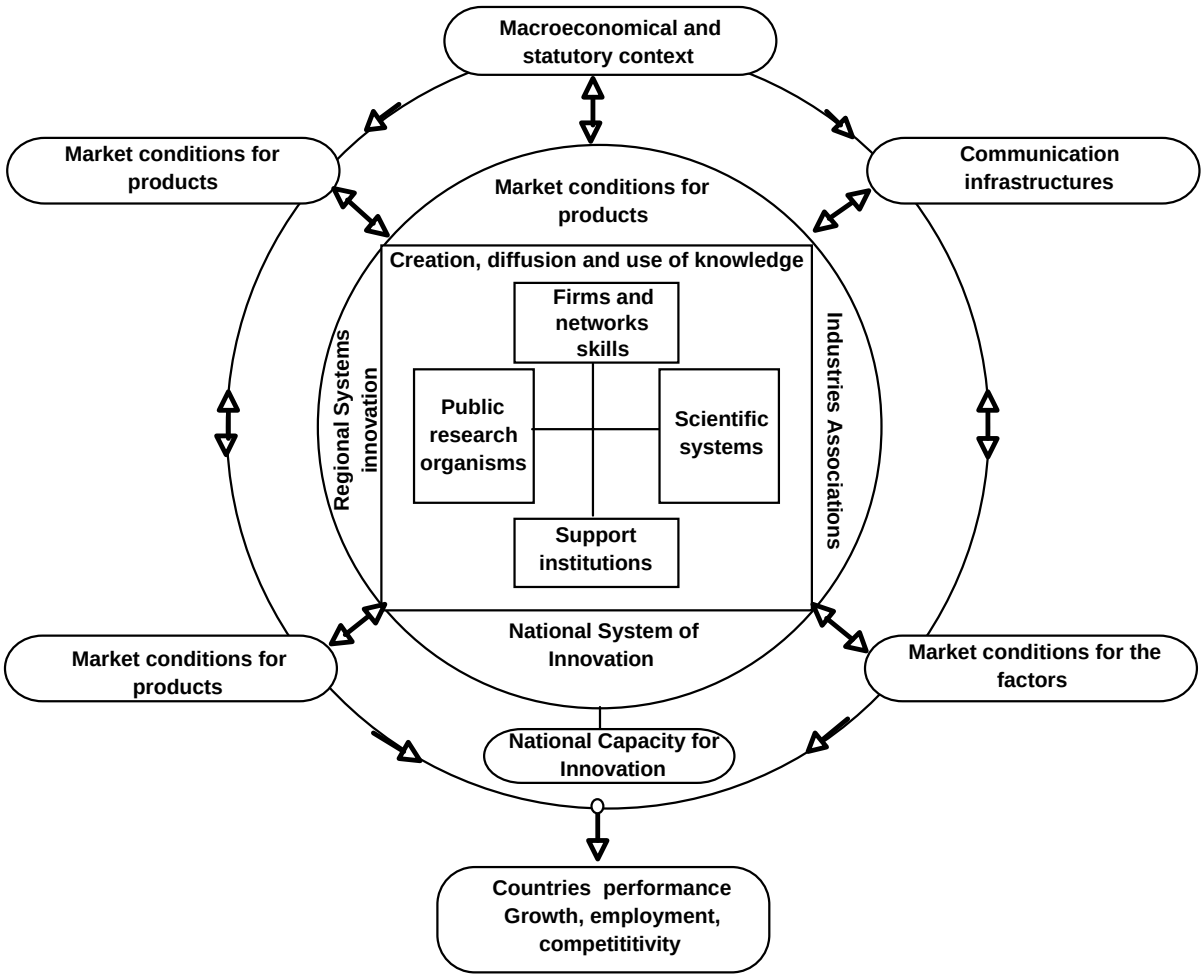
Regional Systems of Innovation

The scheme of fig. 3 introduces the concept of Regional Systems of Innovation placed at the same level that the National System of Innovation. The current literature (Cooke, 1998) considers this concept as new, although related concepts such as "regional innovation policies" "regional innovation potential", "innovation networks", together with "technopoles" and "high technology complexes" have been present since the early eighties and have been treated and developed along the last two decades. (Cooke, 1998).

The outstanding elements that led to the building of the RIS concept are the changes in behaviour of the firms driven by the close link between competitiveness and innovativeness and the consequent rewamping of technology policies by the governments of Western countries.

Firms have reacted to this new situation by moving from the competition front to one where there is search for the optimal mix between competition and collaboration. Instrumental to this approach are the notions of "cluster" (Porter, 1990) and the recognition of the importance of culture to economic activity, coordination and development (Cooke 1998, Muñoz et al., 1996)

Figure 3. *Diagrammatic representation of the National System of Innovation and its relationships with different environments and factors.*



Source: OECI. Taken from "La competitivité de l´industrie européenne, 1998

Among the main streams of economical theory, the neoclassical economics failed to explain innovation and technological change, while the evolutionary theory of economics allowed for rectification of the failure of the neoclassicals in relation to innovation studies. This theory has found a growing number of supporters and was compatible with systems approaches and allowed the analytical inclusion of previously heretical notions as "economy culture" and "economies of association", to quote Cooke (1998), a further step "was to integrate evolutionary economics and regional development theory in respect of innovation . Finally, regional innovation systems had been conceptualised in terms of a collective order based on microconstitutional regulation conditioned by trust, reliability, exchange and cooperative interaction" (Cooke, 1998).

European initiatives in this context

The European Commission, aware of the European gap to make effective the link between competivity and innovation, launched in 1995-96 the "*Green Book on Innovation"* and promoted a long debate at national level. The debate was framed under the concept of the National Systems of Innovation taking into account the economic, social and cultural realms on which the different actors (firms, scientific and technical institutions, government) establish relationships and rules.

The Green Book defined innovation in a broad sense as "the adequate production, assimilation and exportation of the newness in the economic and social domains… Research, development and application of new technologies are key elements to the process of innovation, but are not the sole ones… Their integration into firms imply that they must carry out an additional effort of organisation, adapting to it their methods of production, management and distribution".

The V framework Programme, as the former Framework Programmes, aims to the improvement of the quality of life of European citizens and the increase in industrial competitiveness but also shows important differences as it is addressed to solve specific problems, through the so called "key actions", and to face the European socio-economical challenges for the next millenium. Particular emphasis is given to the SMEs

and to increase their active participation in the Fifth Framework Programme in order to improve their innovation activities (line III is entitled SMEs and INNOVATION).

Innovation and technology policy in Spain

During the transition period after Franco's death, Spain attempted to remedy her backwardness in science and technology. These topics were placed at the centre of the political agenda by the Socialist Party (PSOE). Its programme before the elections of 1979 and 1982 included specific actions to drive the modernisation of the country, among them education, research and development ranked high.

Under the great political goal of improving the coordination between resources and political actors, the specific aims were the following:

- To increase the public resources devoted to R&D activities, with the hope to drive also an increase in the research and innovation efforts of the private sector.
- To promote the competitiveness of the scientific community in the world context.
- To introduce the culture of research and innovation into the businesses and their managers.
- To foster the links between the science realm and the industries, in order to allow for a better use of the knowledge produced by universities and public research organism.
- To favour dialogue and collaboration between the political actors of the State and the Regions. The Law for Scientific and Technological Development, known popularly as the "Law for Science", enacted in 1986 was the main political instrument for those goals that were implemented by the *National Plan for Research an Development* which was designed as the functional and operative instrument of the Law. Its first edition was launched in 1988 and lasted until 1991. Two other editions, corresponding to the 1992-1995 and 1996-1999 periods, have followed.

  In the next sections the evolution of the situation along the last ten years will be described while some specific issues and questions will be raised in each chapter[1]

[1] It is important to mention the endeavours carried out by the COTEC Foundation (Fundación COTEC para la Innovación Tecnológica) in analysing the evolution of the R&D and innovation systems in Spain.

General indicators and country characteristics

One of the main question is to situate Spain in the European Union context with regard to some general dimensions and with respect to the characterisation of the science-technology system.

OECD and Fundación Cotec Report 1999 provide grounds for this characterisation in comparative terms.

1995 S & T system

Country	**Population (1995)**	**Surface (1,000xKm^2)**	**GDP 1995 (10^9x ecus)**	**Researchers (thousands)**	**Patents (thousands)**	**GERD (million US dollar)**
France	58.1	552	1,173	151.2	96.2	27,052
Germany	81.7	357	1,850	231.2	109.6	38,498
Italy	57.3	301	834	75.5	67.9	11,224
UK	58.6	245	845	148	97	21,149
Spain	39.2	505	431	47.3	57.7	4,722
Remaining EU	77.2	1.277	1,309	168	424.7	24,825

Source: *OECD (1998), Fundación COTEC (1999).*

With all the limitations of the case, it is worth noting the good correlation between the figures for GDP and number of researchers, patents and GERD expenditure in France, Germany and United Kingdom and particularly in the rest of the EU where the number of patents is surprisingly high with respect to number of researchers and R&D expenditure. In Spain the number of researchers is high for the level of expenditure -low spending research- and for the value of the GDP – low efficiency of research into production. Whereas the number of patents is amazingly high and contrasts with current beliefs about the low productivity of Spanish R&D in this domain. However, the great number of these patents is solicited by non-residents (low self-sufficiency rate).

A "*White Book on Innovation"* has been prepared and discussed along 1997 and 1998 as a follow-up step of the European Green Book on Innovation.

Evolution of the factors related to R&D and innovation activities

R&D Expenditure

The expenditure in R&D is considered as the first input indicator expressing the non-material investment for the future competitivity of countries and their industries. Spain has been lagging behind according to this indicator.

At the beginning of the eighties Spain was spending in R&D activities around 0.3 per cent of the GDP. The efforts undertaken during the eighties led to a strong expansion of the expenditure that followed until 1992. The crisis of 93 and 94 witnessed a decline though a new regain was observed from 95 onwards (table 10)

Table 10. *Indexes of the evolution of the total R&D expenditure in Spain and comparison with the big four European countries.*

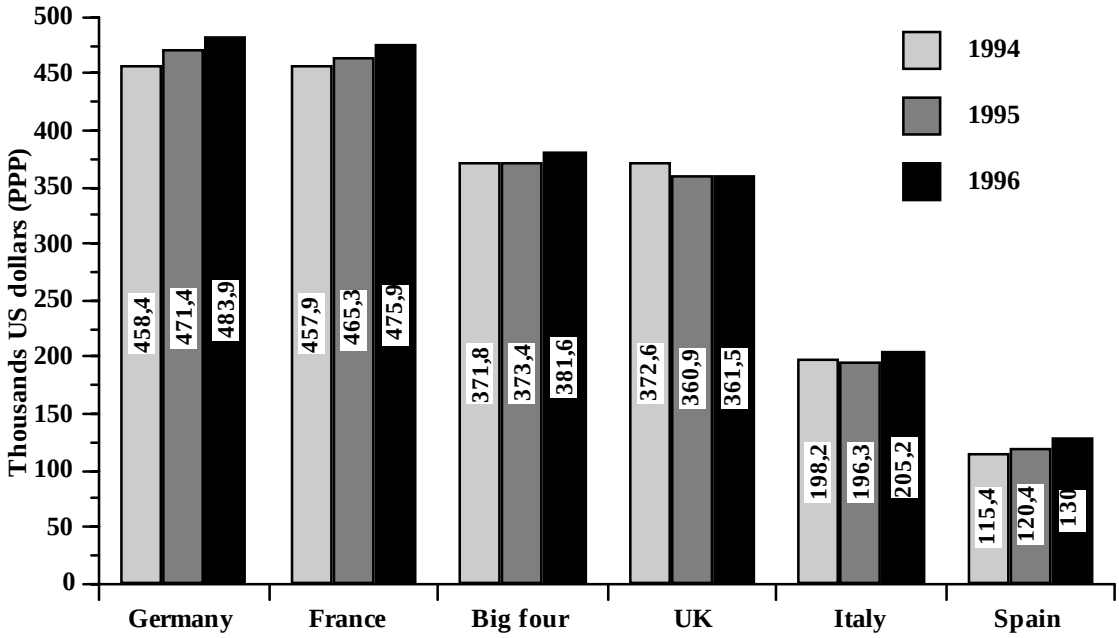
	***Spain* Indexes**				***Four big EU countries***	
Year	**Current PTA**	**Constant 1998 PTA**	**GERD**	**GDP**	**Total Expenditure R&D**	**GDP**
1990	100	100	100	100	100	100
1991	115	100	100	110	125	110
1992	130	110	105	120	130	115
1993	125	105	105	125	130	120
1994	120	100	95	130	130	125
1995	125	105	100	140	130	130
1996	140	110	100	150	130	135

Source: *OECD (1998), own elaboration*

The data recorded in table 10 show that the R&D expenses grew in parallel with the GDP, while in the four big European countries, GDP grew faster than the expenditure in R&D.

In the same direction pints out the expenditure in R&D per inhabitant and year (fig.4).

Figure 4. R&D expenditure per inhabitant and year in Spain and the four big European countries.



Source: OCDE (1998), COTEC (1999)

This figure for Spain amounts to one third – one fourth of that of the big four countries, although the gap is decreasing since 1995 and 1996.

These two data are an indication of a slight trend to convergence with Europe of the Spanish expenditure in R& D.

In spite of this positive trend, Spain is failing to surpass the ceiling of the technological effort measured as percentage of the GDP. During the expansion period, reached a peak at 0.91 per cent, declining to 0.8 per cent in the crisis year and remains stable since then at around 0.85 – 0.87 per cent.

The question remains open to see whether this is a structural or a functional threshold or both , an issue that requires further investigation.

Human resources

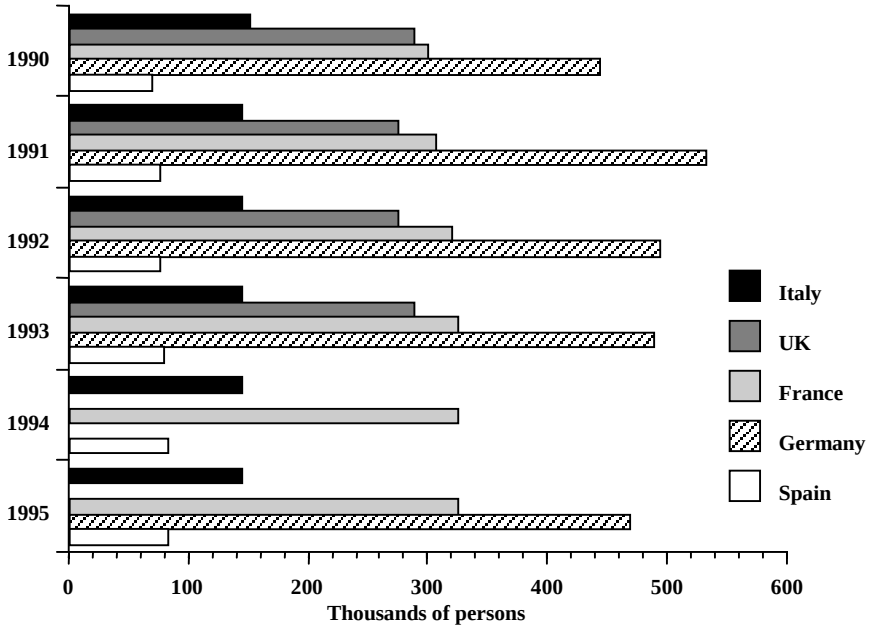
This indicator is the second input indicator that holds particular relevance for the National System of Innovation concept. For its effective integration, a complex set of

actors have to intervene and cooperate: government, universities, public research centres and firms in the process that goes from the promotion initiatives to the employment passing through education and training of this highly skilled personnel.

The deficit in human resources devoted to R&D activities was identified as a critical one in any effort to update the Spanish System of Research. The R&D National Plans have so incorporated specific programmes (*Programas de Formación de Personal Investigador)* whose expenditures amounted to figures between 10 – 15 per cent of the resources of the National Plan (2,000 – 3,000 millions current PTA per year).

The data gathered by the OECD for the four big countries in comparison with Spain show an increase in the number of employees during the period 1990-1995 for the whole of Europe with the higher rate found in Spain (80,000 persons – 47,000 researchers in 1995 representing a 14 per cent increase with respect to 1990). These facts seem to drive Spain to a convergent line (fig. 5) according to this parameter.

Figure 5. Evolution of R&D personnel in Spain and European countries (thousands of Persons).

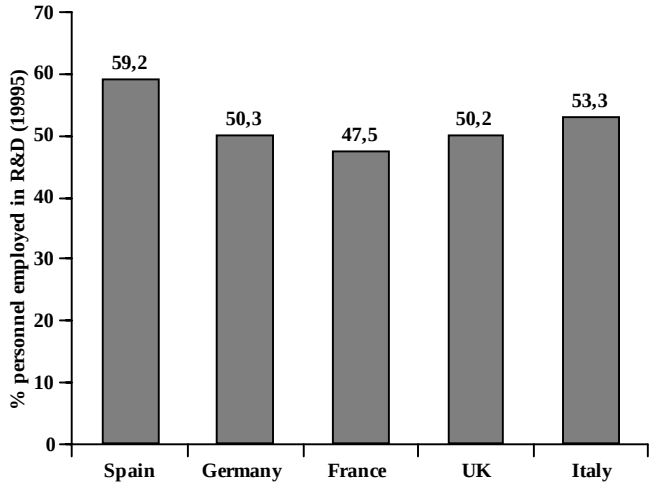


Source: OCDE (1998), COTEC (1999)

However, there are also some specifities in the case of Spain that point out to an opposite direction. Fig.6 compares the percentage of researchers in the total amount of personnel employed in R&D in Spain and the big four European countries during 1995.

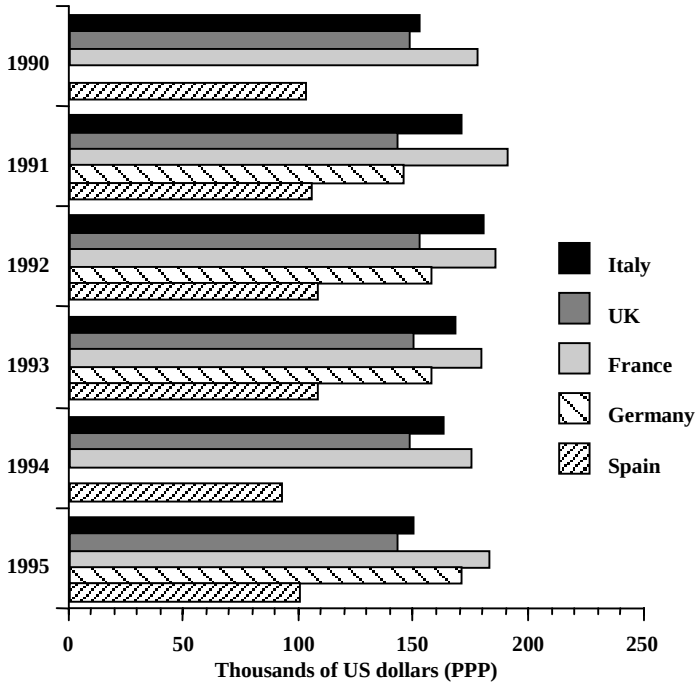
This rate higher by a 20 per cent than that of the other countries suggests a more academic-scientific and less organised system for Spain. It can be also argued that qualified personnel in Spain is performing in R&D activities at lower level than their skills. The average expenditure per researcher in Spain rounds up the 60-65 per cent of that spent by the average researcher in the main European countries and the trend does not seem to change (fig. 7), an additional argument in pointing out the lack of convergence in the performance of human resources.

Figure 6. *Researchers percentage in the personnel employed in R&D (1995).*



Source: OCDE (1998). COTEC (1999)

Figure 7. *Evolution of average expenditure per researcher in different European countries.*



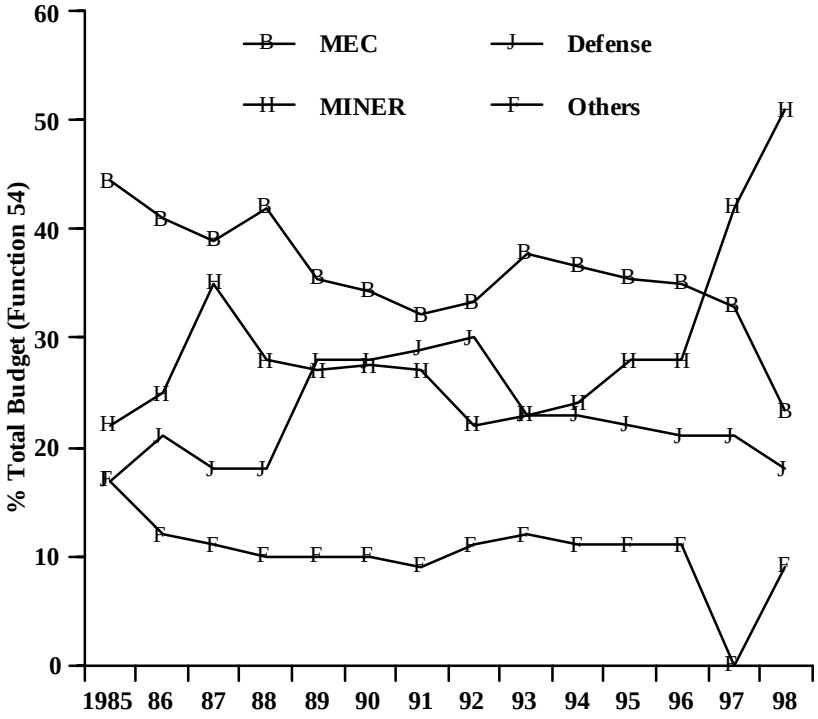
Source: OCDE (1998), COTEC (1999)

Public Sector Expenditure

The public expenditure can be easily followed through the national budget and includes the own resources to develop activities of the public research centres, the capital transfer to other actors (firms) and the internal expenses for programme managements as well as the funding of specific programmes and projects.

After the Law of Science, there is a specific budgetary chapter in Spain, referred as "Funcion 54" that collects mostly of the credits devoted to fund publicly R&D activities. One of the first aims of the establishment of function 54 was to foster internal coordination between the Ministries by increasing the level of the resources of the R&D Natural Plan in relation to those of the sectoral ministries. However, this goal has not been attained. Some ministries like the Ministry of Industry and Energy (MINER) has shown a continuous and significant increase since the early nineties while the budget of the Ministry of Education, Culture and Science (MEC)– responsible till 1998 of the National Plan– has been stagnant or declining (fig. 8).

Figure 8. Evolution of the budget of R&D activities in different ministries



Source: Fundación COTEC (1999)

The expenditure of the public sector in Spain has followed a constant pace along the nineties with figures amounting to 0.55 – 0.50 per cent of GDP, except for a decline in this parameter observed from 1994 onwards (0.5 – 0.45 per cent). The tendency to decline has been stronger in the four big European countries taken as reference, in particular for Italy where the public expenditure has fallen in percentage of GDP to the level of Spain in 1995 and 1996.

Business sector – Technology and Innovation

The business sector emerges as the main actor of the National System of Innovation concept. The measurement of the technological effort of the firms is a complex issue that requires to identify and estimate a set of parameters: expenses in R&D activities, the efforts in innovation activities, the balance in technology trades as well as the economic support provided to the firms by the public sector.

Unlike in the big four European countries, Spanish firms are spending in R&D less than 50 per cent of the total national expenses. The expenditure, including the support given by the public sector estimated to be about 10 per cent, has never reached a value higher than 0.5 per cent of GDP. This figure is clearly divergent from those of the business sector in Germany (between 2-1.5% GERD), France (1.5% GERD), United Kingdom (1.5-1.3% GERD) or even Italy (0.8-0.6% GERD) during the period 1990-1996.

Sectoral distribution of R&D effort in the business sector

The technological effort expressed as the rate between the expenses in R&D and the Gross Added Value at national level by cost of the factors has been declining in Spain from 1992 to 1996 (see Rapport 1999 of Fundación COTEC). In terms of big sectors only two, agriculture and manufacturing industries, have shown an increase.

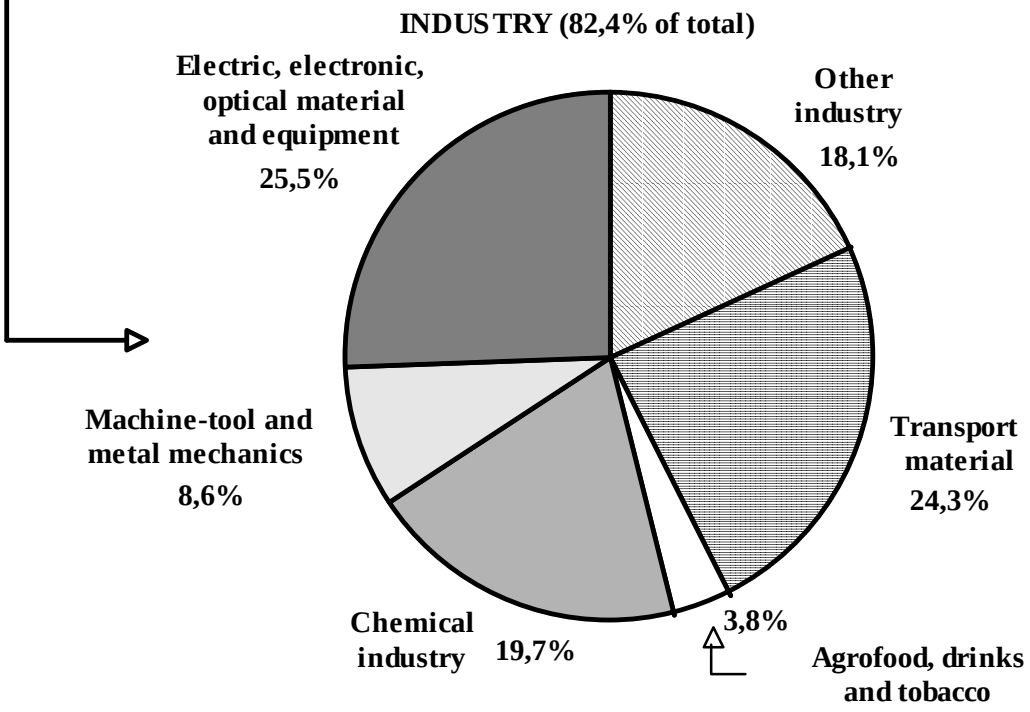
Sectors with poor implication in R&D activities like building and services for sales, but very relevant to Spanish economy (see before), showed a very important decline in R&D effort. On the other hand, the manufacturing industries are those investing largely in R&D (82.4 per cent of the total amount 327.9 milliards PTA(1997). The lion's share of the industry effort is from three sectors of activity: chemistry (19.7% of the industry effort; electric, electronic and optical material (25.5%); and transport material (24.3).

A summary of the situation is given in table 11.

Table 11. *Evolution between 1992 and 1996 of the sectoral technological effort in Spain.*

BIG SECTOR	R&D expenses* GAV (%) 1992	R&D expenses* GAV (%) 1996	Economic relevance
Agriculture	0,10	0,20	Medium
Energy and water	0,59	0,34	Medium-high
Manufacturing industries	1,70	1,91	Medium
Building	0,04	0,02	High
Services for sales	0,16	0,10	High
Total	1,00	0,93	

* The technological effort is calculated with respect to the Gross Added Value to the costs of factors and not with respect to the Gross Domestic Product



Source: Fundación COTEC (1999) and own elaboration

Innovation and R&D in the business sector

The survey on Technological Innovation that was established and performed by the *Instituto Nacional de Estadística* (INE) since 1994 following the Oslo Manual and following the indications of Eurostat affords a new instrument to identify and characterise innovative firms in a broader sense than those performing traditional R&D activities and, at the same time, to compare and match both type of activities.

This analysis is interesting because the results of 1996 for innovation activities, unlike those of R&D activities, show a 28 per cent increase in the resources devoted to these activities as compared with 1994. The figures (794 thousands millions PTA 1996) represented the 1.1 per cent of GDP (1 per cent in 1994). The ratio between innovation expenditure by firms in Spain and percentage of GERD is 3 (1.2 vs 0.4) while in the European Union is near 2 (2.5 per cent in innovation, 1.2 per cent in R&D activities), a suggestion of the lower involvement of Spanish industries in research activities. Moreover, the percentage of firms characterised as innovative firms (respondents to the INE survey) was small (10.7 per cent of industries in 1994, and even decreasing to 9.6 per cent in 1996). However, as a positive data, the percentage of innovative firms able to develop R&D activities increased form 24.9% in 1994 to 32.9% in 1996.

The analysis by sector of economical activity does match well with previous analyses and data. Table 12 records the sectors with the highest percentages (>30 per cent), of innovative firms and of innovative firms performing R&D activities (> 50 per cent).

In addition to the five sectors recorded, it is worth to note that sectors like chemistry (including pharmacy); tobacco; metals ferrous and non-ferrous; machine-tool; ofimatic and informatics, as well as optical and watches instrument and equipment; with percentages of innovative firms lower than 30 per cent, show nonetheless very high percentages of the innovative firms performing R&D activities (between 60 and 90 per cent).

Table 12. *Sectors of economical activity with high innovation and R&D performances*

	Percent of	
Sector	**Innovative firms**	**Those firms involved in R&D**
Pharmacy	54.12	78.78
Electronic components	34.39	76.12
TV. Communication	46.54	86.12
Aerospatial	38.07	69.9
Other transport material	32.82	73.66

Source: INE, own elaboration

The technological balance presents a strong deficit with the covering rate moving around 10-15 per cent. This characterises the Spanish innovation system as highly dependent on foreign technology, a situation that sharpens when there are strong political and social push for technology. The deficit appears to be structural. The automobile sector is the one that shares the most important part of the technology purchasing (fluctuating around 45 per cent). The most innovative sectors such as pharmacology, electrical and electronic technology are accounting for 2-4 per cent of the technology transfer whereas intermediate sectors such as chemistry, computers, food, communications do rise to 4-6 per cent of the technology transfer payments.

The size of the firms appears as a critical variable to understand the strategies of technological innovation, R&D investments and technology transfer. The Spanish SMEs (less than 200 employees) are investing less with respect to sales than their larger counterparts. However, the active technological strategies do influence the sales of SMEs more positively than those of large firms. Both small and large business share the decrease in their R&D investment with respect to the volume of sales that has been noted during the last years.

Innovation, technology and the Spanish regional dimension

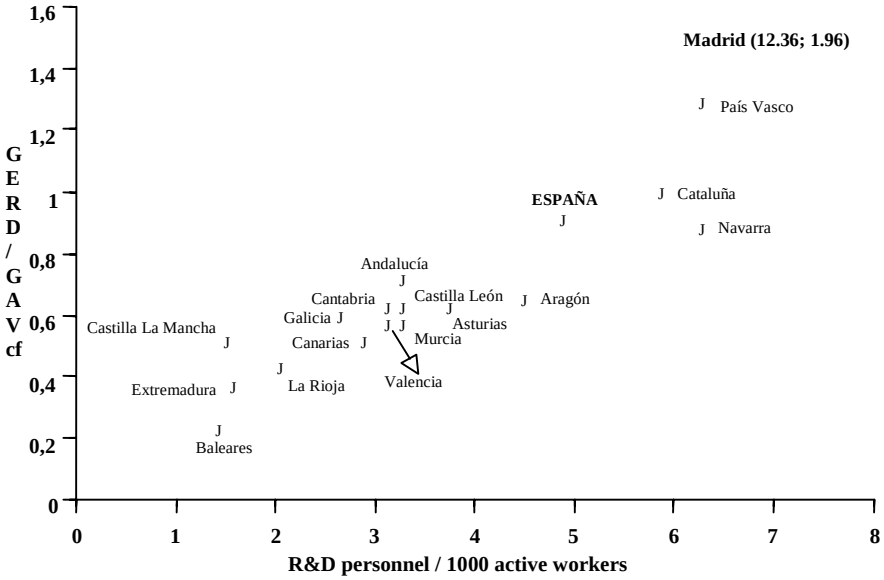
The introduction of the regional dimension into the analysis of technological and innovation issues in Spain reveals the existence of evident heterogeneities and divergences between the regions.

The concentration of research capabilities and technological effort in Madrid remains as one of the main characteristics of the R&D and innovation systems in Spain. In 1996-1997, Madrid concentrates the 33 per cent of the national GERD, though the gap with Cataluña (21 per cent) has been shortened.

The three regions that can be considered as the front runners and those possessing a pretty well equilibrated system of innovation according to the scheme of fig.3 are Madrid, Cataluña and País Vasco (9% of national GERD). All the three are non Objective 1 regions and account for 63 per cent of the R&D expenditure. The other three non Objective 1 regions – Baleares, La Rioja, Navarra – behaved quite differently with regard to R&D and innovation activities. Navarra remains close to the three front runners, both in economic support – expenditure with regard to GAV to the cost of factors and number of personnel involved per one thousand of active workers -, but La Rioja and particularly Baleares, the region with the great economic income per capita, are clearly lagging behind (fig.9).

Figure 9. Technological and research effort of the Spanish Regions.

Correlation between economical effort and personnel (1995)

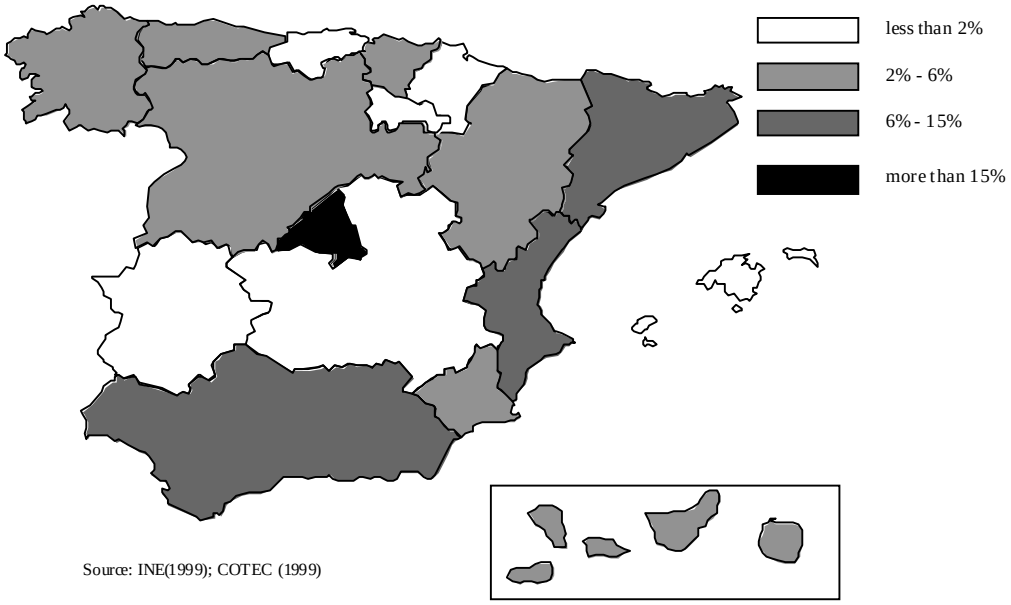


Source: INE (1999), COTEC (1999)

On the other hand, the 11 Objective 1 regions shared only the 32 per cent of the total GERD in 1996-1997, a situation that has not changed during the last decade with the operation of the R&D National Plans.

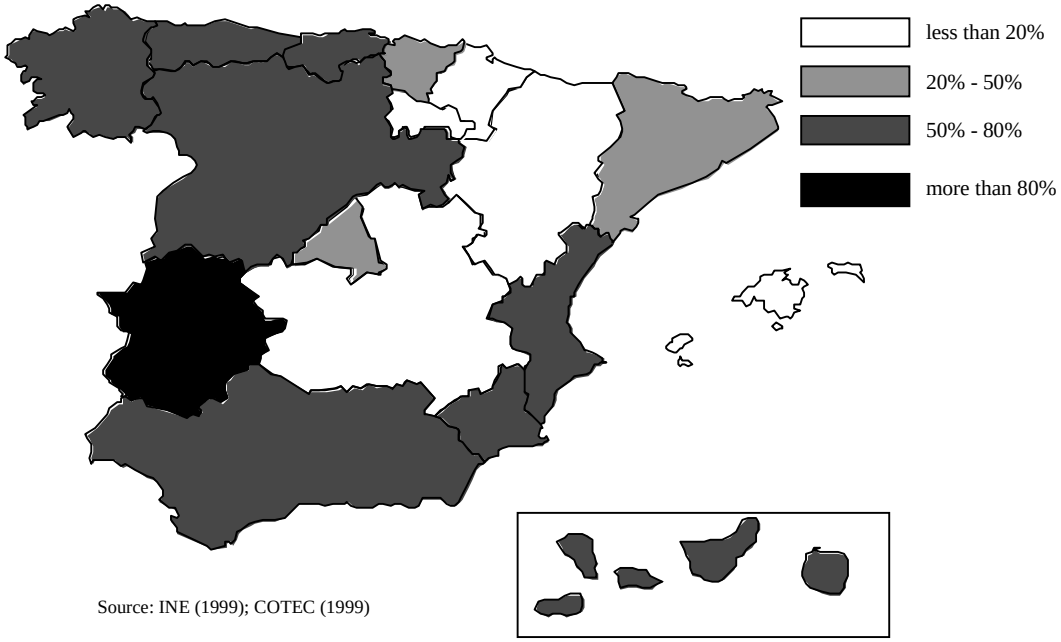
Figure 10.

a) *Distribution of the weight of Public Research Organisms and universities in the Autonomous Regions in respect to the national total (%), 1997.*



Source: INE(1999); COTEC (1999)

b) *Relative weight of Public Research Organisms and universities R&D expenditure in each Autonomous Region(% of each region, 1999).*



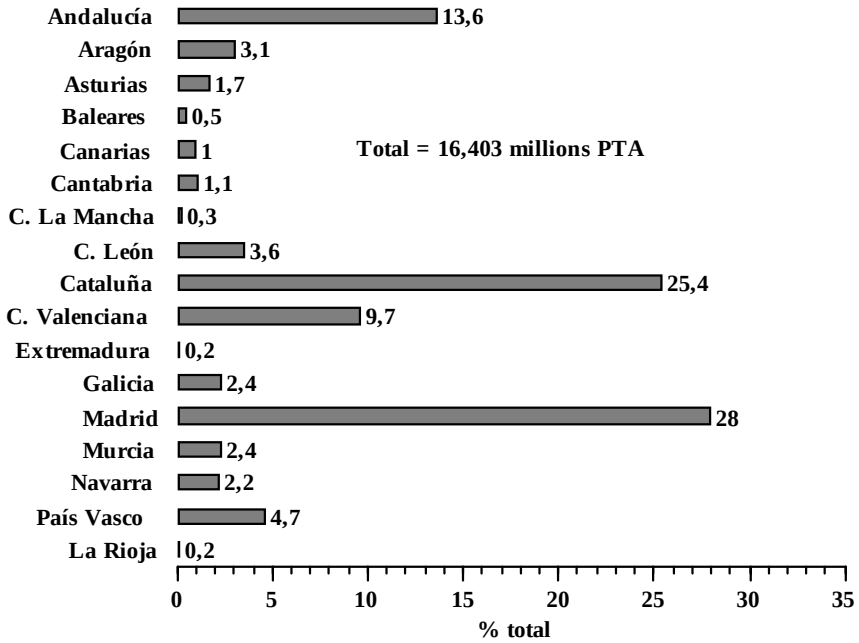
Source: INE (1999); COTEC (1999)

The relevance of the public sector (research organisms and centres and universities) marks another significant difference between the Spanish regions with regard to the research and technological effort. The R&D support in Objective 1 regions rests mainly on the important weight of the public sector (expenditure > 70% of the total), particularly due to the involvement of the universities whose efforts are accounting for around 54% of the R&D expenditure. The maps of Fig 10 illustrate the different profiles shown by the Autonomous Regions of Spain in respect to the weight of the public sector research system both at national and regional level. The data serve to strengthen the disparities and paradoxical positions held by the regions. The public sector from Madrid does account for more than 15 per cent of the total at national while it does represent less than 20 per cent at regional level. The public sector of Baleares and Extremadura contribute with less than 2 per cent to the total of Spain but represent more than 80 per cent of the regional effort. Demographic, organisational and economical variables should be taken into account to explain these facts. The share of the funds allocated to the Autonomous Regions by the R&D National Plan (year 1997) and the whole Fourth Framework Programme is shown in comparative terms in fig.11 (A and B, respectively).

The data do match in general with the strengths and profiles of the different regions in relation to research and technological potentialities: There are however some differences. The National Plan seem to be, within certain limits, redistributive in the allocation of funds: the gap between Madrid and the following regions is smaller than could be expected on a single background basis. The non-Objective 1 regions (7, including Aragón) received 64 per cent of the National Plan, while the eligible Objective 1 regions did receive 36 per cent, a slight increase with regard to the basal share of these regions in the national GERD. The situation is opposite in the case of the European Framework where Madrid is having the lion's share, followed by Cataluña to a great distance (20 percentage points in terms of funds) and larger than 30 percentage pints with Andalucía, País Vasco and Comunidad Valenciana. Specialisation, infrastructures and culture may be critical factors to explain these outcomes.

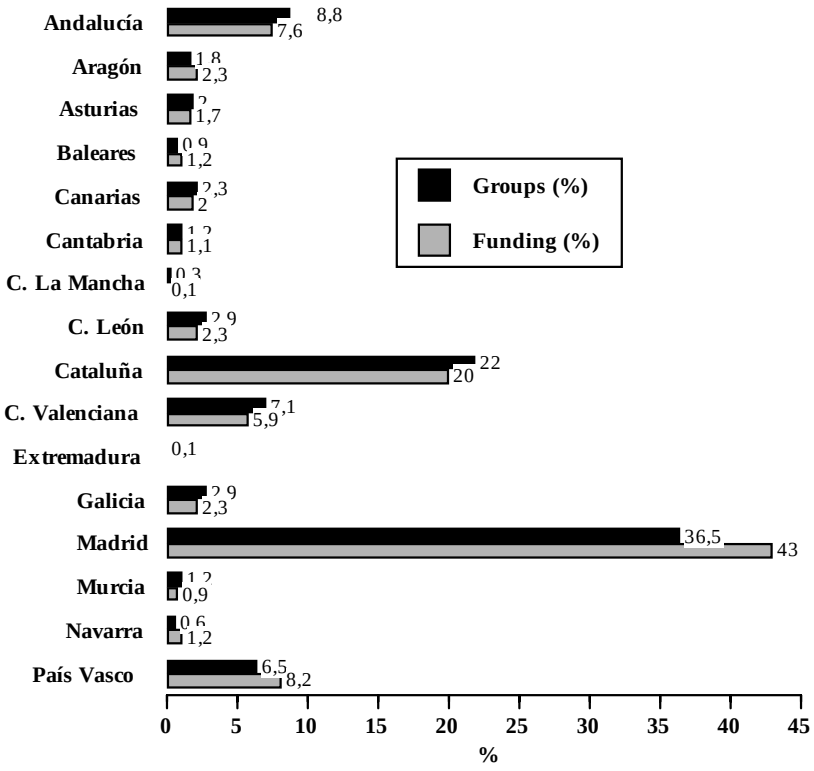
Figure 11.

a) *Distribution of funds allocated by the R&D National Plan to the Autonomous Regions (year 19997)*



Source: CICYT (1999) Memoria de Actividades del Plan Nacional de I+D. COTEC (1999)

b) *Spanish participation in the IV Frame work Programme by Regions (%)*



Source: CICYT (1999) Memoria de Actividades del Plan Nacional de I+D 1997

Concluding remarks

1. It is likely that Spain do possess a National System of Research, but there is no a specific, well defined Spanish National System of Innovation.

2. There are patches of systems of innovation in some of the Spanish regions (Cataluña, País Vasco, perhaps Madrid), though a better identifications of these systems is needed through particular, case by case, studies[2]. The incorporation of the analogy of the "ecosystem" where hierarchical principles (layers) and adaptation concepts do apply might be useful and give new insights for this further analysis.

3. Economical criteria do not allow a grouping of the regions of Spain in terms of innovation capacities and assets. Non-Objective 1 regions are characterised very differently according to their research and technological efforts. Three of them (Madrid, Cataluña and País Vasco) are the leaders in those efforts whereas Baleares and La Rioja are the laggers. Navarra and Aragón occupy intermediate positions in terms of human and economical resources devoted to R&D and innovation activities.

4. Objective 1 regions share a predominant role of the public sector in their R&D efforts, although there are also marked differences between them. In general, it can be said that Spanish less-developed regions do possess incomplete, “primitive” systems of innovation.

5. There is a poor correlation between the degree of economical convergence with Europe and the level of research and technological efforts as illustrated by the cases of Baleares and La Rioja or by the positive economical performance during the last years of some Objective 1 regions (Castilla-León, Castilla-La Mancha, Extremadura…)

[2] During the meeting, Alvaro de Miranda (East London University, ESST) suggested that the existence of (or the acquisition of) a "national" conscience could be a relevant cause of the developing of "regional" Systems of Innovations. This argument may well apply to the case of Spanish regions (whether historical or not) that would be acting with this "conscience" in a globalised or europeanised world. What was considered as a threat for the Spanish System of R&D could be a positive factor for the innovation policies, strategies and actions.

6. The percentage of innovative firms in Spain is lower than those of most European member countries. Moreover, the Spanish innovative firms are less active in R&D activities than their European counter parts. The trend seems to be changing to a slight increase in the number of innovative firms and essentially to a strong increase in the R&D vocation of those firms.

7. The most innovative sectors in Spain are those behaving as such since long (agriculture and manufacturing industries are showing better performance than services, energy, building)

8. Among the innovative sectors, the industries belonging to areas of innovative tradition standing at least for twenty years are the most prone to perform R&D activities and programmes, i.e. pharmaceutical, electronic and optical material and equipment, transport material.

9. Spain is moving towards convergence with Europe in economical and innovation and technology but the paths of convergence for these two parameters are moving quite differently and do not match according to geographical and temporal parameters.

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