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Summary

There is simultaneous trend of regionalisation and decentralization in Europe, a trend that has also affected the science and technology policy domain, with an open debate on the functioning of the multilevel governance system. Regional authorities have become directly involved in the design and implementation of regional S&T policies, however the interventions of sub-national governments are much more diverse than the prevailing view about the convergence of regional policies towards innovation policies might imply. This article describes science, technology and innovation policies adopted by five Spanish Regional Governments between the mid-80s and the beginning of the 21st century from a comparative perspective. The paper firstly describes the policy approaches (academic v. industrial) adopted by the regional authorities. Secondly, we analyse the explanatory factors in order to reach certain conclusions about the circumstances under which regional governments are able to implement policies of one or the other approach. Despite the influence of some structural factors, especially as regards initial political preferences, the analysis highlights the relevance of the mobilised interests when they are concentrated in the region, showing that changes in policy orientation are particularly difficult when those interests play a role in the administration of such policies. Preferences towards a policy reorientation are more likely to succeed with the aid of appropriate administrative arrangements, especially along with significant budget increases.

Key words: *Regional R&D policies; political preferences, policy diffusion, interests and institutions; Spanish regions.*

JEL classification: 038, R5

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1. Introduction

For many years, the relationship between science and politics has identified the latter with national governments (COZZENS and WOODHOUSE, 1995); however new processes, the emergence of intermediary organisations (BRAUN, 1993) and new actors, such as NGOs or Parliaments (CRUZ-CASTRO and SANZ-MENÉNDEZ, 2005), evidence that this relationship is today far more complex.

In Europe an essential aspect of this complexity is the development of a multilevel governance system (MARKS, 1992; MARKS, HOOGHE and BLANK, 1996) as a result of simultaneous processes of europeanisation and regionalisation of policy arenas (HOOGHE and MARKS, 2001). R&D and innovation policies are domains for which the consolidation of a multilevel governance system is assumed (ELDER, KUHLMANN and BEHERENS, 2003). While the national governments and EU levels have been studied extensively, the level of the regional authorities has attracted less attention from S&T policy scholars. Regional development researchers have increasingly focus their interest in innovation and regions, as arenas and actors, as a results of a convergence between regional policies and technology policies into regional innovation policies (HASSINK, 1993); but still one of the challenges faced by science, technology and innovation policy research is understanding the underlying dynamics of regions and their involvement in RDT policies (LARÉDO, 2003).

There is a growing trend in Europe (and elsewhere) of “decentralisation” and “regionalisation” (LOUGHLIN, 1996), either as result of an attempt to improve efficiency and effectiveness of some policies or as a bottom up mobilisation processes, that go beyond the divide between “unitary states” and “federal states”. Traditionally only some of the federal states had an involvement of regional authorities in science, technology and/or innovation policies; for instance in Germany and Switzerland the constitutional arrangements for governing the research system and even some basic research institutions, such as the German Research Council (DFG) or the Swiss National Science Foundation, were designed for cooperation (WILSON and SOUTARIS, 2002) between the Federal Government and the Landers or Cantons long time ago. But today centralised states, such as France, Sweden or the Netherlands have involved regional and local authorities in development and innovation policies (KAISER and PRANGE, 2004b).

A pervasive explanation of the increasing regionalism and regionalisation in Europe has been the impact of EU structural funds (BENZ and EBERLEIN, 1999; ADSHEAD and QUINN, 1998) and also the European Commission' role in "awaking" or enlightening sub-national governments, that has contributed more to promote strategic thinking among regional players than to measured outcomes in terms of RTD and innovation objectives (KUITUNEN, 2002); scholars insists on a variant of the arguments related to the "power of policy ideas" (HALL, 1989) or policy diffusion (MAJONE, 1991; DOLOWITZ and MARSH, 2000); this is the case for the United Kingdom (MARTIN, 1998), even in the context of devolution (KEATING, 2002), and France (SMITH, 1997), but also for other federal countries, like Austria in which their Landers entered in innovation policies mostly as result of policy diffusion processes from the EU (STURN, 2000). This influence of the EU level is also accepted for Germany, even if Länders implemented innovation policies and regional development in the mid-seventies as a way to "respond" to the industrial crisis and economic recession of the time (SCHERZINGER, 1998).

Apparently there is an underlying agreement that, at the European level, regional authorities had intervene in the S&T policy domain mainly with innovation and economic development policies, even if in some federal countries like Germany or Belgium regions have also responsibilities on public higher educations institutions¹. In the last years, European regions have become increasingly involved in activities of regional development, with more emphasis in innovation policy approaches; however what is less explored is the "policy-mix" that dominates the regional interventions in this policy domain. The Region and the regional authorities are becoming more and more arenas and actors of the science, technology and innovation policies and as European Regional Governments become more involved in S&T and innovation a better understanding of the forces and dynamics that explain regional governments' choices is needed.

This paper contributes to this debate and the analysis of the RTD and innovation policies of regional governments presenting some Spanish experiences. Because of their high level of decentralization, political autonomy and financial capabilities, some Spanish regional authorities have taken early initiatives that provide us with insights about the possibilities of intervention and the resulting regionalisation in R&D systems and policies. This article examines the features and evolution of the S&T policy of five

Spanish regions, suggesting that they illustrate significant changes and dynamics at regional level in Europe. Spanish regions are good cases for understanding how policies can vary between regional governments; two ideal types (academic v. industrial) of policy approaches have been defined.

To control for the EU policy diffusion argument, in this paper we will present cases of regional authorities that started interventions into RTD and innovation policies before the spread and diffusion of the EU suggested models, and some cases of regional governments that from the beginning made more emphasis on traditional science policies than into innovation².

The objective of this paper is neither to review the impact of the regionalisation of S&T policy on research systems³ nor to analyse regional innovation systems⁴. The paper addresses the science, technology and innovation policies that some of Spain's regional governments adopted between the mid-80s and the start of 90s, seeks to outline their determining factors, as well as explaining their stability and evolution and to draw some general conclusion about the circumstances under which regional science and technology policies of a particular orientation are more likely to be implemented. We explain comparatively why regional governments, when faced with similar challenges, have often implemented very different policies, and draw some lessons of the determinants of S&T policy choices for regional authorities.

Politics is usually the neglected element in S&T policy analysis despite the existence of some traditional analysis with this emphasis⁵ and this paper wants to contribute to fill in that vacuum. Eventually, it aims to open the black box of the political processes underlying the regional governments choices.

2. Modelling regional government choices in science and technology policy

For our analytical purposes, science and technology policies are mainly a process for allocating budgetary resources from the regional government; around these policies a distributive type of politics (LOWI, 1972) is likely to emerge, a system for allocating public resources among the R&D and innovation system's actors that, despite pursuing general objectives, directly benefits these actors.

Our analysis characterises regional governments' S&T policy, the dependent variable, in terms of its approach: its direct target or beneficiary. Broadly speaking, there are two ideal types⁶ of policy approaches -that in practice tend to appear together-, though one predominates over the other. The first is the academic approach, which is geared towards fostering academic research and mainly towards universities and public research centres. The second is the business approach, which attaches greater emphasis to applied research and technological innovation processes in business. Both approaches seek to increase and foster the production of new knowledge and skills, yet while one aims to finance academic activities, without direct connection to short-term results, the other aims to foster private investment and raise companies' level of technology, and to tie public research to the transfer of results to the private sector. So, in our opinion, the first step towards characterising policies and the associated politics entails answering the question asked by LASSWELL (1936) "*Who gets what, when and how?*".

We will not enter into the discussion about the connection of these ideal types with the linear and systemic models of innovation. However, it is just fair to mention that some have argued that the best policies for fostering economic growth and competitiveness are more closely tied to the "business approach" (SOETE and ARUNDEL, 1993). In general, governments recently have been placing more emphasis on innovation (EC, 1993; EC, 1995) and specific objectives that lead them to implement more business-oriented models, and this is especially true when the R&D policies have been tied to regional development policies (LANDABASO, 1995). However, some sectors have also questioned that the business-oriented model should be applied to public S&T policies, stressing the economic value of basic research (PAVITT, 1991; PAVITT, 2000; SALTER and MARTIN, 2001) and calling for a greater balance, within innovation policies, for the public funding of this type of research (OECD, 2004).

Three indicators have been used in the empirical characterisation of regional policies in line with the two proposed ideal types. First of all, the volume of the regional government's budget allocated to funding academic research and business research respectively. Secondly, the nature and targets of the actions (such as plans, programmes, instruments, etc.). Thirdly, the creation of regional research centres and infrastructures in accordance with the nature of their ties (university versus industry) and their activity⁷.

This comparative analysis⁸ involves five Spanish regions that account for 80% of Spain's R&D activities: Andalusia, Catalonia, Galicia, Madrid and the Basque Country; their regional authorities launched research and development policies in the Eighties and have consolidated and institutionalised them. These regions have been governed by different parties and there are certain differences in their economic structures, general characteristics and size. Additionally, the regions are not contiguous (see figure 1), so spatial diffusion from one to another should not be expected as an important explanatory factor. We have carried out detailed case studies covering the situation from the mid eighties to early two thousand.

Figure 1.- Selected Spanish regions



3. Characterising S&T policy choices of five Spanish regional governments

Regions in Spain have such broad political powers that the political system has been labelled as quasi-federal (MORENO, 2002). The regional governments are constituted as the result of the majorities formed in the regional parliaments. In the Spanish Constitutional arrangements, the competence attribution between central and Regional Governments, were established between 1978 (approval of the Spanish Constitution) and 1983 (approval of the last Regional Constitution). In this decentralised political context, central and regional government can develop its own R&D policy because science and technology policies are shared competencies.

Regional governments are playing a growing, and very often decisive role, in the dynamics of institutions and research actors. For instance, like in Germany and Belgium, almost all of Spain's public universities are controlled and supervised by the regional governments, from whose budgets they receive block grant funding. The regional governments were given control of the entire public health system, and therefore of all the research conducted in public hospitals. Regional governments have also been responsible for agricultural research centres since the mid-80s. However,

unlike what happened with agricultural research or the universities, central government did not transfer any funds or resources specifically for R&D policy⁹. Therefore it was the regional governments themselves who made the decisions of when and how to launch their own S&T policy, in line with their own preferences and available financial resources.

In the mid-80s, some Spanish regional governments began allocating their own budgetary funds for promoting R&D activities, and since then have approved specific laws and created S&T policy action frameworks. Today all Spanish regional governments have defined and implemented science and technology policies and they contribute, from their respective budgets, to fund the Spanish research system, with an amount equivalent to 60% of the central government's competitive R&D subsidies. Yet what is interesting about the S&T policy models that they adopted is that, despite all facing similar challenges (Spain's underdeveloped R&D capabilities and low innovation performance in relation to its neighbouring countries), they chose different models of action.

Before asking why regional governments started to implement diverse S&T policies we will now characterise the approach of the S&T policies adopted by governments in the five cases selected on the basis of the two ideal types defined.

The budgetary resources allocated to R&D by regional governments reflect policy priorities. Yet the first indicator regarded as an essential feature of the different approaches is the amount of budgetary resources allocated to actions oriented to financing academic research (taken independently of funding higher education) or, alternately, to fostering R&D or industrial innovation. Table 1 presents a summary of the distribution of the regional government funds allocated to the S&T and innovation policies¹⁰.

Table 1. about here

The clearest example of a regional academic orientation is the Andalusian policy. Over time, despite not representing a significant part of Andalusia's budget, the regional government has allocated three times more public funds to the Research Plan than to its innovation and technology policy.

The distribution of funds in Madrid and Catalonia also underscores the mainly academic-oriented nature of their policies. In Madrid's regional R&D plans, new

technologies research or business R&D projects have accounted for 11% of all funds over the last ten years and more recently, in the 3rd Regional Scientific Research and Technological Innovation Plan (2000-2003), they have grown up to 32% of the budgetary resources assigned to S&T policy. A very similar situation exists in Catalonia, where industrial innovation-oriented schemes represented around 8% of the funds allocated to the Regional Research Plan in the mid-90s.

Galicia's R&D policy was clearly academically-oriented from the mid Eighties to Nineties, although at the end of that decade the distribution of resources was more balanced: 60% to academic research and 40% to business-oriented research. In recent years, policy has evolved towards a model that clearly favours the latter, and in which the promotion of basic research only accounts for 36% of the funds allocated by the last Galician Regional Research and Innovation Plan (2002-2005).

The Basque government has developed a S&T policy mainly geared towards the funding of private technology centres and business R&D activities, chiefly the creation of R&D departments and project development. Until the mid-90s, the science policy represented 0.2% of the region's total budget, while the technology policy accounted for 1% (MOSO, 2000: 406). Over the years, the Basque Government has allocated approximately 3 or 4 times more funds to technology policies than to science policy. More recently the Basque Regional Science and Technology Plan (1997-2000) allocated 17% of funds to basic research and 83% to technology programmes (MOSO, 2000: 489).

In the basic characterisation of the regional policies we have also found diversity with respect to the nature, targets and instruments of the S&T Plans; whereas in Madrid, Andalusia and Galicia policies have been implemented by means of funding academic R&D projects and research training and mobility fellowships; Catalanian interventions have targeted the creation of public academic research infrastructures together with human capital investment through research training and mobility schemes avoiding project grants. At the other extreme, the Basque government has designed plans and programmes primarily in support of technological centres as service providers for SME companies and to directly subsidy industrial development projects.

Finally, the dominant orientation of the Basque R&D policy and its instrumentation have been geared to financing private technology centres capable of meeting companies' R&D needs, in clear contrast to the other three regions, where the

academic model predominated. In Andalusia, Catalonia and Madrid the creation and funding of research and technology centres have been linked to public universities or the activities of Regional Government Departments, such as Agriculture or Industry. This dimension of S&T policy has been more active in Catalonia, where the majority of the centres created and promoted as part of the regional R&D policies have been associated to public universities.

Despite the dominant academic approach of regional research policies in Andalusia, Madrid or Catalonia, actions were also launched to promote technological development and innovation, generally as part of another policy domain. These technology policy actions have formed part either of industrial policy actions, regional development or regional economic policy actions and were not assigned either the same budgetary funds or the levels of political priority as the former. Furthermore, in Andalusia, Madrid and Basque Country, the science, technology and innovation policies have remained in different policy domains¹¹. In these regions, the departments of education have had the control of science policy while the departments of industry or economy have overseen technology and innovation actions. This has also been the case of Catalonia during the last 15 years, although at the start of the Eighties both areas were "coordinated" by an interdepartmental structures. Galicia's Regional Government is the only example of institutional and administrative integration, where after the initial separation, a unique institution (the Secretariat General of R&D) overseen by the Office of the President of the Regional Government, was set up to develop an R&D policy. This institutional change was very important in the process of implementing a more business-oriented regional R&D policy.

The evolution, stability and change of orientation of these regional governments' policy preferences differ from one another (see table 1). On the one hand is the Basque Country, with governments whose R&D policy preferences have remained stable around technological and industrial development. This type of political preferences are also to be seen in Catalonia's first regional governments, in circumstances in which the R&D policy domain was separate from universities and education. The preferences of the Conservative nationalist government in the first legislatures were to develop an R&D policy with a certain business or industrial orientation, organised interdepartmentally. However these preferences did not materialise. Throughout the Nineties, these governments' political discourse began shifting towards the goal of

investing more heavily in developing the academic R&D system and transferring technology from universities and research centres to industry. Then political objectives began to attach importance to the issue of the quality of research and the need to make the whole Catalonian R&D system more competitive internationally.

The regional governments' political preferences in Madrid, Andalusia and Galicia have evolved –in the first and latter cases with a change of ruling party- from academic models to models geared more towards technology transfer and innovation, and towards fostering collaboration with business. Policy preferences have changed over the years in these three regions, although only in the Galician case has the real evolution of policies mirrored this change of emphasis in the discourse¹², because the situation in Madrid and Andalusian regional governments has been characterised by the stalemate.

4. Structural factors for explaining S&T policy approach

After characterising the regional authorities choices in S&T policies we will review what has been traditionally used as the key factor of policy adoption: the existing material conditions of the regional R&D environments. Socio-economic conditions, their relative level of development and, above all, the weight of the different R&D actors in the region are essential factors when it comes to explaining policy approaches. The structure of resources has traditionally been regarded rather determinant, so that one might view the dominance of public sector researchers as a prerequisite for regional governments to adopt academically-oriented policies. Furthermore, the existence of a dense industrial and business structure could be seen as a pre-requisite for the development of a business-oriented R&D strategy.

Table 2 displays this diversity of socio-economic contexts. In terms of these regions' relative wealth, in the mid-80s, the per capita income of Catalonia, Madrid and the Basque Country clearly outranked Andalusia and Galicia, which was 75% of the national average, while the former three were 20% higher than average.

Table 2 about here

From the viewpoint of their productive specialisation, the Basque Country and Catalonia obtained more than one third of their Regional GDP from industry, which in Andalusia and Galicia dropped to around 20%. Besides, these regions' industries were more traditional than the industrial sectors in Catalonia, Madrid or the Basque Country.

In the same period, there was a significant imbalance between business investment in research among regions. In the mid-80s, Galicia and Andalusia formed part of the science-technology periphery. Furthermore, in relative terms, universities had a higher than average share of the region's R&D expenses, accounting for 34.6% and 36.7% respectively, while companies accounted for 35.4% and 30.5%. The equivalent figures for the whole of Spain were 19.6% and 56.1% respectively. Meanwhile, the figures for the Basque Country and Catalonia were 83.5% and 72.4% (see table 3).

Table 3 about here

In the Basque Country and Catalonia, more than 60% of R&D staff and 59 % and 44% of researchers respectively worked in the business sector, while in Galicia and Andalusia only 11% and 12% of all researchers worked in industry. Generally speaking, industrial companies contributed little to the regional R&D expenditure in the less developed regions; instead, the universities and public research centres were the biggest contributors to the research activities in such regions.

Therefore the distribution of R&D capabilities does not appear to explain the actual orientation of policies directly. In view of the weight of the R&D actors, the Basque and Catalanian governments should have chosen a policy oriented to favouring business, which they did at first, although the Catalanian government soon changed its approach. Given the structure of resources in Andalusia and Galicia, where business had a very limited role, one might have expected the governments to have initially chosen academically-oriented policies, as they indeed did, although in the mid-90s, the Galician government changed its preferences and its policy approaches.

The material basis could explain the initial orientation of the preferences of those regions' ruling parties in the mid-80s; however while structural factors can help to understand initial preferences, other elements of political factors are required to explain the continuity and change, the attempts to transform and the evolution of policies.

5. Political explanations of the diversity of S&T policies

This section puts forward an explanation in which policy and politics play a central role. The institutionalist approach to policy (MARCH and OLSEN, 1984; STEINMO, THELEN and LONGSTRETH, 1992) regards the institutions as the rules of the

game and the incentive structure that actors have to confront (HALL, 1986). The variables underlying both the policy choices and the extent to which it varies from one region to another may be summarised as: ideas, interests and institutions¹³.

One initial hypothesis could be that governments have preferences as to which policies they implement, and that the reason for the choice of specific policies lies in their political preferences (DRUCKMAN and LUPIA, 2000). However, our analysis does not take such preferences for granted or derived from partisan ideologies, because it is important to know where they originate, how they are transformed and how they are related to the evolution of policy paradigms (HECLO, 1974; HALL, 1993) or actors' ideas (HALL, 1989; HASS, 1992). An alternative hypothesis would be that the actors with interests in such policies mobilise to develop alternative models and to put pressure on governments' choices (MOE, 1980; WALKER, 1991). Of course, the organisation of the policy domain, the science, technology and innovation policy administration model, and the institutional arrangements both matters, and are important aspects for characterising politics and political dynamics around policies.

Generally speaking, this analysis has considered the two sets of explanatory factors or independent variables: on the one hand the regional government's policy preferences and ideas, and on the other hand the interests surrounding this policy and the design of institutions. In the rest of this section we present an analysis of the factors that can be decisive in orienting policies in order to draw certain conclusions about the circumstances under which regional governments are able to develop and implement policies of an academic or industrial approach.

5.1. Policy preferences and ideas

An important factor traditionally used to explain the policies adopted by governments are the political and policy preferences (Brooks, 1999). Some literature has associated preference-forming with the ruling parties' ideological orientation (HIBBS, 1977; BOIX, 1998). If we apply the model to S&T policies, one would expect left-wing parties to orient policies towards the public sector, while the conservative parties would favour business (DICKSON, 1984/88).

However, if one looks at our cases, the governing parties' ideological orientation does not seem to explain policy preferences in this direction. In Andalusia and during the eighties in the Madrid government, the Socialist governments adopted academically-

oriented policies; however, in Galicia the Conservative government also took an academic approach during its first years in power. In the Basque Country and Catalonia, ruled by Conservative nationalist parties in the analysed period, the initial preferences were business-oriented, although Catalonia was swift to change the orientation of policy intervention. Thus, the political preferences manifested by the parties and by the discourses of the respective region's Presidents would only plausibly explain the real orientation of regional R&D policies in the Basque Country; in all the other cases, the two variables tend not to match one another for all the period considered.

Having discarded political parties' ideological orientation as policy's sole explanatory factor, we will now examine other complementary elements. These include the framing of problems and the dominant policy ideas and the imitation of models or experiences from elsewhere.

5.1.1. Framing the problems: Issues and policy ideas

In S&T policies, as in other public policies, the form of identifying and defining the problems facing the government (SCHÖN and REIN, 1994) is relevant to understand choices, and usually has an associated causal sequence of solutions (WEIR, 1992). In our cases there were countless problems associated to R&D, yet the result was heavily influenced by the way in which the governments coded them, selected them as priorities or placed them on the agenda (KINGDON, 1984/95).

In Galicia, when the policy first came into being with a Conservative government, the problem was that the region lacked a proper research system, so launching such a system became the top priority and, to a certain extent, appeared as the first step in the secular matter of economic backwardness and development. This policy coincided with the university development strategy that led to the creation of two new public universities in 1989. Policy-makers saw a need to increase the number of universities in the region and invested in producing more university graduates and researchers in general. Andalusia's science policy strategy was also linked to the expansion of higher education, which would also serve to alleviate the region's chief problem, namely unemployment, the result was the creation of four new public universities.

In Madrid and Catalonia, which boasted a large number of research centres and universities, but also in Andalusia with a big public research sector, the perception was that national R&D resources were insufficient, and therefore the solution was to provide

additional R&D funds. In these regions, research policy has basically focused on three ideas: first, that the context and driving forces behind scientific research were academic and public; second, that scientists should have a key role in research policy; and third, that regional policies should supplement, rather than compete with or replace national actions.

In contrast, the ideas of the Basque S&T policy were linked to an underlying model regarding the role of research in the innovation process. The option in favour of private applied research and technology transfer centres located close to the region's SMEs was also based on the idea that university, as it was in the Eighties in the Basque Country, was not a feasible as the main engine of the development of the S&T system (MOSO and OLAZARÁN, 2001: 411).

5.1.2. Imitation and policy diffusion

Imitation and policy transfer are processes of policy learning (HALL, 1993). We have mentioned that the influence of the EU level as an explanatory factor was not very relevant for the Spanish regions selected. Spain only joined the EU in 1986 but the S&T policy initiatives taken by the regional authorities started before the authorities had the opportunity to have experiences with the structural funds, and much earlier than the development of the specific EU initiatives, in mid nineties, like RIS (Regional Innovation Strategies) and RITTS (Regional Innovation and Technology Transfer Strategies). In fact stronger forms of policy transfer are more likely to occur in highly institutionalised governance regimes (BULMER and PADGETT, 2004) and this might not be the case yet for S&T policy.

In some regional policies, such as in Andalusia and Madrid, the source of “inspiration” of the models adopted seems to lie directly in the National R&D Plan and central government's policy¹⁴; the Galician regional government was also very quick, between 1987-89, to implement the ideas put forward in the National R&D Plan.

Therefore, the Andalusian, Madrid and Galician regional research plans and schemes were designed to supplement the national policy. Until the mid-90s, the party in power in Andalusia and Madrid was the same party as in central government (the Socialist)¹⁵. In the Galician government, between 1987-1989, with a socialist-led coalition government, there was also a greater extent of isomorphism, as there was in Madrid and in Galicia, both with conservative governments, when the conservative

party won the national elections in 1996. Therefore a Regional Government's ideological orientation can reinforce imitation with respect to the central government if the ruling party is the same as the party in central government.

Unlike the three previous cases, the emergence of the Catalanian and Basque research policies was, to a larger extent, due to a political option of building their own framework of powers that included R&D activities; ruling parties in these regions were nationalist and conservatist parties. In Catalonia, the regional government invested in academic research policies but placed particular emphasis on human capital formation and research centres creation to avoid duplication over the programmes and instruments of the National R&D Plan.

In the Basque Country, it was the Department of Industry that played a decisive role in building the R&D policy, placing emphasis on technology and in fact looking outside the country, e.g., at the German Fraunhofer (FhG). The Basque regional government consciously avoided the model of creating public research centres, which it deemed too slow for meeting its industry's needs, and thus defined a technology centre promotion model in which 50% of funds would come from the regional government, while the rest would come from research and service agreements with industry (MOSO and OLAZARÁN, 2001).

The diffusion of policy models resulted either from abroad (other countries experiences) or from above (the national government) was relevant, specially when the government had the same policy orientation; in the policy model adopted by the national government, the National R&D Plan resembled the EU R&TD Framework Program, but with a dominant academic orientation.

If this diffusion-imitation process was a determining factor in the policy orientation of regional authorities, we could predict academically-oriented policies in those regions that have imitated the National R&D Plan most, and other types of policies in those regions that have avoided such imitation. This relationship is fairly clear in Andalusia and Madrid from the side of imitation and on the Basque Country from the side of avoiding imitation, but it is not such a strong explanation for the case of Catalonia; however the Galician government's shift to a business-oriented policy, in 1997, came at a time when central government was changing its S&T policy, and reinforcing its industrial oriented actions, both with conservative parties.

5.2. Institutional designs and politics: the role of interests

The dependence of the R&D system's actors on public funds, together with the limited alternative sources of finance, may partly explain the different degrees of mobilisation of the actors who directly benefit from the policies.

In Madrid, the fact that its research establishments' share of national R&D funds steadily declined from the Nineties onwards spurred academic interests into lobbying the regional authorities. Similarly, in Catalonia, when the public universities were transferred to the Regional Government in 1985 and the Constitutional Court threw out the Regional Government's appeal regarding the transfer of research powers in 1991, the universities stepped up pressure on the Catalonian authorities to play an active role in the funding of Catalonian research actors. In Andalusia too, universities and public research establishments developed strategies for raising regional research funds. In the Basque Country, due to the mobilisation of certain technology actors, the priority was given to the industrial technology policy and the science policy was relegated to a second place from the very start.

5.2.1. Coordination and advice in science and technology policies

The existence and structure of the R&D Policy Advisory Councils reflect the dominant orientation of policies. In the Basque Country, the Council was formed by technology centres' managers and engineers, while in Andalusia and Catalonia it was the universities that were most active, and in Andalusia their university representatives even played an institutionalised role in the distribution of the research funds. In Galicia and Madrid, all the Councils' members came from the academic world until the Conservative Party won the elections to the Regional Government and appointed members from the business world.

The substantive contents of research policies favour the actors' involvement in the operation and legitimation of such policies, which is why policy communities (RICHARDSON y JORDAN, 1979) tend to form. Andalusia and the Basque Country are the clearest cases in which policy communities began to form throughout the Eighties. In the former it was academic interests and in the other, industrial interests, that forged ties with the institutions and began playing a leading role in the design and configuration of the regional science and technology policy. In both cases the leading role and relevance remained in keeping with their respective governments' preferences and goals during the

Eighties; the strong ties between the Conservative nationalist party that ruled in the Basque Country with the region's industrial interests, and the Andalusian governments' preferences for an academically-oriented model favoured and reinforced the consolidation of these policy communities, a consolidation that afforded the policy great stability, but subsequently hampered the change of orientation.

According to the institutionalist literature, the way in which a *policy domain* is organised affects the dominant orientation, because it facilitates or hampers the influence and expression of the system's forces (SCKOCPOL and FINEGOLD, 1982). Nearly all the regional governments have interdepartmental bodies to coordinate the work of the departments responsible for S&T policies¹⁶, yet the fact is that there is a considerable degree of institutional separation, and even isolation of the science and technology areas of these policies, which in most cases have had different bureaucracies and clienteles, and whose global characterisation depends on one department having a bigger say in the R&D policy. The degree of institutional separation or integration of the two main areas of the regional S&T technology policies is not directly related with one policy approach or another. Even though science and technology policies are separated in Madrid, Andalusia and Catalonia and the three have implemented an academically-oriented model, they also are separated in the Basque Country, where regional policies are industrially oriented. The institutional integration in Galicia, from 1997, does seem to have enabled the implementation of increasingly business-oriented policies, in line with the government's political preferences. However, the Andalusian Department of Industry failed in its attempts to coordinate the Andalusian Research Plan between 1994 and 1996. The integrated coordination in place in Catalonia during the Eighties did not stop the policy actually implemented from being academically oriented, despite the political preferences expressed by the regional government. What the comparison does demonstrate is that the institutional separation of both areas strengthens the dominant interests in the regional policy, whether they be academic or industrial.

5.2.2. Interest mobilisations and professional trajectories of policy makers

Imitation of what is done at other policy levels could be taken as a part of the “rational” policy making, but when describing policy learning one important fact is who brings the ideas or models and who learns (HECLO, 1974). Weak bureaucracies –such as the regional governments' bureaucracies in these fields- are normally regarded as being

prone to greater external influences, both from the individuals who take up positions of responsibility and mobilised interests (SABATIER, 1988, 1998). The emergence of new actors transforms the policy domain structures (BAUMGARTNER and JONES, 1993).

In some regional governments, the origin of the respective Ministers of Education, Science or Industry had a significant impact on the way that the problems were defined but, above all, on the choice of institutional mechanisms and methods for acting in this field. The regional policy-makers' prior experience with national R&D policy and, from 1986 onwards, the regular exchange and dialogue between national and regional policy-makers¹⁷ facilitated the adoption of the organisational models, which resembled the national structures (to facilitate cooperation), or were consistent with the regional policy-makers' prior experience as researchers.

Whenever regional S&T policies have followed a basically academic trend, the origin and professional trajectory of the regional policy-makers is seen to have been closely linked to the world of academic research and its organizations¹⁸. In Andalusia and Madrid, the regional ministers of Education who implemented the regional research policy came from public research centres or universities; they had professional trajectories connected to research and were familiar with existing R&D policy mechanisms. Linked to their origins, their interests were among those affected by this type of policies, and they saw the system's problems as problems related to the lack of public financing.

In Catalonia and Galicia, policy-makers also have a university background, despite their governments' political preferences and, in some moments, regional policies have followed a business-oriented model. Whereas the Catalonian government's policy-makers came from the field of engineering, in the Galician Government, in the two phases of its science and technology policy, they have come from the traditional university establishment.

In the Basque Country, although most of the Department of Education's senior officials have a scientific background and university-related roots, in the Department of Industry, which has far more influence over the design of the regional R&D policy, most of the political appointees came from industry, either from testing laboratories or technology centres (MOSO, 2000: 257).

Consequently there is no general correspondence in the five cases analysed between policy-makers' professional origin and trajectory and their preferences/actions regarding regional R&D policy approaches, because although this factor would seem to reasonably explain the cases of Madrid, Andalusia and Basque Country, it is not such a strong explanatory factor in the cases of Catalonia and Galicia. Therefore the weight of this factor must be understood in combination with others.

5.3. Institutional arrangements and budgets as constraints of policy change

The case of Andalusia, though also the case of Madrid, shows that a shift of policy preferences of governments towards more business-oriented models, similar to the shift that occurred in both regions from the Nineties onwards, is unlikely to be implemented once certain institutional structures have been established and such structures have been occupied, to a large extent, by academic researchers, who build up prospects about regional R&D policies.

In Catalonia, after it was transferred to the sphere of Education, the coordination body became an instrument that was used almost exclusively by the Department of Education and the resultant policy model was basically academic. In Madrid, where the relative concentration of public R&D centres, together with a relative decline of this region's share of state funds, created strong expectations as to how the regional administration would compensate for this decline. When R&D policy comes under the sphere of Education and Universities, it often adopts an academically oriented approach. Once consolidated, regional R&D policies have shown a considerable degree of path dependence and feed-back that generate expectations among the most favoured interests¹⁹.

Generally speaking, economic recessions (such as the 1992-1996 recession) or political crises (as in Andalusia from 1994 to 1996) generate contexts in which public spending tends to shrink and may result in R&D expenditure no longer being a budgetary priority. At such times, the policy has been geared towards universities and public R&D establishments, and if any funds had to be allocated to business, they have not been oriented to R&D, but to industrial restructuring, employment, etc. That was what happened in the Eighties in Catalonia, which kept waiting to be transferred powers (and the respective budgets) that never arrived. In Galicia, when R&D became a higher political priority on the regional government's agenda, the R&D budget grew

considerably in the regional government's total budget, from 0.47% in 1997 to 0.76% in 1999, which favoured the success of the move towards a more business innovation-oriented policy model; the academic community did not interpret those changes as a relative loss of resources, despite the fact that the new government body (the Secretariat General of R&D, which reported to the Presidency) was created to increase coordination, permit a more business-oriented policy in line with the government's preferences, and neutralise academic interests to a certain extent.

The clash between the Catalanian governments' initial preferences for an industrial-oriented policy and the heavy lobbying by academic interests, in particular by the universities, for a policy oriented to their needs, might have led to a different outcome in a context of budgetary growth of resources, a context that did not occur in the Eighties but in the Nineties²⁰, when political preferences and the institutions had already been consolidated towards the academic model.

Similarly, in Andalusia and in Madrid, the crisis of the mid-90s contributed to hinder a change of orientation of a heavily academic policy. In Andalusia, responsibility for the Andalusian Research Plan passed from the Department of Education to the Department of Industry, between 1994 and 1996, in a context of global freezing of resources, and the academic community perceived this change in terms of competition for public resources, and the incipient reorientation of policies as losses rather than coordination-derived gains. The industry-related sectors felt that, despite such intentions, in a Department concerned with employment and in the presence of an economic crisis, the emphasis could not be placed on the technology policy but on the companies facing a crisis. In 1996 the Department of Education regained control of the Andalusian Research Plan that, in budgetary terms, continued to earmark most of its scant resources to academic research.

In 1995 the Regional Government of Madrid changed hands when the elections were won by the Conservative Party, whose preferences were more inclined towards business innovation; the new government soon began to leave its institutional mark in the area of Education by creating the Directorate General of Research, abolishing the Scientific Council and replacing it with a Science and Technology Council that, unlike its predecessor, included business representatives. These changes of orientation also coincided with a cutback in resources, the budgeted funds for 1995-96 being cut almost by half. The institutional design was different but the way that policy was influenced by

interests did not change substantially and the 2nd Regional Research Plan (1994-1998) only allocated 8.4% of the Plan's total budget to business projects.

All these comparative experiences show that it is difficult to re-orient R&D policy towards business when expenditure freezes or during recessions. On the other hand, the feasibility of reforms is generally associated to an increase in the funds available for the policy such that the interests that lose out in the policy do not identify the reforms with a zero sum game.

6. Conclusions: Lessons from the Spanish regional authorities involvement in S&T policy for the EU multilevel governance

The trends of regionalisation and decentralization in Europe represent some challenges for research. Regional authorities have become directly involved in the design and implementation of regional S&T policies, however the interventions of sub-national governments are much more diverse than the prevailing view about the convergence of regional policies towards innovation policies might imply.

In this paper we have first described two ideal types of regional R&D policies, academic or business oriented; second we have characterised the S&T policies of some Spanish regions trying to establish the circumstances under which certain explanatory factors influence the choices of these policies more heavily than others. The analysis of five cases has shown that although in some regions, such as the Basque Country, the prevalence of industrial interests in the R&D system could predict the regional policy approach, the existence of strong business interests in a given region, such as Catalonia, was not a sufficient condition for governments to develop policies dominated by this approach even if they prefer such policies. The Catalanian case shows also that government' preferences alone may not be determinant, in the presence of growing mobilisation of academic interests.

We have also found that when the government's preferences clearly favour a policy change, this can be achieved through suitable institutional and administrative arrangements, above all in contexts of significant budgetary increases, as occurred in Galicia at the end of the Nineties. If shifts towards a more business-oriented policy are proposed when the economy is at a standstill or at times of policy budget cutbacks, academic research-related interests are far more likely to associate these changes to a zero sum game in favour of business interests, than if this occurs in a context of global

growth of resources. Therefore the regional public R&D expenditure cycle in addition to the structure of policy domain is a variable that marks the answer to the question about the conditions under which certain policies can be implemented successfully in the presence of strong academic interests.

What the comparison does demonstrate also is that the institutional separation of both areas reinforces the dominant academic or business interests in the regional policy, and that the neutralisation of certain interests prompted by the creation of interdepartmental bodies is possible in a context of increasing resources and more doubtful otherwise, as demonstrated by the comparison between Catalonia in the Eighties and Galicia in the Nineties.

One could say that a pro-business science and technology policy cannot be easily implemented from a Department of Education (or Research and Universities). As we have seen, moving the policy domain to interdepartmental structures related to the regional President's office, as in Catalonia and Galicia, favoured the isolation of interests and an approach other than the solely academic approach.

Being part of a multilevel system has neither determined the entry of regional authorities in science and technology policies nor the orientation to the innovation policies as it has been the case in other European countries. To understand what happened we have looked mainly at the internal politics of the region.

In general, the higher the level of development of a region's academic system (regardless of the level of development of the business system), the harder the regional government finds it to impose the objectives of a research and innovation policy geared to favouring economic growth first and thus to give priority to the pro industry approach. Besides, the cases of Madrid, Andalusia and Catalonia show that, once institutional structures have been established and populated by academic researchers, who form a policy community, governments find it hard to significantly reorient their strategies towards business interests despite the changes of discourse and a certain evolution of preferences in that respect. In short, these cases highlight the importance of institutional arrangements in distributive policies such as R&D policies, and that mobilised interests can press to prevent institutional changes and policy reorientations when they seem to threaten their interests.

However, the policies proposed by certain regional governments (Andalusia, Catalonia and Madrid) have slowly evolved from models that place emphasis on the public funding of academic research towards other models that emphasize technological innovation and transfer processes and fostering collaboration with industry, and in some cases –Galicia- have even changed significantly. Apparently government preferences have changed over the years, although the implementation of these changes has been hindered both by the economic and budget scenario of the mid-90s and also by the consolidation of an academic policy community in this field.

Evidence presented here contradict the dominant interpretation of the innovation policy diffusion from the European level to the regions, in the emerging multi-level governance systems, as some of the Spanish regions made S&T policy choices diverge significantly from the dominant approaches to innovation policies.

Table 1: Some features of the science, technology and innovation policy approaches adopted. Spain

| Regions | Year of beginning of the regional S&T policy | Distribution of Regional S&T funding | Policy formalised into a policy document | Regional science, technology and innovation policy approaches and dynamics |
|-----------------------|--|--|---|---|
| <i>Andalusia</i> | 1984 | 75% academic research 25% technological modernisation (1996) | Programa de Política científica (1984-1987) (<i>Programme for Science Policy</i>) | Policy oriented to universities and public R&D centres in the 80s and the 90s (<i>academic approach</i>) Failed attempts to diversify the policy towards industrial connection-related aspects in the mid-90s |
| <i>Catalonia</i> | 1981 | 92% academic 8% industrial R&D (1993) | I Pla de Reserça de Catalunya (1993-1996) (<i>1st Catalanian Plan for Research</i>) | Policy oriented to universities and public research centres in the last 15 years (<i>academic approach</i>) Failed attempts to develop a business-oriented policy at the start of the Eighties |
| <i>Galicia</i> | 1987 | 60% basic and applied academic research 40% industrial research (1999) | I Plan galego de Investigación e Desenvolvemento Tecnolòxico (1999-2001) (<i>1st Galician Plan for Research and Technological Development</i>) | Policy oriented to universities and public centres from mid-80s to 90s. (<i>academic approach</i>) Successful reorientation-diversification of the policy towards a more pro-business model since 1997 (<i>industrial model</i>) |
| <i>Madrid</i> | 1986 | 89 % academic research 11% industrial innovation (1994) | I Plan Regional de Investigación de la Comunidad de Madrid (1990-1993) (<i>1st Regional Plan for Research of Madrid Region</i>) | Policy oriented to public centres and universities (<i>academic approach</i>) from 1987 to 1995 Changes in the political discourse towards a more industrial/business model that have not transformed the main policy approach |
| <i>Basque Country</i> | 1980 | 17% academic research 83% technological programs (1997) | Plan de Estrategia Tecnológica para el País Vasco (1990) (<i>Plan for a Technology Strategy of the Basque Country</i>) | Dominant policy oriented to technology centres and business in the two last decades (<i>industrial approach</i>) Shift of emphasis from the supply (<i>technology centres</i>) to demand side (<i>clusters of companies</i>) |

Source: Own elaboration.

Table 2. Socio economic indicators of Spain and the five regions (average values 1987-1989)

| | Andalusia | Catalonia | Galicia | Madrid | Basque Country | Spain |
|---|-----------|-----------|---------|--------|----------------|--------|
| Population (thousand of inhabitants) | 6,936 | 6,067 | 2,880 | 4,905 | 2,152 | 39,162 |
| % Spanish population | 17.7 | 15.5 | 7.4 | 12.5 | 5.5 | 100.0 |
| Gross domestic product (GDP) | | | | | | |
| Billion of pesetas (1) | | | | | | 35,889 |
| % total Spanish GDP | 13.4 | 18.4 | 5.7 | 15.3 | 6.6 | 100 |
| GDP per capita. | | | | | | |
| Thousand pesetas (1) | | | | | | 916 |
| GDP per capita / national average (100) | 75.5 | 118.8 | 77.2 | 122.3 | 120.3 | 100 |
| Industrial Added Value | | | | | | |
| % Spanish industrial added value | 9.8 | 25.1 | 4.7 | 13.1 | 10.5 | 100 |
| % Industrial added value / regional GDP | 18.3 | 34.0 | 20.4 | 21.4 | 39.7 | 24.9 |

(1) Final exchange rate (2000): 1 euro = 166.386 pesetas

Source: Own elaboration from diverse data from Spanish Statistics (INE)

Table 3. Gross expenditure in research and development (R&D) and researchers (FTE) by institutional sectors in Spain and the five regions (average values 1987-1989)

| | Andalusia | Catalonia | Galicia | Madrid | Basque Country | Spain |
|---|-----------|-----------|---------|--------|----------------|-----------|
| GERD / PIB (%) | 0.40 | 0.70 | 0.26 | 1.96 | 0.92 | 0.70 |
| Total (in thousand euros). | | | | | | 1,717,937 |
| % Spain | 7.7 | 18.6 | 2.1 | 43.1 | 8.5 | 100 |
| Distribution by sectors | | | | | | |
| Business Sector (in thousand euros) | | | | | | 964,083 |
| % Spain | 4.8 | 24.0 | 1.1 | 43.1 | 12.7 | 100 |
| Government (in thousand euros) | | | | | | 404,702 |
| % Spain | 9.8 | 8.5 | 2.9 | 61.6 | 1.1 | 100 |
| Higher Education (in thousand euros) | | | | | | 337,174 |
| % Spain | 13.5 | 15.1 | 3.9 | 21.3 | 5.9 | 100 |
| Distribution by sectors as % of the Region | | | | | | |
| Business sector (% of region) | 35.4 | 72.4 | 30.5 | 56.2 | 83.5 | 56.1 |
| Government (% of region) | 30.0 | 10.8 | 32.7 | 33.7 | 3.0 | 23.6 |
| Higher Education (% of region) | 34.6 | 16.0 | 36.7 | 9.7 | 13.5 | 19.6 |
| Total Researchers | | | | | | 30,182 |
| (% Spain) | 7.9 | 14.6 | 22 | 31.7 | 6.9 | 100 |
| Researchers in Business sector | | | | | | 8,260 |
| (% Spain) | 3.7 | 23.6 | 0.9 | 45.4 | 14.9 | 100 |
| (% of the researchers in the Region or Spain) | 12.8 | 44.1 | 11.6 | 39.2 | 59.2 | 27.4 |

Source: Own elaboration based on National Statistical Institute (INE) R&D Statistics

Notes

¹ A step further in the process of involvement of the regional authorities in RTD policies has been reported in the literature: some German Landers, like Bavaria or Baden-Wurtemberg, started interventions with or without the Federal government involvement in issues of their regional interest such as the creation or promotion of regional research capabilities, for instance the bio regions (DOSHE, 2000; KAISER, 2003; KAISER and PRANGE 2004a), or intervention instruments such the Bavarian Research Foundation (Bayerische Forschungsstiftung); more recently Scottish authorities are entering into regional science strategies (LYALL and TAIT, 2004), anticipating a trend of intervention of sub-national governments on science policy matters (COOKE, 2004b).

² Although this is not the focus of our paper, however it is interesting to note that at a time in which economic theories questioned the “linear model of innovation” and there were arguments supporting the power of ideas diffusion in shaping the policy (MYTELKA and SMITH, 2002), some Spanish regional authorities adopted traditional science policy instruments, policies targeted to the construction of research capabilities.

³ Nevertheless some trends are worth mentioning: a) increasing funding opportunities and research strategies for research actors favours the free-rider behaviour and reduces the effectiveness of the steering through priority setting programs; b) relevance of the policy coordination problems that “multilevel governance systems” create, when political authority is lacking, and the need to address them specifically with new institutional arrangements (BENZ and EBERLEIN, 1999); c) changes in the way of access and representation of interest groups (GRANDE, 1996).

⁴ There is a bunch of literature under the frame of regional innovation systems (COOKE, 2004a; COOKE, BOEKHOLT and TODLING, 2001), which in general has underscored the specific characteristics of regional policies and the importance of the political framework (COOKE, GÓMEZ-URANGA and ETXEBARRÍA, 1997); this paper attempts to complement these analyses to draw some relevant lessons for the EU regions.

⁵ Despite a recent renewed interest in the study of science or technology politics (e.g. GUSTON, 1999) little attention has been paid to politics, because much of this research focuses on normative issues (EWERS and WETTMANN, 1980; METCALFE and GEORGHIOU, 1998). With respect to the specific explanation (or evaluation) of regional or state S&T policies, there is a significant literature on the State governments’ intervention in technology policy, specially in the U.S. that should be taken into account; see for example: COZZENS and MELKERS (1997), FELLER (1992), LAMBRIGHT and TEICH (1989) or LONG and FELLER (1972). In Europe this interest is more recent; see for example KOSCHATZKY (2003).

⁶ We use here the ideal types in a Weberian way, as heuristic instruments, even if they can not be found empirically in reality.

⁷ In the academic approach ideal type all funding for R&D would go to the universities and public sector research; the promotion of new research centres would be exclusively linked to the university and government sectors; and the Plans and R&D programs would use traditional instruments for funding fundamental research such and projects or grants; conversely opposite features regarding the funding targets, and links would be found in the industrial approach ideal type.

⁸ This study was conducted with qualitative methods: documental analysis and in-depth interviews, with an in-depth questionnaire, lasting more than one hour, with regional science, technology and innovation policy-makers and actors. The authors conducted 18 interviews in Andalusia (ROMERO, SANZ-MENÉNDEZ and CRUZ, 2003); 20 in Catalonia (CRUZ, FERNÁNDEZ and SANZ-MENÉNDEZ, 2003), 13 in Galicia (FERNÁNDEZ, SANZ-MENÉNDEZ and CRUZ, 2003) and 18 interviews in Madrid (SANZ-MENÉNDEZ, CRUZ and ROMERO, 2001). The Basque Country analysis is based on the research conducted by our colleagues Olazarán and Moso, who collaborated in this project.

⁹ Modern science and technology policy became consolidated in Spain at the start of the Eighties, during the first Socialist government, and was institutionalised when Parliament passed the Science Act (Law 13/1986) (SANZ-MENÉNDEZ, 1995; SANZ MENÉNDEZ, 1997).

¹⁰ The basic characterization is constructed over the dominant features in mid nineties. 2002 is the last year considered.

¹¹ After the Andalusian regional elections in 2004 a new unified Ministry of Innovation, Science and Enterprise has been created.

¹² In the Nineties, the political discourse began changing quite significantly both in terms of electoral manifestos, and in the fundamental principles underlying the plans and programmes that were approved.

Those changes occurred both in these regions and in the rhetoric of the national policies, which evolved radically from 1997 onwards, with the Conservative government, towards industrial approaches.

¹³ This model has been previously applied to explain the institutional construction of national science and technology policy in Spain (SANZ MENÉNDEZ, 1997).

¹⁴ The political impetus given to the Spanish R&D policy in the mid-80s, embodied by the passing of the Science Act in 1986 and by the National R&D Plan (1988-1991), was inevitably a point of reference in the models and the ideas adopted by the Regional Governments, with their incipient R&D policies.

¹⁵ The fact that the S&T policy model implemented by central government under the Science Act (SANZ MENÉNDEZ, 1997) was academically-oriented reinforced this approach in Andalusia's and Madrid's policies.

¹⁶ It was also the case for the national government (SANZ-MENÉNDEZ, MUÑOZ and GARCÍA, 1993)

¹⁷ The institutional framework for the dissemination and exchange of R&D policy practices was the General Science and Technology Council created by the Science Act, which was formed by representatives of the national government and the regional governments. It is interesting to note that the Regions were normally represented in this Council by their Ministers of Education, with the sole exception of the Basque government, which was represented by the Minister of Industry, which was responsible for its technology policy.

¹⁸ Albeit with a significant difference between policy-makers from traditional faculties and from engineering schools.

¹⁹ For example, the Basque technology centres also lobbied the political and institutional authorities when the Department of Industry cut their public funds between 1987 and 1991, and managed to turn the technology centres into one of the linchpins of the Basque R&D policy approach.

²⁰ In 1988, the Regional Government of Catalonia only set aside 0.09% of its budget to R&D, while in 1996 the figure was 0.46%.

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