Policy choices, institutional constraints and policy learning: The Spanish science and technology policy in the eighties

Luis Sanz Menéndez

Instituto de Estudios Sociales Avanzados (CSIC)

Madrid, February 1994
Policy choices, institutional constraints and policy learning: The Spanish science and technology policy in the eighties

Luis Sanz-Menéndez

(with the collaboration of Emilio Muñoz)

Institute for Advanced Social Studies, Spanish National Centre for Scientific Research, IESA-CSIC, Alfonso XII, 18, 5. 28014 Madrid, Spain.

Abstract: The article reviews Spanish science and technology policy in the eighties. It assumes that these policies are not only the result of rational choice processes, but also the outcome of institutional arrangements and political battles. It develops a framework which considers that ideas, interests, and institutions must be part of the analysis and includes insights into the limits that political institutions impose on the social learning process about policies. With this frame it attempts to provide an explanation of the main reasons for the specific choices made in science and technology policy in Spain: Why was it included on the political agenda of the new socialist government? Why were the choices and institutions so much science oriented? Why was there no technology-innovation policy until the end of the decade? What was the dominant policy paradigm in science and technology policy? Which interests were at work? Why was he learning process about science and technology policies so limited?

Keywords: institutions for science and technology, learning about policy, public policy, science and technology policy, Spanish national innovation system.


Biographical notes: Luis Sanz-Menéndez gained a PhD in Sociology and Political Sciences (1983) from the University Complutense of Madrid. Until 1990, he worked in the Regional Government of Madrid, as a Head of the Studies and Research Board in the Economy and Industrial Development Department, where he founded and was director of the Journal Economía y Sociedad. He has been, since 1990, Research Fellow at the Research Unit on Science and Technology Policy - RUSTEP - at the IESA (Institute for Advanced Social Studies) of the CSIC (Spanish National Centre for Scientific Research). He has also been Associate Professor, from 1982, of Political Sociology at the School of Political Sciences and Sociology at the Complutense University of Madrid. Temporarily, 1992 to 1994, Dr Sanz-Menéndez was a Research Associate at the Berkeley Roundtable on the International Economy/Institute of International Studies (BRIE-IIS) of the University of California at Berkeley. His research interests include: R&D and innovation, public policies - specially on science, technology and innovation - and regional analysis. Emilio Muñoz is Senior Research Fellow in biology and biomedicine,
and a member of the Research Unit on Science and Technology Policy - RUSTEP - at the IESA (Institute for Advanced Social Studies) of the CSIC. He served, between 1983-1991, in different managerial positions in the Spanish R&D Administration, as General Director of Science Policy, General Secretary of the Interministerial Commission for Science and Technology and President of the CSIC (Spanish National Centre for Scientific Research).

1 Introduction

This article reviews Spanish science and technology policy over the last decade. It is an appraisal of its evolution rather than a precise evaluation of strategy choices, goal definition, and the tactics for implementing these strategies.

The article sets out to explain the definition of an explicit science and technology policy, and its change over time. The dependent variable of the analysis is science and technology policy, and it refers to government initiatives - for instance R&D programmes, subsidies or credit schemes to encourage technical innovation, tax measures, etc. - explicitly designed to develop, support and encourage science, technology and innovation. Public policies that have unintended consequences for science and technology as well as exclusively private sector science-technology strategies are not considered. Science and technology policy is not analysed only as an ensemble of instruments or measures, the institutions involved are also principal elements of the explanation, because effects can become causes.

The outcome, the specific science and technology policy, that arises from these political choices, cannot be understood only as a result of the rational process undertaken by bureaucrats and politicians at a given time. Specific Spanish institutional structures constrained the goals, the strategies and the choices. The state capacity to define and implement any policy is affected by the institutional framework. The assumption here is that science and technology choices and strategies developed by the state in Spain can be explained in terms of the constraints that ideas, interests, and institutional arrangements imposed on the political process.

Two clear implications come from the analysis: reforms or radical changes are complex, in spite of the will of the reformers, owing to the linkage between policies and institutional frameworks. Times for reform are 'rare', and policy windows close very rapidly. The second one is that reformers had to think very carefully in order to understand the forces at work in the process of recasting the institutional framework of science and technology, owing to the political consequences of their initiatives for the future. Political institutions in support of science and technology development, are a decisive constraint on the future choices for science and technology and for the social learning process about policies.

2 Different approaches to science and technology policy

Freeman points out that scholars, especially economists, have approached the analysis of science and technology policy from different viewpoints. There are diverse views or 'concepts' of what it is about: some see it as a rationale arising directly from economic
theory; others as a group of governmental programmes to encourage science and technology; or as an ensemble of choices and institutions shaping economic performance.

With conventional economics one can deduce a type of policy derived from economic theory that maximizes the collective welfare in terms of a Pareto-Optimum. In this approach, science and technology policies are related to normative economics. Here the interest lies not in how decisions (choices) are made, but in what decisions are made. The right decisions, the 'policy implications', follow naturally from the analysis of the economists. The diversity of the real policies is an irrelevant issue, and this approach does not consider national specificity, either as a constraint or as an encouragement of real policy choices that are compared with those 'ideal types' that the economic modelling produces.

Also science and technology policy means, empirically, governmental programmes, schemes or actions which have been introduced and operated to encourage science and technology or catalogues of instruments to promote science and technology policy.

We also find blends of approaches, classifying the type of instrument of technology policy by its theoretical foundations, or trying to identify national patterns for technology policies.

Particularly interesting for the purpose of this paper is an increasing concern in the last few years among some economists about the institutions for science and technology. A number of researchers have drawn attention to the role of some key national institutions which might explain the diverse scientific and technological performance of different countries. Institutions are independent variables in this approach - which is much more powerful and accurate than the neoclassical one - which nevertheless lacks an overall comprehension, a dynamic view of the institutional settlements, especially the political ones.

**Rationale for intervention**

In each one of these approaches two simple ideas constitute the leading assumptions for the analysis of science and technology policies: (1) science and technology may be subject to planning, and (2) organizations, firms or countries should be able to develop purposive actions in relation to planned science and technology.

Policy means a proposal for deliberate activity to affect the way that organizations or nations work, and policy always expresses intentions (purposive action) to go in one direction and not in another. A 'rational' approach to policy-making is implicit, and consistent with the basic neoclassical assumptions.

For this reason economists are always trying to find a 'rationale' for science and technology policy. Science and technology, in general, are relevant issues of public welfare, but the importance of science and technology for national goals does not imply a need for a policy (support). Economists think that a case for government involvement in science and technology must be based on the argument that private industry, acting in response to market incentives, will under-invest in those activities. Market failure could be a rationale for government intervention, in addition to military or national security considerations. Economic analysis has identified some issues: insufficient appropriability, risk, size of R&D, spill-overs, externalities, that could help to explain why public intervention is needed. But, a rationale for state intervention is not the same as principles for correct intervention.

Towards the end of the fifties, the dominant view about science and technology was
based on Nelson and Arrow. The problem was centred on market failures and their relation to the appropriability of the returns of investments. Technology was equal to knowledge and information, and the contradictions between the production of information and ability to appropriate the results provided the rationale for state intervention. The policy conclusion was that the state should support and protect the production of knowledge, at least basic knowledge, because, given the characteristics and properties of information, the market by itself will allocate resources inefficiently. The incentive systems could be based on the establishment of property rights (patents and other systems of protection) or on the allocation of public resources to the research activity.

In the seventies, and especially in the eighties, another approach to technology started to develop. Instead of concentrating on incentives the problem arose from the dynamic properties, the interdependencies of the technological diffusion process. According to this view technology has two sides, one is codified knowledge, that is easily replicated, and the other is tacit. The first can be reduced to information, while the second corresponds to capabilities embodied in individuals (skills) or organizations. In the process-oriented framework, the policy problem is not one of incentives, but one of interdependencies to help the transformation of knowledge, from basic to applied and from codified (generic) to tacit (specific). So the problem is more one of diffusion than of production.

The policy conclusions from these research programmes are different, but complementary. When processes of diffusion and interdependence encounter incentives and organization systems they generate a coherent dynamic, making technology a source of the Wealth of Nations.

3 Science and technology policy as an institutional outcome

A rationale for policy defines the reasons for public involvement. But policies are the outcome of specific processes - policy-making processes - that are political and are institutionally constrained. Choices are taken from ideas, and these ideas about policy are 'arranged' or 'organized' in policy paradigms. Other elements must be included in the analysis of the outcomes, such as policies and political institutions; interests and institutions also constrain and shape the policy choices taken and, by enhancing or inhibiting the social learning about public policy, the policy change.

In the following I will concentrate on some specific outcomes, science and technology policies, that will be the dependent variables. The ideas of economists, or policy-makers, are part of the inputs for the design of public policy, but government policies can only be understood in the light of the political and economic processes from which they develop.

First we must develop some analytical framework about the origins of science and technology policy. The adoption by one country of an explicit science and technology policy could be viewed - as dual opposites - as the result of some socioeconomic preconditions or the effect of an international diffusion process.

There is no doubt that below a certain level of economic development there are no opportunities for science and technology policy. The threshold of economic development should be visible, in the field of science and technology, through the existence of groups
of scientists or firms with social influence.

Countries which adopt science and technology policy early, can produce ideas and innovations, but latecomers to the field will try to imitate choices already taken by others: world leaders, innovators, or neighbours (patterns of hierarchical or geographical diffusion can be identified). 17

By defining the problem in terms of national vs. international factors we could accept that international dynamics is an important factor in the adoption of policies as a model of actions by countries. But, if this environment defines the parameters and the opportunities, the national institutions constrain the real choices and shape the policy outcomes.

In an attempt to explain the adoption of ideas and policies by countries, three hypotheses 18 may be considered: The first one stems from the action of a professional rationale. 19 Economists or other planners determine what is a relevant issue, and then the idea diffuses through international organizations, professional and academic societies. Later on, the ‘diffused’ idea is adopted by governments because it is rational. A possible and simple explanation for the questions of different timing between countries lies in the distinct capabilities of the national actors, economists or planners, involved in the process, although the reasons for carrying out different types of policy remain as yet unanswered.

A second hypothesis concerns the relevance of some social groups, 20 particularly the scientists and/or firms. This relative relevance allows for the possibility of building a social coalition of interest around issues related to science and technology to introduce them into the political agenda. This view would explain the support and the speed of adoption, but it does not tell us very much about the specific configuration of a science and technology policy - although its orientation to science or technology would depend on the relative weight of scientific or business communities - unless we accept that the state acts by simply reflecting the societal balance of forces.

A third hypothesis, referred to as political, 21 accounts for the role that administrative problems play in the policy-making process. Adoption of policies will be influenced by the institutional configuration of the state and its prior experience with related policies. The state will be predisposed toward policies of which it already has some favourable experience, and even the demands of political parties and interest groups may be based on their conception of state capacities and existing policy legacies. This view could help to explain the variability of science and technology policy configurations, but not which policies are to be adopted or the generation of new policies.

In conclusion, science and technology policy is a product of ideas (generic or specific propositions of normative character arising from economists or other planners as a 'rationale', as well as from scientists and firms as an expression of their 'interests'). It is also the outcome of policy and political processes resulting from the conflict of interests, fights and compromises. An explanation of science and technology policies - generation and adoption - should not rely on any one single hypothesis: 'rational', 'social coalitions', or 'political structures and capabilities'.

As we have already said, our idea of policy is strongly linked to the institutional framework. At this point, the introduction of a 'middle range' concept such as that of institutions helps to establish an intermediate path between a macroglobal explanation and microbehavioural one. 22 The definition of institutions, in broad terms, includes both formal organizations and informal rules and procedures that shape their conduct. 23

Institutions constrain and refract politics, but they are never the only 'cause' of
outcomes; other forces are involved. Institutions shape how political actors define their interests and structure their relations of power to other groups. Institutions structure the political battles, and in doing so influence their outcomes. As a consequence institutions produce regularities in the results, and can help to understand policy continuities over time within countries as well as policy variations across countries. Institutions matter because they constrain the choices available to the actors and help to define their interests, but they also shape the distribution of power among them. However institutions, not being the rational construct of the actors, are also an outcome (conscious or unintended) of political choices and strategies, political conflicts and, usually, the outcome is a political compromise.

The institutional framework is heavily path dependent, helping to explain the continuities. Institutions, like living organisms, adapt and change. The institutions, and among them those of science and technology, are not built for ever, they constrain, but also they slowly change, they adapt to new environments and new situations through two major processes: organizational search and external pressures. There are different institutional dynamics: slow processes of search and transformation in institutional arrangements (e.g. latent institutions become salient; old institutions are put in service of different ends with new actors; when there are changes in output, old actors adapt); along with big changes, which are produced regularly in specific periods and times at critical junctures.24

In the institutional world there is no general efficient equilibrium, only 'local equilibriums', or for analytical clarity in stability terms, a 'punctuated equilibrium'.25

Policies and institutions change, and one of the modalities of adaptation is learning. Politics is not only 'power', it is also 'puzzle' and much political interaction constitutes a 'process of social learning expressed through policy'.26 In a general sense, learning can be taken to mean a relatively enduring alteration in behaviour that results from experience; usually this modification is conceptualized as a change in response (made in reaction) to some perceived stimulus. Social learning could thus be defined as a deliberate attempt to adjust the goals or techniques of policy in response to past experience and new information'.27 There are different types of learning process, about goals, policy instruments or precise settings, and they accumulate in different ways into the policy paradigm. In relation to learning processes about policies, there are factors to be considered: history and context,28 the agents (experts, politicians or bureaucrats) of the learning process, and the institutional locus of the learning process.

We will consider the policy-making process whereby policy choices are taken as driven by ideas in terms of policy paradigms and institutional constraints. We will also see the building or recasting of political institutions as compelled by power (political battles) and institutional constraints.22 The political institutions for science and technology 'puzzle' (contribute to the accumulation of social learning about policies), but also they 'empower' (structure the political battles, and in doing so influence their outcomes). Public policy is a way of intervening in science and technology by the state. The state, central to this analysis, acts in its own right to model the economy29 through 'regulation of property rights' and 'allocation policies'.

The state is very relevant for science, technology and innovation performance. It can recast the institutional bases that define the parameters - incentives, opportunities and constraints - of the game in science and technology. Also, the way the state organizes its policy-making capabilities, i.e. the political institutions in support of the science and
technology, is important because it determines the locus for the social learning process about policies. The political institutions in ‘support’ of science and technology (policy-making bodies) have the ability to ‘manipulate’ the entire institutional system (rules, incentives, etc.). They are relevant in organizing the social learning process, as this is a condition for the development of the capabilities to adapt institutions to new situations and changing environments and the ability of the institutional system to reproduce itself. In our view one of the features of ‘appropriate’ political institutions in order to ‘maximize’ the learning process and the ability to adapt, is the degree of ‘policy coordination’\(^{30}\) of political institutions that intervene in science and technology policy.

4 Science and technology on the political agenda: Recasting Spanish institutions

Within this framework of analysis, our purpose is to explain the main factors which inspired science and technology policy in Spain, and the building of the political institutions in support of science and technology.

At the beginning of the eighties the main characteristic of the Spanish system of innovation was its weakness and underdevelopment. For example, in 1981, gross expenditure on research and development (GERD), almost stagnant from the beginning of the seventies, was 0.39 per cent of Spanish GDP, and most of the science and technology activities were performed by public agencies.

At the beginning of the seventies the OECD\(^{31}\) advised Spain to make more efforts in science and technology, but the commitment of the Spanish Government was very weak. No attempts to improve coordination in science and technology or to define a serious developmental strategy were made in those years by the state. The only institution established to ‘coordinate’ research activities was an Advisory Committee on Scientific and Technical Research (CAICYT), established in 1958, and provided with a National Fund during the sixties, to support research in a way which replicated the US National Science Foundation model. This CAICYT was first dependent on the Ministry of the Presidency of Government, although the responsibility went later to the Ministry of Education and Science, which was the administrative and political ground of the biggest performers of R&D in those years: universities and the Spanish National Centre for Scientific Research (CSIC). Much later, in 1978, the Centre for Industrial Technological Development (CDTI) was created, with a loan from the World Bank, addressing its activities to promote technological development by private firms.

There were few opportunities, between 1975 and 1982, for public action in science and technology. In that period the main problems on the political agenda were the transition to democracy and the economic crisis. The first priority was to solve the political issues before starting to think about other topics. The lack of mention of science and technological development in the 1978 ‘Pactos de la Moncloa’ - the national agreement for the transition to democracy - was an example of the low priority given to it.\(^{32}\)

The science and technology problem had existed for a long time, but no effective actions were launched by any government. The general socio-economic prerequisites, the ‘minimum socio-economic level of development’, that played the role of threshold effect for the adoption and development of science and technology policies had been achieved years before. The academic and scientific groups had reached a sufficient size to have
active interests in relation to science and technology, although they were not well organized. However not many firms were concerned about these issues in those years.

After the victory of the Spanish socialist party (PSOE) in the October 1982 elections, the situation changed in terms of discourse, actions and initiatives: science and technology were entered on the political agenda. The adoption of explicit actions in science and technology by the Spanish government have to be explained by the hypothesis outlined before: the diffusion of ideas, the building of social coalitions and specific political processes were at work.

These new ‘concerns’ about the situation of science and technology in Spain were expressed in the political programme of the socialist party. The policy initiatives in science and technology were undertaken within a broad programme of modernization that inspired political action. This gave science and technology access to political initiatives from the government. Many members of the government and the PSOE were university professors, and so had ‘a personal interest’. The political discourse of modernization was also trying to solve historical Spanish problems. Thus the first years of the socialist government opened a process of recasting many institutional arrangements - sectoral specific - and one of these fields was science and technology policy.

The influence of policy entrepreneurs working for the socialist Government was a principal element of the process; the search for rationality, the desire for coordination, were part of the ‘culture’ of the new policy-makers. The action of these policy entrepreneurs could be described in terms of interest and rational ideas to solve national problems. But they were working within political structures of the same fragmented and 'clientelistic' framework that characterized the francoist public administration.

The problems of Spanish science and technology were there, also the ideas and models (the policy paradigms) of how to intervene. Special interest gravitated toward more active support, but it had to wait until a political party could put the issue onto the political agenda within the government to find a way to put together the problems, the interests, and the solutions. That process in Spain resembles much more the ‘garbage can’ theory of decision-making, than a rational choice model.

5 **Puzzling and empowering: choosing policies and building political institutions**

Public action in science and technology was aimed at correcting structural problems that were considered the most acute by the policy-makers. The strategy was concentrated mainly in the Science Act, passed in 1986, and in the R&D National Plan, first issued for 1988-1991. The Science Act was a landmark in the regulation (redesign) of the Spanish science and technology system; it was intended to provide the foundation for solutions to the chronic weakness of the scientific and technological base. In the preamble to the Act, the legislature defined this weakness as ‘a lack of social stimuli, deficiencies in the instruments to guarantee the efficient intervention of the Public Institutions to programme and coordinate the use of the scarce resources available, lack of connection between the research objectives and the related sectoral policies and between the research centres and the productive sector’.

The main actions proposed to deal with these problems were the increase of R&D funds and the improvement of co-ordination between all bodies involved in the
formulation and implementation of research and technological development policies. The two tools defined in the ‘Science Act’ to achieve the aims of promotion, co-ordination and rationalization were: the ‘R&D National Plan’ (composed of R&D programmes, such as microelectronics, new materials, biotechnology, etc., that gather the lines for R&D activity), and the Inter-Ministerial Commission for Science and Technology (CICYT), a political body to define and propose the National Programmes and their budgets.

By following a chronological path, in what follows we will first address the analysis of the designing and building of political institutions for the development of science and technology, and later the particular configuration of science and technology policy, their aims and instruments, the content of their programmes. The political battles around the configuration of political institutions occurred mainly in 1985, while the debates about the design and contents of the policy came later, in mid-1986 and 1987.

Political institutions for coordination

In the diagnosis of the problems of Spanish science and technology, a principal role was granted to the absence of structures and procedures of public policy coordination. Using this argument some of the actions of the policy entrepreneurs were directed to changing the patterns of ministerial distribution of authority over R&D activities.

Some of the policy innovators were in favour of the creation of a Ministry for Science and Technology, that could concentrate and coordinate strategy and public actions. This proposition was a clear attempt to change the authority allocation. But while policy makers or specialists are focused on the substance of policy and on the consequences of different arrangements for outcomes in the policy area, politicians (specialist or nonspecialist) concern themselves with more immediate political problems: who takes jurisdiction, who can take the credit, and, more remotely, to whom an innovation grants power and other resources. The allocation of state authority over R&D activities became a power struggle.

When the issues are ‘political institutional innovations’, as those proposed, a bargaining process with other areas of Government and interests always occurs. Spanish politicians did not see the ‘opportunity’ for a solution to the coordination problem in terms of a Ministry for Science and Technology, and they compromised with (inside the Government) this institutional framework: the Interministerial Commission for Science and Technology (CICYT).

The CICYT has a dual structure: one political, with representation of the main ministries with R&D (science and technology) activities and competences; and the other an administration based on the Ministry of Education and Science. The CICYT never developed a long-term bureaucracy, because appointments to the positions were mostly temporary for university professors and researchers.

The hierarchical level granted to the CICYT was a General Directorate. This was criticized by the OECD, because such third level institutions cannot guarantee either the coordination or priority setting of science and technology matters in the government agenda.

The policy-makers' expectations concerning the CICYT's capacity for political coordination were supported in the National R&D Plan and the ‘National Fund for R&D’. Prospects for guaranteeing the coordination of objectives in policy terms were boosted by the expectations of growth of the National Fund for R&D (management and controlled directly by the CICYT), and the simultaneous reduction of the sectoral R&D programmes
Policy choices, institutional constraints and policy learning

(ministerial funds). In this situation Ministries should have a strong incentive to participate and cooperate inside the CICYT.

**Policy choices for science and technology**

While the controversy about the political model for the coordination of public initiatives was relevant, not much debate or political argument occurred *vis à vis* the content of science and technology policy.

The policy-makers shared a policy paradigm, that we could call 'a linear model of innovation'. This had some implicit components as aims and instruments, which contributed to policy choices. And the policy choices fit the dominant interests in new political institutions for science and technology. We will characterize the general features of science and technology policy, and in that way the dominant policy paradigm:

1 *More oriented to science than to technology*: In the overall actions of government and in the policy choices, science appeared more a priority than technology. The majority of the new funds that the R&D National Plan raised were for scholars in the 'scientific' field at universities and research centres. Also the actions of redefining institutional rules for actors in the science system were more systematic: a University Reform Act (LRU) was approved early in 1983 to give self-government to the universities; a huge increase in real incomes for professors; economic incentives for academics to work as contractors for firms or other branches of administration; etc. Less relevant was the support for the technological development of industry, that in those years had some sectoral actions such as the National Programme for Electronic and Computer Industries (PEIN), or changes in the regulatory environment of the R&D activities of firms.

2 *More oriented to production of science and technology than to diffusion*. The policy choices were driven by the idea of producing new knowledge more than the idea of imitating, diffusing and using knowledge available. This approach was the inheritance and central core of the 'linear model' and was pervasive in the science and technology policy.

3 *More oriented to 'high tech' industries than to 'mature' ones*: The policies concentrated more on knowledge connected to 'new' technologies and high-technology sectors - where Spain never had any competitive advantages - than on the mature ones, where Spanish firms and scientists have traditionally been stronger. From an industrial viewpoint science and technology policy was not neutral because it represented a discriminatory strategy against 'mature' sectors of the Spanish economy.

Those were the basic elements of the policy paradigm of the Spanish policy-makers. The aim was to 'produce more', to increase R&D resources and personnel, regardless of the results. And the instruments used were mainly different types of financial incentives (grants for researchers in universities or public laboratories, subsidies and credits for industries, etc.) granted to develop 'R&D projects'.

This strategy and associated policy choices, although cheered by many social actors, appeared controversial in terms of the national capabilities and economic development opportunities. Only the labour unions (CCOO) which were ideologically connected with the communist party and some regional governments ruled by 'nationalist parties' (in the Basque Country and Catalonia), with a strong link with small and medium size industrial capital, criticized the R&D Plan. Nevertheless they agreed with the general idea of introducing science and technology into the political agenda.
6 Ideas, interests, institutions and the political process

How do we explain the specific outcomes (policy and political institutions for science and technology)? We have already argued that interacting rational actors are not enough to explain the phenomenon. A complex set of ideas, interests and institutions have to be introduced, as critical elements, but we also need to revalue them within history and context.

Process timing and historical context are relevant factors. In other developed countries after some years of science policy the emphasis of policy appears to turn to technology and innovation. In Spain, a latecomer to science and technology policy, policies were developed in the same period, in a complex equilibrium, coinciding with debates on the major reallocation of public authority (coordination).

Policies on science and technology were produced by policy entrepreneurs with the political impulse of an electoral victory, but in relative isolation from social agents. These policy entrepreneurs were not professional policy-makers, just amateurs. In terms of the policy paradigm they adopted the dominant ideas available: the 'linear model of innovation', which is very much science oriented. In the mid-eighties strong criticism developed against this model, but it fitted perfectly with the interests of the Spanish policy entrepreneurs (university professors and researchers from the public sector).

However a policy paradigm, as a 'paradigm', has 'practical models of action', and those to be imitated were coming mainly from the R&D Framework Programme of the European Community. As history shows, policy-making always copies and imitates processes and 'scholarly entrepreneurs and organizers paid close attention to other countries'. Adoption or imitation of policy paradigms was a way to legitimate actions and initiatives. Copying from the leading country or the most successful model grants you some legitimacy.

The policy outcome was a mixture: the 'science orientation' coming from the linear model policy paradigm and the dominant scientific interests; the R&D National Plan as an ensemble of programmes coming from the European Community R&D Framework Programme; and a selection process of R&D projects that was influenced by the ex ante evaluation procedures arising from the US NSF traditions, which have been applied in the Spanish CAICYT.

One cannot avoid the question why the firms’ interests appeared so passive in the definition of the contents of science and technology policy. Some elements of the explanation are: the relevance in the industrial sector of public owned firms, the dominant position of the banking sector (which does not always share the interests of the industrial firms) in the Spanish economy and, the joint presence of local manufacturers and importers in the industrial associations. The 'high tech' oriented policy matched a group of interest and firms, companies that had not been very competitive in the international arena, but had access to their public clients (phone companies, Ministry of Defence, public television, the Ministry of Health, etc.). In that period, procurement policies were considered as a way of supporting national manufacturing and as a strategy for technological development in defence industries. Also, the more mature and traditional sectors were less organized and less represented in the central business association (CEOE).
The past legacies as constraints

Policy entrepreneurs were working within policy paradigms, but they performed their job in an administrative context where institutional legacies have also modified and redefined their actions.

The track of the past was in the policy contents and in the absence of real selection of priorities in the R&D National Plan. The later justification of the real lack of priorities was the idea of ‘sowing the seeds’. The process of designing the new science and technology policy was done inside the old administrative structures of the CAICYT. The old advisory commissions (‘ponencias’) organized by disciplines worked as pressure groups in defense of their ‘areas of research’. The policy bias towards some areas or disciplines could be understood in ‘clientelistic’ terms.

The CICYT was presented as a completely new political institution for the promotion, design and coordination of science and technology; but, the past legacies were present in the configuration of the CICYT, which resembled the old CAICYT and not only in name.

In terms of its abilities to coordinate policies, the weakness appeared very soon. CICYT was in charge of the ‘coordination’, but at the same time was one of the agents of implementation; other agents were the CDTI and other ministerial departments. The institutional structure of science and technology policy was presented as coordinated, but in practice it was under the hegemony of the views of scientists and academics. In political terms, the ability of the CICYT to enforce ‘coordination’ was only possible if strong political commitment from the government to science and technology policy was continued, together with the same policy view in the R&D National Plan.

The regular working of the government does not easily allow the incremental concentration of funds from different Ministries into the National R&D Fund. Also, as the situation has evolved and political priorities have changed, from 1989-1990, a faster increase in the amount of resources for other sectoral scientific and technological activities - not coordinated by the CICYT – has occurred. The instruments for coordination did not work.

In the same context, the amount of money allocated to the National Fund stagnated and continued to be managed by scientists (appointed by government without accountability or external evaluation procedures); also an increased tendency to reserve the National Plan only for ‘scientific’ purposes can be detected; not to mention the ‘clientelistic’ tendencies and the management ‘capture’ of some of the programmes by groups of scientists. A second edition of the R&D National Plan, 1992-1995, has been approved, and no relevant change has been introduced in the model, priorities or instruments. The scientists managing the CICYT system thought that science was the only national priority, and that the money should be used only for their activities.

For the policy-makers of the CICYT, industry was almost marginal, a place where scientists should go to ask for more revenues, not a strategic place for science and technology activities. This subordination of industry in the overall strategy contrasts with the tendencies existing in Europe and elsewhere.

Political games in government and bureaucracy

Why did this view of science and technology policy consolidate and in what context? The policy choices and the political institutions built were also influenced by the context, by the specific political process that happened then, inside the limits of past legacies.
In the formative years of science and technology policy, different ministries and administrative bodies could have played a significant role, including the Ministry of Defence that defined its own strategy almost without limit and constraint. In the Spanish case, the Ministry of Economy and Treasury is usually not interested in specific policies. This ministry works in practice like the vice-presidency because it includes finance, treasury, economic planning and budget.

The Ministry of Education and Science controlled the universities and the most important research centre (CSIC). In those years the ministry had a great political influence; the minister was a member of the executive committee of PSOE, had easy access to the president, and appeared as a jacobin 'rational' reformer.

The Ministry of Industry and Energy had in those years some instruments for action in technological development (the CDTI), and the institutional and bureaucratic relation with the firms. But in the agenda of that ministry the main issue was industrial restructuring (Reconversion Act) and the negotiation of specific terms for the process of Spain’s entrance into the European Community, signed in 1985. Also one occurrence, a ministerial crisis in mid-1985, produced a change of minister. The 'newcomer' arrived with new ideas and concerns about science and technology, but without any specific political weight. It was the moment for the institutional configuration and final negotiation of the Science Act; the cooperation between the Ministries of Education and Industry was strong, but the initiative of the process was in the hands of the education policy-makers. A new change of Minister of Industry made more difficult the rapid reorientation of activities.

There was political strength in Education and weakness in Industry. A team of policy entrepreneurs in Education and Science, almost all university professors, with a policy paradigm and their personal interests, helped to define a very active policy in that area and to dominate the first design of the science and technology policy, in terms of choices and in terms of political institutions.

7 Learning about policies with institutional constraints

After the Science Act and the National Plan the policy orientation was mostly dominated by science and scientists, in a world of increasing focus on technological and industrial policies. The political institution for 'coordination' had a low capacity of enforcement. At the same time its management was 'dominated' by scientists and academicians.

Probably the 1986-1988 overall design of public action in science and technology was 'doubly' unadapted: it was too science-oriented at a time when economic returns from investments in science and technology were demanded. And too much production-oriented in a country without scientific significance or industrial strength in new technologies.

External pressures to adapt the science and technology policy started almost immediately. The successive R&D Framework Programs of the EC, with more emphasis on technological development by industries, were clear elements. Social learning processes about policies were at work, but colliding with the management of the CICYT.

Policy-makers always try to learn about policies. There is a regular process of social learning inside the policy paradigms. But what would happen if the lessons to be learned, say more technology policy, do attack the interests of the groups that manage the CICYT system? Probably they will not like to learn and they will mainly show their seeming
success.

The new political institutions in charge of coordination (CICYT) could help to block the process of change of orientation to technology, because the new institutions had contributed to building new interests (those of academic researchers), and new clients in the policy-making process organized around this way of management of the R&D National Plan 45.

The process of social learning about policies does not seem very efficient in the institutional ‘locus’ of the coordinating CICYT, probably also because the policy-makers were not professional bureaucrats. In the CICYT no change of emphasis in the objectives or aims of policy was proposed. In this situation only a first level of learning, around precise settings of the instruments, could happen.

The Science Act recognized the role of the Centre for Industrial Technological Development (CDTI) in the implementation of the technology policy in relation to firms. The CDTI also served as a channel of communication for the Ministry of Industry with the most relevant experience of the EC R&D Framework Programme. The policy-makers from the Ministry of Industry developed a learning process from others (participation in ESA, R&D Framework Programme, Eureka Programme, etc.) and learning by doing (PEIN that started in 1984) that helped to adapt the Spanish policy choices to the European environment, and become more technologically and industrially oriented.

But if the learning process of policy-makers was at work in the technological area, the political institutions just built avoided the opportunity to reform, change or adapt science and technology policy. Also, the battles between departmental bureaucracies around the ‘responsibility’ for the policies were very common in a public administration with a tradition of fragmentation.

By the end of the eighties an increased number of ministries and public agencies, not to mention Regional Governments, that the CICYT had been unable to coordinate, started or continued to develop science and technology programmes or activities on their own: as the Research Fund in Health (FIS) or, the Programme of Action in Industrial Technology (PATI) launched by the Ministry of Industry as a way of organizing different sectoral programmes, although the coordination discourse of the National Plan and CICYT is kept alive.

But in practical terms both policies (science and technology) started as clearly competing policies in terms of aims, but also in terms of clients, especially in the programmes to boost the cooperation between academic research and firms. Whatever the reasons for the growing relevance of the technological side of policy, in institutional terms, the independence of technology policy means that Spanish science and technology policy has moved away from coordination strategies. A recent step in the ‘decoordinating process’ or, as we could imagine, in the creation of the new political institutions for science and technology, arrived in mid-1992. The approval of a new ‘Industry Act’ recognized the capabilities of the Ministry of Industry to define an independent technology policy coordinating it with industrial policies.

If the stress of policy has moved from science to technology, the emphasis of technological policy is still innovation production oriented. That means that the ability to learn about technological policies is limited; the policy paradigm that still remains dominant in Spain is ‘production oriented’, more than ‘technology oriented’.46 It is possible to observe a ‘pendular’ movement towards technology policy that reveals problems of consistency in the public management of science and technology policies.47
and is also due to the fact that the different actors and logics involved could push the choices to the pure arbitrary balance of political power between Ministries. Science and technology sides of policy are each as relevant as the other, and there must be support for each, with specific national balance.

If the theory of social learning about policies is correct, a change in the locus of authority for science and technology policy could presage a change in the policy paradigm. However this former type of change usually comes after the policy paradigm becomes the object of political argument. Who could help in the challenge? Some areas in the central administration (that helped to start the movement to more diffusion oriented policies in the Ministry of Industry), the 'mature sectors' of industry, the regional governments, or new policy entrepreneurs (copying some models that bureaucracies of small countries developed or the new insights of some programmes of the EC bureaucracy of Brussels). The outcome depends on the ability to mobilize a sufficient coalition in the political arena.

8 Summary and conclusions: Policy learning and appropriate political institutions

Policy-makers usually share a policy paradigm, and in the policy-making process they develop different types of social learning process, that is they adjust the goals and instruments of policy to experience and new information. But ideas are not the only ingredient of science and technology policy. There are social interests that play important roles, especially in critical junctures while recasting institutional settlements. Policy-making, design and implementation, is a politically shaped process, and political institutions and state capabilities are important constraints on the choices available to policy entrepreneurs. An appropriate policy not only depends on agents (firms, research centres, etc.) doing science and technological activities, but their relations are also determined by the type of political structures that the state builds to regulate and to support them.

We have looked in this paper at science and technology policies as an outcome, not just as a normative result. The theoretical question is concerned with how politics and political systems could shape rational policy for encouraging science and technology, and how national institutions could define different limits for effectiveness and efficiency of science and technology policies.

The analysis of Spanish science and technology policy during the eighties has demonstrated important implications: First, while the problems of science and technology in Spain were identified many years ago, they had to wait until a critical juncture to enter the political agenda. The victory of the socialist party gave rise to an interest in promoting specific actions in the field of science and technology. This means that the timing of the adoption of the policy could best be explained by social forces, by the interest that erupted in the political arena with the socialist party.

Second, this does not explain the specific configuration of policies and political institutions to support science and technology. Some policy entrepreneurs (armed with the 'linear model' of innovation, a policy paradigm which fitted their interests) played the role of putting together problems, solutions and interest, as in 'garbage can' models of the theory of decision-making.

Third, the ability of policy makers to define solutions was very much shaped by the
legacies of state policies and by the political context of these years. And the institutional solutions adopted for policy coordination were very determined and bargained on those years.

Fourth, the content of policy was more production-oriented than diffusion-oriented, in accordance with the policy paradigm, and was also more science than technology oriented, fitting the interests of the policy entrepreneurs that promoted and controlled these processes.

Fifth, the political design of policy coordination, failing to concentrate the authority over R&D in a specific locus, was very much captured by scientists' interests.

Sixth, politics and policy-making not only represent power but also learning. From the implementation of sectoral policies (learning by doing), from the development of the R&D Framework Programme (learning from others), and from a changing international policy paradigm, the Ministry of Industry developed a process of incremental 'readjustment' of the concrete settings and the instruments, moving the emphasis to technology policy, in accordance with international tendencies. The political institutions (CICYT) in charge of coordination did not develop such a social learning process due to conflicts with the interests of their managers. That meant that under the institutional political configuration, which gave the control of the R&D National Plan to the scientist, the capabilities of learning about policies were very limited.

Finally, by the end of the eighties and beginning of the nineties the legitimization of the CICYT as an authority locus had started to be reduced, because the changing political balance in the Spanish Government. Its policy coordination failures, and an increased 'trial and error' of science and technology policies is on course in many departments, agencies, and regional governments. But still the majority are working inside the old policy paradigm: produce more than diffuse.

If this analysis is correct only a sharp change in the balance of political power could probably give rise to a more 'appropriate' policy balance: towards emphasising use, the application, diffusion and on creation sophisticated markets, on the one hand, or promoting directly the development of particular products, technologies or suppliers firms on the other.

If our interpretation is correct we must say that the Spanish science and technology policy of the mid-eighties was not as radical a reform as policy entrepreneurs thought. And one can still wait for a more radical change in the science and technology policy area, in spite of the reorientation, at the beginning of the nineties, towards a more technologically oriented policy.

It is worth remembering, at a time of interest in recasting institutions to improve economic performance, the importance of understanding how social learning about policies and how the configuration of institutions affect this process could not be greater.
References and Notes

1 For helpful criticisms on earlier drafts of the article, I am grateful to Benedicte Callan, Stephen S. Cohen, Benjamin Coriat, Jacques de Bandt, Giovanni Doisi, Clara E. Garcia, Ulrike W. Hodges, Richard Nelson, Ludolfo Paramio, Jorgen Wettstead and David Wield, and to the participants in a presentation at the Institute of International Studies in the University of California at Berkeley for comments and suggestions. Of course, I am responsible for the article’s remaining deficiencies. Financial aid was provided by the Spanish Ministry of Education and Science (General Directorate for Scientific Research), and institutional support facilitated by the University of California at Berkeley. Also, help and friendship was furnished by the people of Berkeley Roundtable of International Economy (BRIE), and Institute of International Studies. Thanks to Barbara and Charles Hadenfeldt and the editor of JJTM for English editorial assistance.


Policy choices, institutional constraints and policy learning


30 Brickman, R. (1979) ‘Comparative approaches to R&D policy coordination,’ *Policy Sciences*, vol. 11, no. 1, August, pp. 73-91.


33 The PSOE represented the arrival to the political arena of new social forces, new generations. PSOE most active member’s were middle class ‘educated’ people: civil servants (university professors, researchers, teachers) or liberal professionals (lawyers). Also a historical link with a labour union (UGT) helped to give the PSOE strong support from the working class.

34 The Prime Minister, Felipe Gonzalez, in the preface to a book, emphasized the importance of science and technology, ‘to face the challenge of technological renewal...is the final indispensable step for the success of the modernization process’ and that ‘the Government is prepared to place our nation firmly in the third industrial revolution.’ (In Castells, M. et al. (1986) *Nuevas Tecnologías. Economía y Sociedad en España*, Madrid, Alianza Ed.)


47 de Bandt, J. (1991) ‘Alternative approaches to developing national technological policies,’
Policy choices, institutional constraints and policy learning

International Journal of Technology Management, Special Publication on the Role of Technology in Corporate Policy, pp. 245-255.