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Policy-making and organisational shaping: the role of Basque technology policy in building an environment for Technological Centres[1]

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Abstract

The aim of this paper is to show how the regional technology policy of the Basque Country has had a strong effect on mapping out the population of R&D organisations, through changing the environmental conditions of previously existing research organisations as well as creating new organisational actors. This research seeks to contribute the debates on the growing importance of Regional research systems, the organisational adaptation to multi actor governance, and the blurring organisational boundaries between public and private spheres of R&D centres. The paper analyses the changes that have been promoted by the Basque regional technology policy in the environment where the Technological Centres' inhabit, between 1980 and 2000, and explain the role of policymaking in R&D organisational change. Six variables emerging from Population Ecology perspective have been used to measure the environment and its changes. These are: hostility, munificence, power concentration, actors' heterogeneity, actors' coordination, and stability of demands.

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1. Introduction

Research organisations are formal groups of people legitimised by the external social system. They have long term continuity aims, and their mission, either partial or total, is to perform systematic research and experimental development scientific work in order to increase the stock of knowledge and its use to devise new applications. The research organisations have a specific structure, clearly defined limits of activity and competence, as well as a formal structure, which comprises different statuses and standardised codes of understanding between its members. In this way, members can be replaced with no harm to the organisation. Research centres are also located in specific R&D environments and are endowed with the necessary technical systems and resources required for carrying out their specific research tasks (Aldrich & Marsden 1988, Ramió 1999, OECD 2002). R&D organisations have mainly been the subject of study for economists that have assessed the effects of innovation and new technologies in the way organisations work and adapt to new market challenges (Porter 1980, 1985; Utterback 1994; Freeman and Soete 1997; Tidd, Bessant and Pavitt 1997). Nevertheless, few academic works have approached analysis of the scientific systems from an organisational perspective, and none have analysed the effects of R&D public policies on the research organisations nor the role of policy as a major source of organisational change. Within some of these works (Crow & Bozeman 1987a, 1987b, 1991, 1998; Bozeman & Loveless 1987; Bozeman & Crow 1990, Sanz-Menéndez & Cruz-Castro 2003) *R&D organisations* are defined as the unit of analysis. They are the administrative and juridical units in which scientists are organised in order to accomplish their scientific job. Other authors (Joly & Mangematin 1996; Larèdo & Mustar 2000) use *research laboratories* as their unit of analysis, arguing that it is a much more appropriate dimension to circumscribe scientists' working environment. According to Joly & Mangematin work, research laboratories are entities made up of one, *two or three different teams, which are free to decide both their research programmes and how to carry out the research.* There can be more than one laboratory within each centre, thus being a hierarchical lower unit of analysis. These authors also argue against *R&D organisations* as units of analysis as they are not homogeneous due to their wide variety of size, age, resource dependence, management and accountability systems, research areas, and scientific outputs. One specific type and location of *research organisation* has been chosen as the unit of analysis for this paper: Technological Centres (TCs) in the Spanish region of the Basque Country.

The major changes operated in Spanish research organisations landscape since the mid-eighties have been assessed in previous works (Sanz-Menéndez & Cruz-Castro 2003; Sanz-Menéndez, Cruz-Castro and Rico-Castro 2005). There was a steady loss of weight of traditional big public research centres in the overall picture, whereas mixed public-private centres flourished and old organisational forms adapted into hybrid forms. The unfolding of new decision making arenas at the regional level and Autonomous Regions' involvement in R&D policy making, account for a high degree of organisational changes. Frascati organisational classifications into *Higher education*, *Government*, *Private sector* and *Non-for profit sector* are inadequate for assessing current trends and foresight future developments. In depth and neat localised works are required to understand the global dynamic picture of R&D

organisations. Technological Centres in the Basque Country have been analysed in this paper because they entail a well defined though small organisational population that has been targeted by a high proportion of policy measures from their regional environment. TCs are key technology and innovation suppliers for industrial private enterprises, whose mission is to instigate new technologies and to facilitate its use as a competitive tool for specific sectors (Giral Mañas 1999). The first Spanish Technological Centres were created as private enterprises in the early 1960s. Nowadays they are a population of 72 organisations spread all around the country with a higher concentration in the Valencia Region territory (in the East Mediterranean coast) which has 16 TCs, and in the Basque Country territory (up in the North of Spain) that has 10 TCs. Common changing trends have been followed by all TCs around the country, i.e. they all belong to their regional semi-public R&D sectors environment following R&D regional policymaking and organisational adaptative capabilities. Analysing their environmental changing pressures illustrates the ways in which altering external dimensions shapes conditions for R&D research organisations adaptation processes. Basque TCs have been chosen because they are the oldest within the National landscape, therefore they have faced more and bigger changes throughout. Five TCs existed before the creation of the Regional Government. *Labein* was created in 1955 within the Bilbao Industrial Engineering and Telecommunication Higher Technical School and its mission encompasses the car industry, the iron and steel industry, the construction industry, and the natural environment sector. *Inasmet* was created in 1962 by private entrepreneurs as the Guipuzcoa Foundry Workers Technical Association, and it has been devoted to industrial processes, new materials, and natural environment ever since. *Ikerlan* was created in 1974 as a research centre specialised in mechatronics within Mondragon Cooperative Group (MCC). *Tekniker* was created in 1981 by the Arms Facturers School in Eibar, and *Ceit* was created in 1982 as a research centre annexe to the Industrial Engineering Higher School in San Sebastián, belonging to the University of Navarre. Despite the wide variety of their origins and founding purposes, all Basque TCs were small testing and certifying laboratories under private management that have gone through key organisational growth processes. They all currently have a non-for profit organisational status, and since the early 1980s their mission has split in two. On the one hand, they develop generic technology products that allow them be at the forefront of their technological areas, thus enabling TCs to be able to tackle any demand coming from their clients and to offer pioneering technological solutions. Funding for developing generic research projects comes from the Regional Government. On the other hand, TCs develop under contract innovation projects for their clients that produce those *processes by which firms master and put into practice product designs and manufacturing processes that are new to them* (Nelson and Rosenberg 1993). Funding for these projects comes from clients' payments.

This paper has two goals. First, to show how from the early 1980s the Basque Government has established an organisational design as one of its technological policy priorities, hence being very much focused on R&D organisations as the main actors. Second, to assess how the enactment of regional technology policies in the Basque Country has involved the creation of a whole new environment for research organisations that existed before its creation. The relevance and interest of this paper is based on the fact that scientific organisations are the basic unit of analysis when focusing on R&D production (Crow & Bozeman 1998). Therefore, policy-making activities focusing on research centres are worth examining. Through analysing the creation and evolution of the Basque Country regional innovation policy and how

Technological Centres (TCs) that existed in its territory have been targeted, this paper offers a conceptualisation of the environment where the relationship between R&D organisations and innovation systems takes place and an analytical framework that can be useful for assessing parallel processes in other countries and other regions.

The research questions addressed in this work are: *How the creation of a regional dimension and its subsequent technology policy impacted on research organisations located in its territory? How Basque technology policy changes has affected research organisations' environment?* The main hypotheses are:
H1: The Basque Regional technology policy has strongly modified organisations' operation environments.
H2: Technological centres existing before the creation of the Basque Autonomous Region have been targeted by key policy measures of its Government.
H3: Technological centres' operation environments have changed depending on the degree to which the Regional Government has targeted them, as the means of accomplishing their policy ends.

2. Theoretical framework and levels of analysis

The aim of this paper is to explain how regional technology policy has shaped research organisations through altering the conditions of the new unfolded environment. To address the research questions, a combined organisational theories framework that encompasses the Population Ecology model and the Resource Dependence approach has been applied. These two theoretical frameworks were developed at the end of the seventies. By that time, organisational studies started to consider the environment as a main concept for understanding organisational change, and this new concept gained a prominent position in the sociology of organisations. Population Ecology and Resource Dependence theories were developed to try to explain organisational change. Organisational Theory literature argues that these two approaches are mutually exclusive since they set out competing explanations of organisational change (Hrebiniak and Joyce 1985). While trying to explain the same phenomenon, *ecological* and *dependence* theoretical frameworks develop different research questions, use a different unit of analysis, and develop their explanations throughout different processes, i.e. environmental selection and organisational adaptation. However, some authors have tried to overcome these differences and to combine these two approaches, arguing that maintaining adaptation and selection processes in two different analytical frameworks is misleading and impoverish research in the field of organisational studies (Greening & Gray 1994; Hrebiniak & Joyce 1985; McKay 2001; Morris 2004; Oliver 1991; Tolbert 1985; Ulrich & Barney 1984).

Michael Hannan & John Freeman made Population Ecology's earliest formulation in 1977. Later, Freeman & Hannan (1983), and Hannan & Freeman (1984, 1986, 1988, 1989) developed it further and completed a full core theoretical body based on biological sciences. They explained changes in organisational populations' increasing and decreasing rates as an effect of selection processes imposed by the environment. These authors claimed that organisational inertia is the dominant force hindering organisational adaptation to external changes; therefore organisational change processes can only be explained through environmental

selection. The research question addressed by these authors was: *Why are there so many (or so few) organisations?* For this purpose, Hannan and Freeman based their initial theoretical development in a Darwinian approach for arguing that only the most fitted organisations would survive in increasingly competitive environments with limited resources. The Population Ecology unit of analysis is an aggregate one, i.e. organisational population. Populations were defined as homogeneous groups of organisations that depend on the same resources niche for their survival and growth. Therefore, what these authors mean by *organisational change* are variations in populations' vital rates –i.e. total number of births and deaths. For analysing these changes, Hannan & Freeman developed an intricate model based on Lotka-Volterra equations. They modelled the *carrying capacity* of the environments, given the limited amount of resources, and subsequently they explained the number of new births and deaths within populations. In other words, population vital rates were explained through the amount of resources available in their environment and through the levels of competitiveness amongst its members for gaining such resources. Temporary frameworks used by Population Ecology are very long, and in most cases last over hundred years

Jeffrey Pfeffer and Gerald Salancik (1978) developed the Resource Dependence approach based on the assumption that organisations have clear priorities, as well as the capacity to react and adapt to their external situations on a short-term basis. These authors asserted that organisations are not self-sufficient but depend on the environment where they inhabit. Therefore, the main goal for Resource Dependence approach is to analyse the way in which organisations obtain those resources that they need to survive. The research question to be addressed under this theory is: *How do organisations cope with uncertainties and dependences coming from their environments?* These authors define organisations as *coalitions altering their purposes and domains to accommodate new interests, sloughing off parts of themselves to avoid some interests, and when necessary, becoming involved in activities far afield from their stated central purposes.* For Resource Dependence perspective, *organisations are social instruments of tremendous power and energy, and the critical issue becomes who will control this energy and for what purpose* (Pfeffer & Salancik 1978: 24). Dominating coalitions within the organisation and decision-making capabilities are considered as key analytical features for understanding organisational behaviour. Resource Dependence focuses on individual organisations as their unit of analysis. What they mean by *organisational change* are adaptation transformations and adjustments of individual organisations to their external environments. This approach models organisational strategies to cope with their external constraints. Three adaptation levels are pointed out: Firstly, organisations try to control those sources where dependence comes from. Secondly, organisations try to negotiate and establish coordination linkages with the sources of dependence, through establishing collective structures of interorganisational action. Thirdly, organisations try to control interdependence relations through regulating and enacting social sanctions. Temporary framework used by Resource Dependence approach is substantially shorter than Population Ecology because it does not assume the environment as a dynamic element throughout the time.

This paper argues that Basque Technological Centres eventual adaptation processes have followed policymakers' changes in their environment. Resource Dependence main hypotheses are assumed and tested. However, applying this solely approach would focus exclusively on how TCs depend on their environments and how

they react towards its specific changes, whereas the environment would be static measured and its dynamic dimension not taken into consideration. Studying the environment is of central importance when analysing changing processes in organisation studies. Emery and Trist (1965) were the first authors that introduced this concept in their analysis, followed by Stinchcombe (1965) and Terreberry (1968). No contribution to organisational studies dropped afterwards has avoided the environmental dimension. The environment is defined as *everything lying beyond the focal unit's boundaries that is relevant for its goal setting or attainment* (Aldrich & Marsden 1988). Because of their dependence linkages, TCs changes throughout the twenty-years length period can only be understood if environmental variations are explained using a dynamic perspective. Therefore, Resource Dependence analytical framework has been complemented with the concept of *environment* and its operationalization from Population Ecology (Aldrich 1979). Basic theoretical assumptions are: The Basque technology policy accounts for a dynamic regional environment, where major changes have occurred from 1980 until 2000. As a consequence of higher resources availability in this new environment, Technological Centres depend on the Basque Regional Innovation System set up by the regional technology policy (Moso & Olazarán 2001). Therefore, the regional technology policy and its influence over the Basque environment are due to be analysed for understanding further organisational changes. Main concepts guiding this paper are *environment*, *dependence*, and *organisational change*.

The environment

Technological Centres' enacted environment (Pfeffer & Salancik 1978) is the Basque Regional Innovation System, shaped by its technology policy. Definitions of environment are found in both Resource Dependence and Population Ecology theoretical approaches. Although these two theories' contributions have been discussed, Population Ecology hypotheses that consider the environment as a dynamic actor have been assumed for this paper's research purposes. Subsequently, Aldrich's (1979: 56–74) conceptualisation that determines six dimensions –munificence, heterogeneity, concentration, stability, coordination and hostility– has been applied for analyzing Basque environment evolution between 1980 and 2000.

1. *Munificence* is the most important of all environmental dimensions because it addresses the main root of organisational dependence. It has been defined as the amount of resources available in the environment for its organisations. In its classic formulation, Population Ecology uses *munificence* as a proxy to measure the environmental *carrying capacity*, whereas for Resource Dependence *munificence* is used for delimiting how much an organisation depends on its environment and therefore which are the adequate strategies to be promoted. For this research purposes, *munificence* is a key dimension to understand why the regional environment is the enacted environment where TCs chose to inhabit, the degree in which Government's decisions affect them, as well as their eventual adaptation process. Given the assumption that organisations depends on external resources in order to achieve their missions and survive, the amount of resources available for them within the Regional Innovation System would be a key variable to asses whether or not TCs had powerful reason to re-enact their environment in the early 1980s. Large variations have taken place in the regional *munificence* along the twenty-years period of study. In order to measure them, three data series have been considered. First, the global Regional Government R&D expenditure as a percentage of GDP has been measured as way to

size how important R&D has been for Basque decision makers through its budgetary compromise. Second, a more accurate variable for TCs' *munificence* has been measured, i.e. the specific amount of resources devoted to TCs financing programmes, in constant euros, throughout the twenty years period. Third, Regional Government funding to TCs has been detached into single series for each of one of the five centres that form the targeted population.

2. Regarding *Concentration*, Aldrich (1979: 68) defined it as *the degree in which basic resources are evenly distributed over the range of the environment or concentrated in particular locations*. Population Ecology assumes that the higher the resources *concentration*, the better survival chances will have those organisations closely located to them. However, may resources be equally dispersed all around the environment, all the organisations would hold same survival chances. Resource Dependence *fathers* of the theory assumed that *concentration* is a dimension mainly developed by economists, which used it as a tool for measuring market *concentration* levels through the amount of products, added value, sales, assets and employment being controlled by large companies within a specific industry (Pfeffer and Salancik 1978: 66). Therefore, the higher the market *concentration*, the greater power would be held by few organisations. However, these authors argue that high levels of *concentration* diminish the number of units due to be coordinated, thus reducing interdependence problems amongst actors. In this paper, *concentration* means the extent to which basic resources are controlled by a reduced number of actors within the environment. Two measures have been applied in order to measure *concentration* levels for Basque TCs. First, how many agencies hold resource allocation decision-making power. Second, how many accessing routes, i.e. funding opportunities there are to the environmental resources, and what are the requirements and conditions imposed to TCs for accessing each of the financing programmes.

3. Population Ecology defined *Heterogeneity* as *the degree of similarity or differentiation between the elements of the population dealt with, including organisations, individuals and any social forces affecting resources* (Aldrich 1979: 66). Resource Dependence perspective does not consider this environmental dimension. For this research purposes, *heterogeneity* means quantity and variety of actors inhabiting the same environment. It has been considered a key dimension because it indicates how many actors would be affected by the same measures. The more actors inhabiting the environment the higher competition relations would be developed amongst them. Two levels of analysis have been distinguished for measuring heterogeneity. On one hand, the number and the importance of all regional research centres inhabiting the Basque environment together with technological centres. Size and R&D expenditure levels of sectors like Universities, private enterprises and public research organisations have been taken into consideration. On the other hand, the inner composition of TCs population has been analysed through measuring the population growth as well as backgrounds and missions of each of them.

4. Environmental *Coordination* has been named differently in each theoretical approach. For Population Ecology, *coordination* means *turbulence*, which is *the extent to which environments are being disturbed by increasing environmental interconnections* (Aldrich 1979: 68). Pfeffer and Salancik (1978: 69) make a similar definition using the concept of *interconnectedness* that has negative connotations, because the more exposed to external influences an organisation is, the less capacity of control will hold over its own adaptative capabilities. Population Ecology and

Resource Dependence agree when they argue that organisations adaptative capabilities will be higher within lower interconnected environments, because the less exposed to external influences, the better organisations will manage to control their own fate. Measuring *coordination* levels of the Basque environment has been done through taking into consideration the character of the relations amongst all TCs and its changing evolution throughout the twenty years object of study. This paper argues that due to the fact that TCs are such a small organisational population, their linkages are key dimensions for understanding their vulnerability against environmental changes. Relevant information regarding its ability to act collectively within the regional environment has been used, such as whether or not specific associations where created, if common reference bodies existed and if they shared any spheres for exerting control and influence.

5. Environmental *Hostility* has a different meaning for Population Ecology than for Resource Dependence. Aldrich (1979: 68) calls this dimension *consensus*, which means *the degree to which an organisation's claim to a specific domain is recognized by other organisations, including governmental agencies.* Population Ecology uses this dimension to develop further concepts of its analytical framework, such as *legitimacy* that is a main concept within this theory, being measured through the amount of reliability and accountability that organisations offer to their societies. However, Resource Dependence approach do not considers *hostility* as an environmental dimension. For this paper purposes, *hostility* means the level of conflict that the Basque environment poses to TCs. Hence, it is a proxy to measure how legitimate and vulnerable technological centres have been throughout. Direct and indirect regulations targeting TCs have been analysed in order to assess what had been the rationales underpinning governmental decision-making towards them.

6. Finally, environmental *Stability* was defined by Aldrich (1979: 67) as *the degree of turnover in the elements of the environment.* Thus, for Population Ecology, environments are stable when their key elements are not easily altered, whereas they are unstable when their key elements get easily altered. Hence, Ecological perspective relates environmental *stability* to inertia pressures governing organisations. It is argued that older organisations with higher levels of inertia would have better surviving probabilities than those younger ones. The latter would suffer from *liability of newness* (Stinchcombe 1965), which is a higher death risk that recently created organisations suffer due to the fact that neither specific routines nor standardized procedures have been developed. *Stability* has a similar meaning for Resource Dependence perspective, though its negative effects would depend on the degree to which it affects key interdependence linkages amongst organisations. This paper has defined *stability* as the frequency of changes in the demands of the environment to the technological centres, i.e. the changing pattern of the Basque Regional Government demands towards them. The Basque environment would be stable if Regional Government's requirements to TCs had been steady. However, it would be dynamic if TCs had to cope with unsteady and unpredictable demands. In order to measure this, all Basque R&D Regional Plans as well as similar reports and internal circulated documents of the Basque Government have been analysed, where information about guiding innovation lines are detailed. Additionally environmental *stability* has been used as a concluding dimension for summing up all the other five's information.

Dependence

Dependence is the second basic concept sustaining this paper. It bridges the relationship between the environment and further organisational adaptative changes, thus making each environmental dimension changes worth analysing. This paper argues, together with Resource Dependence theoretical approach, that the reason why organisations eventually adapt their incomes patterns, their structures and their outputs to the external environment is the fact that they depend on the environment where they inhabit, since they are not able to generate all the resources required to self maintain and they have to enter into transactions with outside suppliers (Aldrich & Pfeffer 1976). Hence, high levels of dependence would account for high influence of environmental changes over TCs living conditions, whereas low levels of dependence would account for low influence of environmental changes over TCs living conditions.

Basque technological centres' dependence on their environment has been high since the latter was created and TCs re-accommodate their missions and their organisational nature to embrace the new situation. The role that technological centres had been developing thus far as technology and innovation suppliers for industrial private sectors located them in a very convenient position for being chosen by the Government as organisations to carry on with a double edge mission. On one hand, TCs kept on working as technological partners of their member enterprises, thus developing client-oriented projects and providing industrial sectors with new solutions to their innovation requirements. Resources for achieving those tasks come from clients' fees and project selling incomes. On the other hand, TCs were released as organisations whose mission included having to keep updated with the state-of-the-art technological advances within their sectors for the benefit of the Regional Innovation System. Therefore massive efforts were to be assigned to so-called *generic research projects*, sort of basic science research projects where no specific market outputs are expected and that serves as technological foresight market searching tools. This non results-oriented portion of TCs' mission –that made a difference between them and pure R&D private enterprises– was the one that made them strongly dependent on the regional environment and the Basque technology policy.

Organisational change

Organisational change is the third basic concept sustaining this paper. It means eventual organisational adaptation process to new conditions posed by the regional environment. Notions of organisational change are taken from Resource Dependence Theory that strongly argues that organisations implement specific mechanisms to adapt the individual organisation to its external conditions. This notion entails the biggest difference between this approach and Population Ecology. The latter defines *organisational change* at an aggregate level thus focusing not on organisations' adaptative processes but on population's size increase and decrease processes.

Despite the fact that technological centres' responses to environmental changes have not been object of study in this paper, organisational change is a key underlying concept in the articulation of this work. May further adaptation processes not be expected, studying changes in TCs environment wouldn't be a matter of interest anymore. Therefore, the relevance of this paper relies on eventual consequences for TCs at the organisational level.

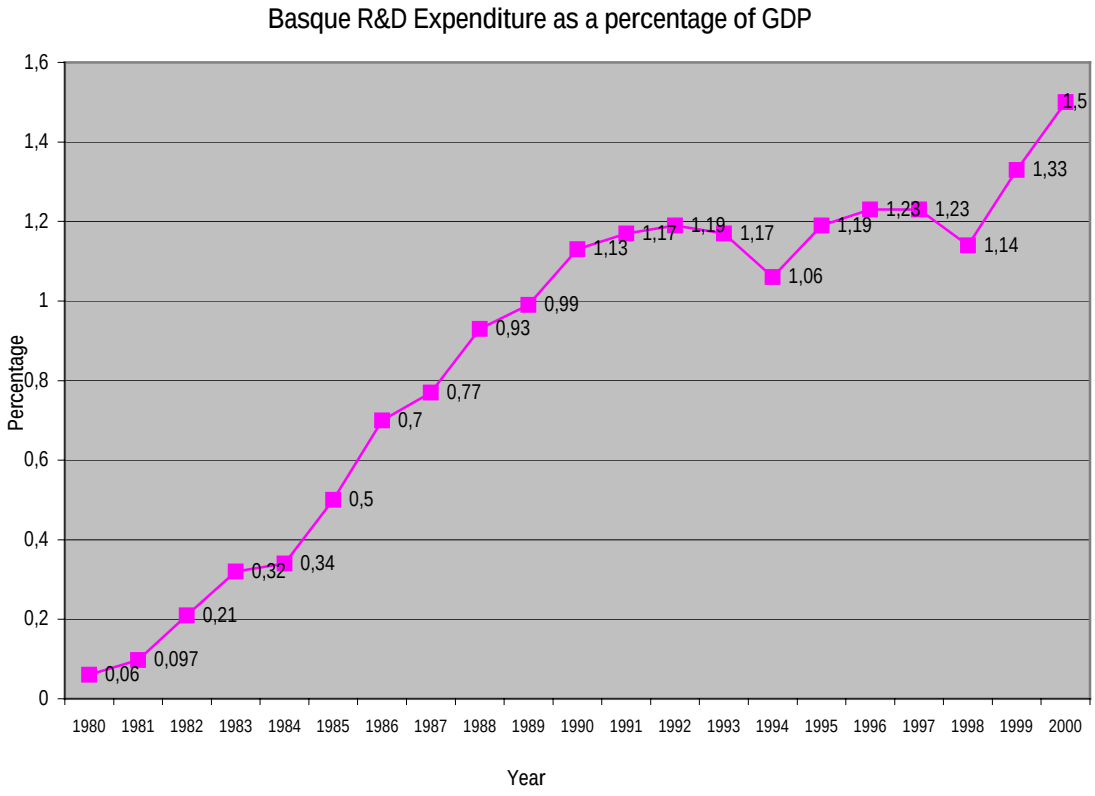
3. The role of the Basque technology policy in shaping the environment for Technological Centres

At the beginning of the 1980's decade, Spain's administrative division in Autonomous Regions created 17 different Regional Governments. Each of these new actors has launched its own regional R&D policies, being very different amongst them. While some regions –such as Andalusia and Galicia– have implemented very *academic oriented* regional policies, others like the Basque Country got actively involved in developing very *industrial oriented* innovation policies (Cruz and Sanz 2005). In fact, decision makers in the Basque Country launched a two-rationales R&D policy. On one hand, *science policy* was developed by the Education Department of the Regional Government and focused on basic and academic research activities. On the other hand, *technology policy* was developed by the Industry Department for underpinning the regional industrial policy through fostering the adoption of new technologies. These two policy domains have remained separate throughout, and while science policy stayed mainly unchanged, technology policy has gone through major changes since early eighties (Moso 1999; Moso and Olazarán 2001). Because of the leading role played by technology policy compared with science policy, the Basque Regional Innovation System hardened into an *industrial* model based on a strong privately orientated technological nature. It stands largely different from National System, which has a strong *academic* character based on the main role played by big public research organisations –mainly the Higher Council for Scientific Research (CSIC)–, as well as from other Regional Systems such as Galicia, Andalusia, Madrid, and Catalonia that also enacted an *academic* model but based on the leading role of Universities as key actors (Sanz and Cruz 2005).

Starting regional policy making activities in the early 1980s entailed a great environmental change for research organisations located in the Basque territory. New decision makers were in charged of policymaking, new programmes were launched, new actors flourished, and new funding opportunities were available. Following Resource Dependence Theory assumptions (Pfeffer and Salancik 1978), it has been argued that those research organisations that existed prior to the creation of the Basque Autonomous Region re-enacted one way or another their operating environment following criteria of resource availability. As a consequence, a threefold situation occurred. First, some centres decide not to redefine their operating conditions and to remain within the National environment as their main resource supplier, therefore their situation was not affected so deeply by the creation of the Basque Regional System of Innovation and its policymaking activities. Second, some other centres overwhelmingly re-enacted their environment following the emergence of this new regional dimension, thus going through deep adaptation processes to match up the new conditions. Third, other organisations were subsequently created under the regional systems of innovation policy making. Technological Centres fit inside the second situation. The analysis of promoted changes that explain TCs redefinition of their environment is as follows.

Munificence

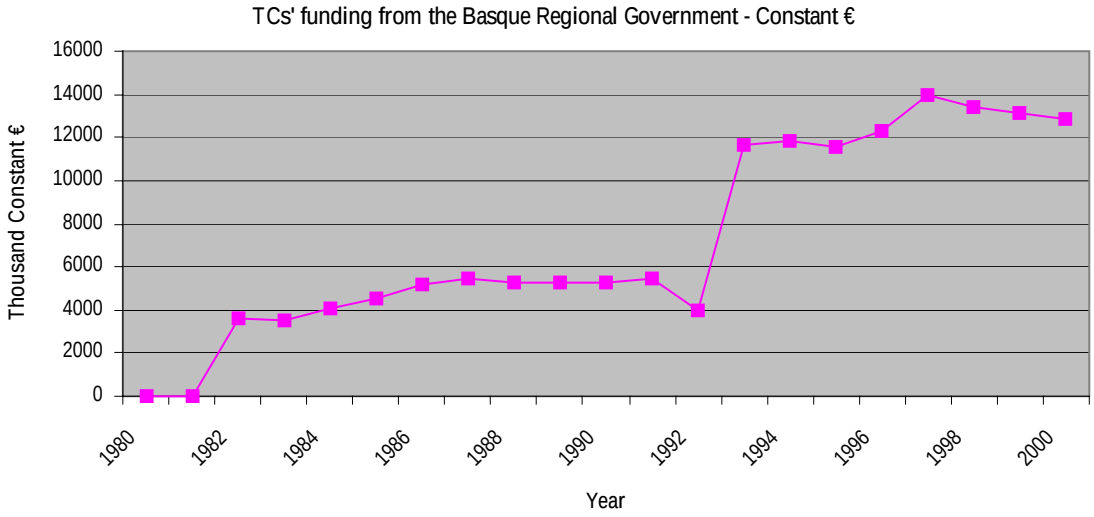
Prior to the creation of the Basque Autonomous Government, regional expenditure in R&D was extremely low, being 0,069% of GDP at the end of the seventies. Graphic 1 shows how the ratio started a constant raising pattern since the creation of the Regional Government throughout the eighties. Despite the fact that between 1983 and 1984 growing rates slightly slowed down, from 1980 to 1989 the total amount of resources devoted to research and development activities grew up close to 1% of GDP by the end of the 1980-decade. The picture looks different for the 1990s decade, where no uniform pattern is noticeable. Nonetheless the slight growth in its early years, from 1992 to 1994 funds went down, going through timidly recovering that drove back to descent between 1996 and 1998. However, at the end of the period a sharp growth occurs, driving R&D expenditure percentage up to 1.5% of regional GDP.



Graph 1: Basque Expenditures in R&D as a percentage of the Regional GD, from 1980 to 2000. Source: Author's elaboration using data from the Basque Government Technology Policy Directorate and EUSTAT.

In addition to the global landscape pictured in graph 1, technological centres also were targeted an important raise in their public funding as a consequence of the new policy implemented by the Regional Government. In 1982, they were targeted the so-called *Decree for Supervised Research Entities*, that entitled those five organisations with an intermediary position between the Industry Department and the sectoral private enterprises. TCs received a semi public status through their new regulations. A similar model to the threefold funding scheme of German Fraunhofer

institutes was designed, where the National Government, the Regional Government and the private sector would be engaged in a similar funding proportion. However, Basque TCs' funding pattern crystallized around a two key sources of income, i.e. on one hand the Industry Department through their *Generic Research Project Funding*, and on the other hand their private client's entries through projects under contract and testing activities. Following Moso (1999: 289), the steady funding support to TCs was the central decision adopted by the Regional Government in its first period regarding technology policy. Graph 2 shows a huge growth in public support from zero to almost 4.000.000 € in 1982. The Basque Industry Department designed a technology policy based on the goal of promoting regional technology-supply capabilities to invigorate their industrial sectors. Regional policy makers decided to enhance and strongly support with public funds those private initiatives that could accommodate to their political priorities and become key organisational tools for implementing their policy. Hence, R&D units were created within private enterprises and TCs became the key actors for implementing the new technology policy of the Industry Department.

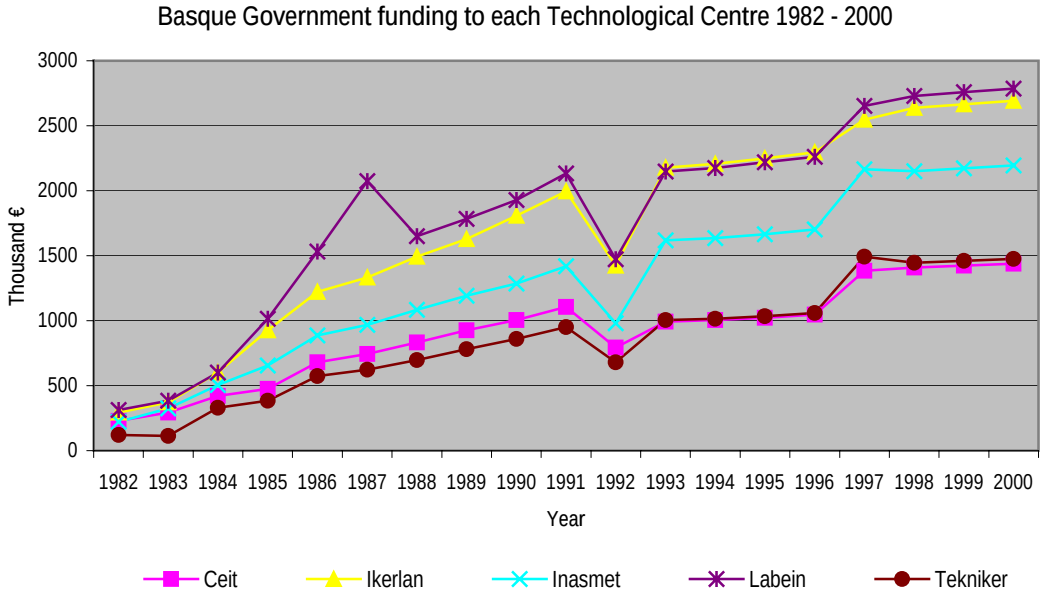


Graph 2: Technological Centres' funding from the Basque Government in constant €, from 1980 to 2000. Source: Author's elaboration using data from the Basque Government Technology Policy Directorate and INE.

As graph 2 shows, the *Decree for Supervised Research Entities* brought about a huge growth in munificence for technological centres. Despite a minor decrease in 1983, the funding scheme from the Basque Government to TCs followed a steady growing pattern of 14,5% in 1984, 11,46% in 1985, 15,44% in 1986 and 6% in 1987. A different growing rhythm happened during last years of the 1980-decade. Following a decrease of 4% of the incomes in 1987, the public Basque Government funding for the subsequent years did not increase more than 0,6% until 1990, when a slightly higher increase of 2,38% occurred.

The 1990-decade shows a rather different picture. Between 1990 and 1992 the new leading team at the Industry Department revisited the original decision of strongly support technological centres, thus implementing a temporary strong funding reduction of 27 % in 1991. Because the new Regional Industry Director was Jon Azúa, Moso (1999: 427) has named this decline as *the Azúa slope* thus asserting that the new leader was having second thoughts about how important should be the role played by TCs from that moment onwards. Also, other priorities became more

prominent on the Department of Industry agenda. Economic situation was going through a recession phase, therefore part of TCs' funding was deviated to cover those needs (Moso 1999: 428–429). Such reduction was strongly contested by technological centres that renegotiated with the Basque Government their position within the regional environment. As a consequence of their negotiating and lobbying efforts, TCs succeeded in signing a favourable funding agreement with the Regional Government for the 1993 – 1996 period (Moso 1999; Moso and Olazarán 2001), that accounts for the huge increase of 196% of their munificence between 1991 and 1992. A growth in TCs' population size also explains this enormous boost in munificence. Two new TCs called Robotiker and Gaiker joined the *Supervised Research Entities* scheme that entitled them with the right to apply for generic projects funding. One year later, in 1994 a new TC called ESI was incorporated, and in 1996 another TC called Leia joined the *supervised* scheme. These new entering centres generated higher funding demands. Therefore, peaks in growing munificence reached in 1992 and 1996 were not only due to negotiation pressures but also to a growth in heterogeneity. Following this, between 1997 and 2000 munificence was stagnated. Decreasing rates of 4%, 2% and 2,6% are depicted in graph 2 for that period. This new pattern indicates crucial changes in the relation of the Basque Government with the technological centres.



Graph 3: Basque Government funding to each Technological Centre, from 1982 to 2000. Source: Author's elaboration using data from the Basque Government Technology Policy Directorate and INE.

Regarding individual funding rates achieved by each of the five technological centres that existed before the creation of the Regional Government, graph 3 shows a common departing point developing throughout into very different levels of public incomes, though a parallel evolution pattern applies for all of them. All five centres obtained high level of entries as a consequence of their participation in the first public call launched in 1982. Rates of income range between 120.000 € (obtained by Tekniker) and 313.000 € (obtained by Labein). Roughly a common growing pattern is depicted for all five centres during the 1980-decade, with the only exception of a remarkable growth for Labein that reached a peak of 2.075.000 € in 1987. Another difference is that whilst Tekniker, Ceit and Inasmet follow a parallel growing pattern,

a more leaned slope can be appreciated in the rising curve of Ikerlan, which is more similar to Labein's pattern.

The 1990-decade pictures three different groups in the individual funding achievements. First, Ceit and Tekniker come together in the lowest level of public incomes, and they do not overcome the 1.493.000 € barrier even in their highest years. These two organisations suffered from the big funding recession occurred in 1992 that accounted for a 28% decrease in their public incomes. Between 1992 and 1993 that amount was recovered, though public support did not reach the same level than before the big decline in 1992. Between 1993 and 1996, Ceit and Tekniker benefited from the same amount of public incomes that rose steadily at rates over 1%. Both organisations raised significantly their incomes in 1997 that became close to 1.500.000 €, and from that moment onwards regional support maintained stable under the 1.500.000 ceiling. Second, Labein and Ikerlan maintain their positions in the highest level of the public funding ranking throughout this period. Labein and Ikerlan follow a very similar growing pattern in their regional governmental incomes, they both suffer from a severe recession of 31% of their public entries between 1991 and 1992, though they manage to recover by 1993 and follow their former growing pattern back again. Big increases take place between 1996 and 1997, and from that moment onwards a steady growing rhythm drives the centres close to 3.000.000 € of public support. Third, Inasmet remains in the middle of these two groups, following a parallel pattern but not receiving as low incomes as Tekniker and Ceit, nor as high support as Labein and Ikerlan.

In conclusion, changes in munificence throughout the two decades point up differences between the 1980-decade and the 1990-decade. Throughout the 1980s, a huge funding niche was opened to TCs and the amount of public resources devoted to sustaining its generic research projects growth was multiplied by 2,6. This growing munificence was the core Basque Regional Government tool to turn technological centres into the key actor of the technology policy. For that reason TCs kept on gaining more and more funding for their generic research activities, therefore becoming increasingly involved in the regional policy. Nevertheless, between 1990 and 2000 regional environment munificence was only multiplied by 1,9 and it also went through severe decreasing periods like 1992 and 1998. This indicates a readjustment of the regional policy priorities and a reallocation of R&D actors within. During the 1990s, technological centres were being gradually removed from their central position whilst fresh new actors were promoted.

Concentration

The Basque Regional environment has been highly concentrated since its early creation. Even though the body in charged of resource allocation has changed twice throughout the twenty years period, it has always been a single body holding decision-making power. Prior to 1989 the Industry Department was in charged of evaluating generic research projects submitted by TCs. The latter negotiated their own framework program for public funding access with the Industry Department, thus setting the boundaries for their individual top financing support percentages. From then on, TCs submitted their generic research projects to the Industry Department on a yearly basis, and the Government allocated money to them following previously set criteria. Hence, bilateral negotiations of the Industry Department with each

technological centre allowed the former to influence and to force modifications on TCs outcomes. The Regional Government exerted such power for trying to avoid overlapping missions amongst them. In 1989 a new body called Unit for Technology Strategy –UET was created within the Industry Department. Ruled by technicians, it took charge of the resource allocation process. Projects evaluation system changed and introduced a *peer review* system for assessing their validity. Thus, stable criteria and steady deadlines were established for TCs, yet no alterations in concentration occurred. Further modifications launched in the 1990-decade altered hierarchical location of UET, though not its decision-making domains nor its solely responsibility over TCs generic research projects.

In addition to the number of units involved in research projects evaluation and decision-making about TCs resource allocation, the variety of projects available for TCs is also to be taken into consideration to analyse environmental concentration. During the 1980-decade, there was only one program for allocating money i.e. Generic Projects. However, this situation changed along 1990-decade. Throughout each of the three Plans launched between 1990 and 2000, the creation of new types of projects gathered momentum. First, the Technology Strategy Plan (PET) for 1990 – 1992 structured TCs funding opportunities around three different types of projects, i.e. *Generic Projects*, *Cooperation Projects* and *Individual Projects*. Second, the Industrial Technology Plan (PTI) for 1993 – 1996 maintained the same projects but divided Generic Projects in *Type 1* and *Type II*, being the latter targeted not to TCs but to clusters and sectoral centres. Third, the Science and Technology Plan (PCT) for 1997 – 2000 introduced a new type of research project, the *Integrated Projects* that joined together *Generic Projects* and *Cooperation Projects*. All these changes pursued to foster and promote joined research projects between TCs and other actors such a Universities, sectoral centres or private enterprises. Thus, joined programmes received more money whereas plain TCs *Generic Projects* received less and less funding. Moreover, new actors were targeted public support after the creation of the Basque Net for Technology.

Heterogeneity

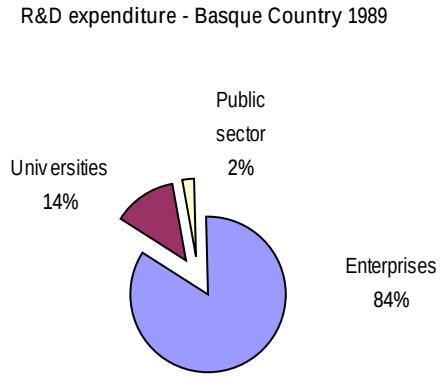
Prior to the creation of the Basque Regional Government, R&D organisational actors landscape was rather small. Public sector was the weakest sector. None of the 92 public research centres under the organisational umbrella of the Higher Council for Scientific Research was located in the Basque Country. Higher education sector was also rather small, with only one Polytechnic School, one private University and some spare faculties from the Navarre University located in the Basque territory. Private sector –that contained technological centres– was the biggest one. At that time, Labein, Inasmet, Ceit and Ikerlan existed as small private testing laboratories devoted to industrial technical support activities.

Despite the fact that private sector was suffering from the devastating consequences of an ongoing industrial crisis that ended up with an industrial rationalization, table 1 shows how it maintained itself in the strongest position within all sectors throughout 1980 and 1990 decade. R&D enterprises population grew from 389 to 556 along this twenty years period, whereas Higher Education sector did not change between 1980 and 1990 decade, and Public sectors only added up two new organisations. Technological centres population was made up of 7 centres in the 1980s, and it grew up to 10 organisations by the 1990s decade.

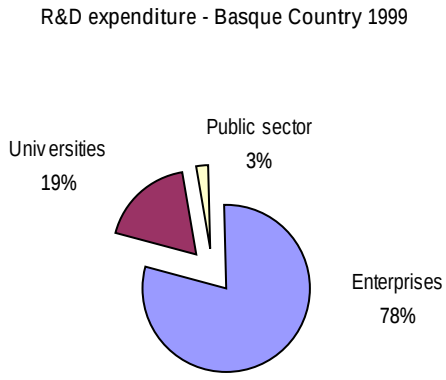
	Total number of R&D actors in 1989	Total number of R&D actors in 1999
Technological Centres	7	10
Enterprises	389	556
Universities	4	4
Public research centres	4	6

Table 1: Total number of Basque R&D actors in 1989 and in 1999. Source: Author's elaboration using data from EUSTAT.

Regarding expenditures, private sector shows a leading position throughout both decades. Nonetheless the growing trend in its population size, a decreasing pattern is found regarding its expenditure ratio within a global landscape. Private expenditures decreased from 84% to 78% between the two decades, whereas public sector grew from 2% to 3%, and Universities grew form 14% to 19% of regional expenditure.



Graph 4: R&D expenditure in the Basque Country by sector of performance in 1989. Source: Author's elaboration using data from INE.



Graph 5: R&D expenditure in the Basque Country by sector of performance in 1999. Source: Author's elaboration using data from INE.

However, big changes in research organisations populations can be found behind big number pictured in table 1 and graphs 4 and 5. Early in the 1990-decade, the Basque Government implemented a *cluster* policy, following Michael Porter's consultancy firm report (Moso 1999). Technology policy turned from being supply driven into being demand-driven, and the new clusters were located as intermediary organisations for leading sectoral technology demands. Hence, technological centres lost their central role within the regional policy, and from that moment onwards clusters took the lead in harnessing industrial sectors demands, thus turning into the new key system actors (Moso 1999; Escorsa & Camacho 2000). Implementers judged this policy as highly successful (Azúa 2003). Subsequently to this so-called *clusterization* of the Basque industry, the regional Government implemented a policy for promoting the creation of new actors such as sectoral centres, R&D units within private enterprises with an independent status, and testing and certifying laboratories.

The *Science and Technology Plan* was launched for the Regional Government for the 1997 – 2000 period. It contained key changes for organisational populations within the regional innovation system. This demand-driven Plan was designed under a systemic rationale that combined science regional policy together with technology regional policy for the first time in the Basque Country. Therefore, the Basque Net for Technology – SARETEK was created for encompassing all R&D organisations under the same association. As shown in table 2, SARETEK contains Universities together with TCs, as well as private enterprises' R&D units, sectoral centres and testing and certifying laboratories, being these four populations classical *technological* actors whereas Universities belonged to the differentiated *scientific* domain. Creating this Net entailed the end of the *supervised research entities* scheme. No more funding contracts for generic research activities were signed under the *supervision* agreements with TCs, because SARETEK opened the door for a new funding system where not only TCs but all the rest of its members were included. Three funding schemes were promoted. First, Basic Research Programmes focused on scientific research activities mainly developed within the University. Second, the Horizontal Technological Programme grouped different areas of interest for the private sectors based on horizontal technologies identified by clusters. Third, Specific Technology Programmes were created for coordination purposes between the Industry Department and other Governmental areas. Within the latter, three different types of research projects were designed, i.e. integrated projects, generic research projects, and cooperation projects. Therefore, not only institutional promotion but also resource allocation schemes were strongly modified by the end of the second decade, thus altering very much heterogeneity within R&D actors and posing new challenges for TCs.

Total number of R&D actors in 1999 – SARETEK	
Technological centres	10
R&D units within enterprises	13
Sectoral centres	4
Universities	4
Certification and testing laboratories	3
Public research centres	2

Table 2: Number of Basque R&D actors within SARETEK in 1999. Source: Author's elaboration using data from SARETEK.

In addition to this, internal heterogeneity within technological centres' population also changed. Only four TCs existed prior to the creation of the Regional Government: Labein, Inasmet, Ceit and Ikerlan. In 1981, the Armoury School in Eibar created a new TC called Tekniker. This new organisation joined the *supervised research entities* group in its first call, in 1982. A strong geographical unbalance affected TCs locations. Four out of five original TCs were located in Guipuzcoa

province, whereas only one out of five was located in Vizcaya province and no centres at all were found in Alava province. Therefore, local authorities of each province decided to enact their own technological centres within their province territory (Moso 1999). The Vizcaya Local Government (*Diputación Foral de Vizcaya*) created Gaiker and Robotiker, as well as Biotek, Embiker and Teletek that were later merged with the former two TCs. Later on, the Alava Local Government (*Diputación Foral de Álava*) created Leia in order to tackle the increasing unfavorable position of Alava province compared with Guipuzcoa and Vizcaya regarding TCs distribution. All those new top-down centres created by Local Governments were very different from the original bottom-up technological centres. The latter were created following private initiatives willing to cope with highly specialized industrial needs, whereas the rest obeyed to a political battle for power as well as competence amongst provinces (Moso 1999). Given that different background and purposes, top-down technological centers did not join the *supervised research entities* group but remained attached to their local environment for a few years. In fact, along their first living period they were massively dependent on Local Government resources support, being a competitive advantage with respect to the original bottom-up TCs. Hence, heterogeneity within TCs population increased very much throughout the 1980-decade not only due the fact that new centres were created but also because technological centres were not a unitary homogeneous type of organisation any more.

Internal heterogeneity within TCs population kept growing during the 1990-decade. Between 1993 and 1994 Gaiker, Robotiker and Leia redefined their operating environment and joined the *supervised research centres* group, thus jumping from the Vizcaya and Alava local environments to the regional environment. Another TC was created by a combined effort of the European Commission and the Basque Government in the same year –ESI, which soon became a supervised TC within the regional environment. A last TC called D.I.P.C. was created in 1999 that joined the new Net SARETEK from its very origins. In conclusion, this increase in heterogeneity also raised competition levels amongst them, thus making cohabitation more difficult amongstst TCs.

Coordination

In March 1980 the first Regional Government was formed under the ruling Basque Nationalistic Party (PNV). Soon after that, a group of industrialists entrepreneurs was mobilized to lobby for a strong industrial rationalization that consolidated classic economic activities and fostered new products (Arrieta 1986). Their demands were successfully processed, and an informal group made up by all TCs' representatives popped up under the name of Advisory Commission for Science and Technology Development –CAIDT. Their main goal was to give professional advice to the Regional Government about the Basque industrial situation, explain their views about the crisis and suggest specific solutions (Moso 1999). Following this author's words, they were highly active in lobbying and producing cogent reports with strong cases about industrial needs, in which they proposed technological centres should play a key role in building up the Basque industrial sector. Moso explains that CAIDT successfully achieved its lobbying goals, thus managing to influence the setting of the first R&D regional agenda. Therefore, the first coordination exercise that brought together all TCs in early eighties was very successful. Hence, a supply driven technology policy built around TCs role was launched. However, CAIDT was

successful because it was an alliance of individuals that even though belonged to different institutions, they behaved in unofficial capacities. Once they succeeded in their main goals, CAIDT was dissolved and never meet again.

Technological centres entered into a common ruling scheme after signing the agreement for becoming *supervised research centres* in 1982. But still, no common forum was promoted bottom-up amongst them. The Regional Government created top-down a common association for all TCs in 1986 called EITE. Thus, the Department of Industry managed to get together all TCs in a single association where communication and negotiation activities would be much facilitated. Because of the strong competence relations amongst all TCs and because EITE was not a voluntary entity designed by them to fulfil their needs, it did not success beyond keeping a common forum where the Regional Government communicated with them. EITE did only work formally, but no real interests arose and no real common actions were taken. Hence, competition relations were stronger than collaboration linkages amongst TCs

Things changed in the 1990s decade with the top-down creation of SARETEK. After promoting and flourishing new R&D organisations populations, the Regional Government created the Basque Net for Technology that dissolved EITE and absorbed its competences including the new wider variety of actors and not only TCs. All new actors were encompassed within a common association. Replacement and enlargement processes of EITE trough SARETEK indicate how TCs lost their key position as leading players of the Regional technology policy during the 1990s decade.

Hostility

1980-decade was very favourable for TCs. Main decisions adopted by the Regional Government were focused on technological centres as leading actors of the supply-driven technology policy. Labein, Ikerlan, Inasmet and Ceit were targeted the *Decree for Supervised Research Organisations* that was a very favourable agreement to them. Therefore, regional environment was far from hostile to TCs. Hostility came from disagreements between the Basque Government and Local Governments about TCs' location. Local Governments in Vizcaya and Alava Provinces adopted a competitive position regarding geographical distribution of centres and decided to launch their own TCs. Those top-down created TCs benefited from a much higher public support that located them in a better position regarding market competition. Despite this unequal competition race, the original 5 TCs occupied an outstanding position as key actor for implementing the regional innovation policy.

Changes occurred during the 1990-decade when Regional Innovation Policy turned round from being supply-driven into being demand-driven. In accordance with this, clusters took the lead in this new policy rationale and TCs were ousted from their one-time privileged position. Moreover, their situation changed dramatically because new actors were promoted by the Regional Government, thus taking away their living spaces and consuming their resources. The Regional Government strategy towards TCs was to fill the Basque environment with many new actors and new intermediary organisations that overcame TCs' importance and slowly removed them from their dominant position as key implementers of the Government policy. Clusters policy was launched as the first step in this new hostility raise, and after that SARETEK was created were they have to share their privileges even with the University.

Stability

The Basque Regional environment remained stable during the twenty years period of study. Being the Regional Policy supply-driven throughout the 1980s decade, TCs leaded the supplying processes thus their missions were not under the Government control and they were free to produce any research outputs coming from their generic projects. However, launching a demand-driven policy in the 1990s placed TCs missions under pressure and made them be more dependent on market requirements. However, despite this increasing dependence of TCs outputs, a steady stability in environmental demands is found throughout the period. The Technology Strategy Plan (PET) for 1990–1992, the Industrial Technology Plan (PTI) for 1993–1996, and the Science and Technology Plan (PCT) for 1997–2000 maintained coherent and incremental technological priorities. It made the environment stable for TCs.

In conclusion, two different periods can be differentiated through analysing variations in Basque environmental dimensions that posed diverse situations to TCs. First, during the 1980-decade measures launched by the Basque Government were overtly in favour of these organizations. A large resources niche was opened exclusively devoted to funding TCs basic research activities. It did not only save some of them from bankruptcy, but also endowed them with a double nature mission through which they occupied a leading position in implementing the one-time supply-driven technology policy. Only one public body through only one channel managed research projects calls and funding procedures, therefore public support access was simple and straightforward. Also, slight variations in numbers of actors did not affect them since their population boundaries were strictly set and their resources assured. The only hostile issues came from local Governments of Alava and Vizcaya Provinces that launched top-down created TCs within their territories to try to tackle with the high concentration of these organizations in Guipuzcoa territory. Despite the fact that the original centres feared market quota and public support would be taken away from them, the Basque Government did not granted the new organizations with any of the privileges assigned to them. It loosened hostility tensions. Given all these circumstances plus previous success in odd coordination exercises, it is surprising that coordination levels amongst them were as low as EITE was top-down created by the Government and never worked as a real communication forum. Stronger linkages and coordinated activities where all five original technological centres were involved were expected given the favourable nature of the rest of the environmental dimensions.

Second, during the 1990-decade all dimensions set a very different course. Munificence suffered from three decreasing cycles and strong irregularities were appreciated between years, with no regular patterns and a clear falling trend at the end of the period. Nonetheless a unique body kept being in charged of evaluating proposals and allocating public funding, a whole new typology of research projects flourished throughout the 1990s, in which TCs were not the only target anymore. Independent R&D units within enterprises, sectoral centres, certification and testing laboratories, public research centres and Universities populated the Basque environment, received public funding, submitted research proposals and were grouped under a common association at the request of the Basque Government. SARETEK encompassed all new elements within the R&D environment, hence dissolving the old TCs association EITE. Moreover, clusters took the lead in the new demand-driven technology policy, and TCs supplying capabilities lost weight within the new public rationale. Hostility increased towards them, and in this occasion it came straight from

the once favourable regional environment. All this shows how the role TCs were awarded during 1980-decade was being revisited, and how the new policy design did not rely on them as central players any longer.

4. Conclusions

Previous works about research organisations have concluded that even though R&D centres are key actors for implementing science and technology policies, the latter remain *gross and undifferentiated* towards them, and do not usually make a different focus following their diversity. It has been proven that science and technology policy does not give *much recognition to the R&D laboratory as a social and political institution* (Crow & Bozeman 1998). However, a very different conclusion comes from this paper. New rules, new belief systems, new modes of governance, and new modes of financing, managing, producing and delivering knowledge and services underpinning scientific production have been developed within regional environments in Spain in the past twenty years (Sanz & Cruz 2005). Some authors have argued that the reason why the Basque technology policymaking has been so effective is that its targets and goals are different from the National policies' (Escorsa 2003). The Basque technology policy established a Regional System of Innovation strongly based on organizational actors and used R&D organisations as the main tool to set their goals and to achieve their purposes. It managed to design a combined group of organisational populations whose profiles were beyond the limits of the classic threefold sectors classification that apply to R&D organisations (i.e. University, public and private sector), and produced a rich and populated system full of hybrids and intermediary organisations. Technological centres were the first population promoted by the Regional Government. Hence, a favourable and rich environment was enacted and fostered for them in the early 1980s. The policy showed an accurate knowledge of R&D actors in the Basque Country, which thus far has been a strong competitive advantage and a quality hallmark. Nevertheless, changing priorities in the Department of Industry followed a new reconfiguration of organisational actors. The Regional Government promoted new organisational populations and favourable regulations were reallocated to them. All this drops to the first conclusion that validates *hypotheses 1* and *3*: Basque Government policy makers conceived their Regional Innovation System in terms of organisations and organisational design. The Basque Regional Policy has played with actors, and living conditions of all R&D organisations suffered from important alterations depending on how strategically located they were within governmental priorities.

Technological centres were chosen as the research object to illustrate how public policies manage to shape organisations through altering their living conditions because they are one of the oldest organisational populations, thus a stronger effect of Basque R&D policy measures on them was expected. Assessing the environment has shown how the regional technology policy entailed the main environmental change that they have ever faced. TCs saw the creation of the Regional Innovation System as an opportunity to redefine and re-enact their operating environments, thus finding the regional dimension as more suitable owing to the fact that big funding niches were opened for them to expand their mission and to become implementing actors of the

regional innovation policies. Therefore, the second main outcome of this paper validates *hypotheses 2*: TCs were targeted some of the most important policy measures from the regional Government. This shows the relevance of analysing all dimensions of the environmental changes as a key step to understand eventual adaptation processes in research centres inhabiting any system of innovation.

The information derived from these two conclusions will be useful for analyzing other regions with similar highly industrialization levels where regional governments would be expected to set out similar nets of organisational actors to fill the gap between private industrial sectors and public policy making.

Given the complexity of the environment where they inhabit and the dynamic and multiple processes they have to cope with, the last conclusion advocates for the need of using a combined theoretical approach to study research organizations. Both Population Ecology and Resources Dependence have shown strong limitations to be solely applied in this study. On one hand, Population Ecology does not assume organizations have the capacity to change and adapt to new circumstances, therefore it requires extremely long periods of study to be able to asses changes at the population level. But changes in the shorter term need to be properly understood not only for organisational managers but also for policymakers and academia; therefore Population Ecology shows inadequacy. On the other hand, Resource Dependence is more appropriated for analyzing shorter periods of time changes, but a lack of dynamism in their hypotheses and in their concept of environment makes it insufficient. Therefore, a combination of both approaches has been the suitable analytical framework to address the research questions posed in this paper. Similar combined approaches are strongly recommended in further similar academic works.

Finally, further developments of this research should apply the understanding of Basque Regional environmental forces required to asses research centres adaptation –munificence, heterogeneity, coordination, concentration, hostility and stability– to introduce a systemic view of the policy making process through addressing the question of how organisations adapt to changes and shape the environment they inhabit, thus affecting R&D policy making in a circular manner.

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