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(Proposal by the Scientific Community to boost Science in Spain)



The structures and instruments of science policy

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Summary

This paper considers the structures and instruments of Spanish science policy. It contains seven sections, in which many suggestions for improvements are presented. Nineteen of these suggestions are formulated as proposals.

The high figures involved in the public funding of research are discussed in the first section.

The proposals are:

- Maintain existing commitments and increase the central government's R+D budget by 25%. Moderate use of Chapter 8.
- Bring about comprehensive agreements between the different political forces to make science policy more stable.
- Make (triennial) *ex-post* evaluations of public R+D efforts.

Project policy is analysed in the second section. This is one of the basic instruments for government action in the research sector.

The proposals are:

- Increase project funds by a minimum of 25% per year over the next four years.
- Substantial improvements to project policy should be made by: increasing the rigour of *ex-ante* and *ex-post* evaluations, increasing the stability and publicity of calls for proposals, linking funding to the size and quality of groups, increasing overheads, increasing the flexibility of fund management by groups, encouraging interdisciplinarity, promoting European and International coordination.
- New kinds of more structural programmes should be created: strategic funding for conso-

lidated groups, for centres and networks of (real) excellence, and for highly demanding doctoral programmes.

- Create a special programme for updating research infrastructures.
- Promote specific programmes that combine research with business innovation.

The third section looks at the public institutions that undertake research, including: CSIC, hospitals, and universities.

The proposals are:

- CSIC should be reformed to increase its scientific strength and its relationship with other agents in the Spanish science and technology system (particularly universities). The administration of CSIC's central structures has to be streamlined. In addition, its authority and management capacity should be significantly decentralised, giving more responsibility to centres and institutes, which should have their own legal status, boards, strategic plans, and clearly defined, strong scientific directions. Such centres and institutes should also be subject to periodic assessments by external scientific committees. CSIC researchers (of any nationality) should be offered indefinite employment contracts.
- Encourage research, and in particular clinical research, in the national health system's large university hospitals. A scientific career in hospitals should be defined and established. Funding programmes for clinical research should be developed and philanthropy encouraged. Thematic research institutes should be created, and research institutes connected to

the pharmaceutical industry. The role of the university should be increased, especially in postgraduate- and doctoral-level education

- Regarding research in a university context: teaching and research should be combined more efficiently, organisational structures should be made more flexible, overheads increased, and attention should be paid to the characteristics of consultancy activities and issues related to intellectual property.
- Aspects of funding for science parks should be considered.

In the fourth section, we propose giving impetus to policies for special programmes and large-scale facilities. The proposals are:

- A long-term policy of special programmes on scientific and technological subjects should be defined and developed. The subjects should be of strategic importance and have expert management.
- There should be a budget heading for the general programme of large-scale facilities.
- The *Comité de Grandes Instalaciones* (Large-Scale Facilities Committee) should be revitalised and strengthened.

The fifth section superficially analyses some of the important topics related to coordinating the central government's R+D policies with those of the regional governments.

The sixth section looks at National Plans and topics related to the organisation of the State's central government with respect to science policy. The proposals are:

- Consider attaching the CICYT to the President's office. At the same time, a vice-presidency occupied by the Minister of Education and Science (i.e. the ministry that has the predominant responsibility for research) could be introduced.
- The creation of a Ministry of Science, Technology, and Universities should be attempted in the medium-term.
- An advisory parliamentary office for Science and Technology could be created.

Finally, the seventh section proposes the immediate creation of a Research Funding and Evaluation Agency (or Committee). The aim of this is to avoid hampering the management of science policy and to follow international models. More specifically, the proposal is:

- Develop an agency (or committee) for evaluating and funding research as soon as possible. This agency would be dependent on the Ministry of Education and Science and include: the *Agencia Nacional de Evaluación y Prospectiva Nacional*, ANEP (Evaluation and Long-Range Planning Agency), the *Comisión Nacional Evaluadora de la Actividad Investigadora*, CNEAI (National Committee for the Evaluation of Research Activities), the *Fundación Española para la Ciencia y la Tecnología*, FECYT (Spanish Foundation for Science and Technology). It would also assume responsibility for all the National Plan's project and human resources policies that are currently directly managed by the Ministry of Education and Science. In addition, it would be responsible for overseeing any new initiatives in these fields.



Public funding of research

R+D figures for Spain

The term “R+D” encompasses activities defined in the most developed countries as accounting for the main driving forces behind economic growth. The growth of a country depends to a large extent on its scientific and technological potential. This can be measured by different internationally standardised indicators. In general, such indicators consider both input into R+D activities and the results. Input indicators include: total R+D investment, relative R+D effort (measured by the number of scientists and technicians as a proportion of the workforce), or R+D investment as a proportion of GDP. Indicators of scientific output include documents and other such scientific products (particularly articles in internationally approved scientific journals), and patents.¹

The ideal instrument for assessing a country’s research potential would therefore be a list of indicators that together clearly reflect the level and variability in scientific input and output factors.

R+D investment

The *Instituto Nacional de Estadística* (INE) is responsible for producing official data on R+D activities in Spain. Since 1964, it has regularly published a statistical study on R+D activities, in keeping with the criteria recommended by the OECD in the *Frascati Manual*.²

A general overview of Spanish R+D investments’ high figures is presented below. These figures are based on INE data. Some of these figures have been simplified, and only a limited number of graphs and tables are presented. This was considered preferable, despite the resulting decrease in precision and detail.

Table 1 and Fig. 1 refer to actual amounts, whereas Fig. 2 and Table 2 refer to funds budgeted for by the central government.

Table 1 presents total R+D investment (we prefer this term to “expenditure”, the word used by the INE) in 2003, the year in which the latest data were available. It differentiates between sectors executing the funds (companies, universities,

TABLE 1. Total investment in R+D (2003) by fund recipient and fund source (in millions of euros)

Execution of funds	Source of funds					Total
	Companies	Government departments	Universities	Foreign Sources	PNP’s	
Companies	3 708 164	494 544	941	232 586	7 204	4 443 438
Universities	160 221	1 739 011	438 394	134 332	20 000	2 491 959
Government departments	97 163	1 053 703	3 342	102 903	4 652	1 261 763
PNP’s	5 873	3 551	70	957	5 425	15 876
TOTAL	3 971 421	3 290 809	442 747	470 778	37 281	8 213 036

Source: INE. Note: The acronym PNP’s refers to Private Non-profit Organizations²

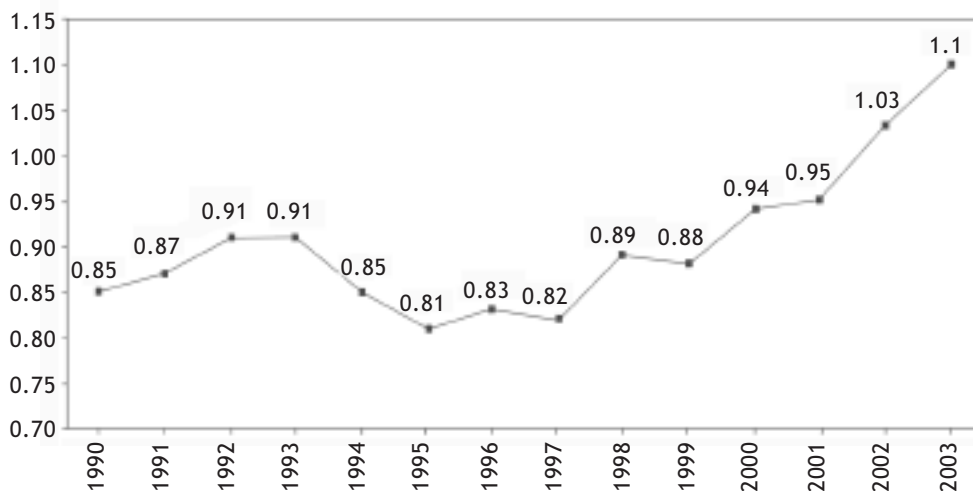


FIGURE 1. Changes in R+D investment, as a fraction of GDP (1990-2003)

Source: INE

research centres) and the source of the funds (companies, government departments, universities, non-Spanish institutions).

Table 1 shows that companies receive the largest percentage of total R+D expenditure: 54%, which represents almost 0.6% of GDP). Universities obtain 30% of the total expenditure. The general government gets 15.4%, whilst private non-profit organisations receive a marginal 0.2%.

Figure 1 presents a dynamic view of R+D figures. It shows changes in total R+D investment as a percentage of GDP between 1990 and 2003.

Table 2 presents the central government’s R+D budget, separated into different items. The data are taken from the National Budget for 2002.

Finally, Fig. 2 gives a dynamic view of Spain’s high R+D figures. Specifically, it shows changes in *Función 54* (R+D) of the National Budget. *Función*

TABLE 2. R+D budget by activity in the National Budget (2002) (in millions of euros)

Item	Total figures		Chapter 8 (loans)	
	M euros	% total	M euros	Chap. 8/total figure (x100)
National R+D Fund	340	9.0	< 1	not significant
CSIC and other MCYT PROs	490	12.9	< 1	not significant
Ministry of Defence (including INTA)	314	8.3	< 1	not significant
Department of Health (including Carlos III)	121	3.2	< 1	not significant
Other Ministries	103	2.7	< 1	not significant
Technological R+D	1944	51.3	1640	84.4
Information Society R+D	412	10.9	349	84.7
Science and Technology Management and General Services	68	1.8	< 1	not significant
TOTAL	3792	100	1990	52.5

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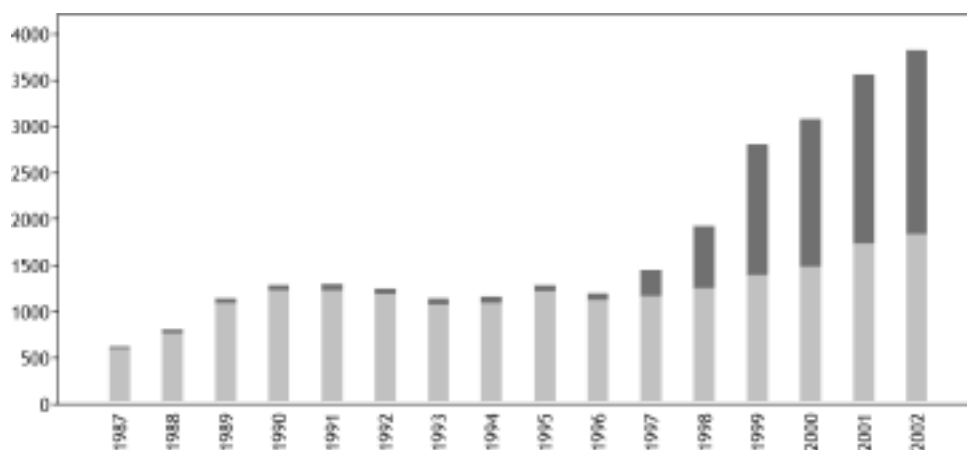


FIGURE 2. Changes in Función 54 (R+D) in the National Budgets and the effect of chapter 8 (loans) on changes in Función 54 between 1987 and 2002 (in millions of euros)

Source: MINISTRY OF SCIENCE AND TECHNOLOGY (2004). *Memoria de Actividades de I+D+I 2002* (data from the National Budgets and the Treasury's *Intervención General de la Administración del Estado* [General State Comptroller])

54 is the section of the National Budget that includes details of all government funds devoted to research. In addition, Fig. 2 shows the impact of Chapter 8, i.e. loans, on *Función 54* between 1987 and 2002. This information is taken from the last Ministry of Science and Technology report (2004) on R+D+I (innovation) activities.

These figures and graphs require some additional comments:

- The conceptual and actual difference between the budget figures and the funds that are finally made available should be kept in mind. For some items (especially Chapter 8), the received funds may be considerably lower than the budget figures.
- Spanish R+D investment as a percentage of GDP is approximately half that of the European amount (15 European countries). The fluctuations observed during the time period examined (see Fig. 1) affirm that there is still no clear short- or medium-term convergence with the European average. Figure 1 also demonstrates that growth in Spain's total R+D investment has not been constant. Investment increased

sharply during times of economic prosperity or when there was a specific political resolve.

- The item corresponding to Chapter 8 (loans) has grown in a clearly disproportionate way in recent years, as seen in Fig. 2 (there has been no improvement in 2005). Loans accounted for more than half of the R+D budget in the last year shown in this figure. If we disregard the item corresponding to Chapter 8, the R+D budget for 2002 is no higher, in constant euros, than that for 1991.
- In addition to the data given in Figs. 1 and 2, it should be stressed that the fraction of R+D corresponding to funds generated by the business sector is small compared to the European average. In 2003, Spain's public R+D funding was 0.57% of GDP, a percentage quite similar to that of Denmark. However, funding by Spanish businesses for the same year was 0.53% of the total. This is less than half the Danish percentage.
- In the last 25 years, the governments of the regions have gradually assumed a leading role

in stimulating R+D activities. They have developed a notable administrative infrastructure devoted specifically to managing scientific and technological policy. It is not easy to compare available R+D investment figures for the central government with those of regional governments. However, it can be estimated that, excluding universities and hospitals, the R+D investments of the regional governments are approximately 25% of the central government's *Función 54*.

Publications

R+D activities contribute to technological improvements in the long-term. In the short-term, their most tangible results are in the form of scientific publications (as well as patents, spin-offs, and other, similar products).

TABLE 3. Scientific production in Spain (1990 - 2003)

	Number of articles	% of world wide production
1990	10 688	1.6
1991	11 903	1.7
1992	13 824	1.9
1993	15 309	2.0
1994	16 214	2.0
1995	18 283	2.1
1996	20 080	2.2
1997	22 077	2.4
1998	23 783	2.5
1999	25 109	2.6
2000	24 984	2.5
2001	26 428	2.7
2002	28 526	2.8
2003	29 605	2.8

Source: INE

In general, several bibliometric indicators are used to measure and evaluate the quantity and quality of scientific production. These techniques can also be used to make forecasts, as they both enable innovative fields to be identified and verify the consequences and interest of scientific results.

Thus, Table 3 shows Spanish scientific production for 2003, measured in terms of the number of articles by Spanish authors that were published in international scientific journals. The figures are taken from the National Science Indicators (NSI) database, drawn up by the Institute for Scientific Information (ISI), Philadelphia. The data show that in 2003 Spanish scientific production was almost 3% of the world total.

Proposals

In recent years, there has been a growing debate on the role of R+D investment in a country's economic growth. There is widespread agreement in the specialised literature that R+D investment is a crucial strategic factor in a country's increasing productivity and competitiveness, even though it represents only a relatively small percentage of total GDP.³

Public funding for research, which makes up a significant percentage of the total R+D funding in Spain, comes from a variety of sources. The main ones are the central government and the governments of the regions. The role of the latter has been gradually increasing, which is clearly a very positive factor. However, the main responsibility lies with the State, both in terms of the amount of funding involved and the central government's constitutional mandate to promote and generally coordinate research (Article 149 of the Constitution).

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In view of: the analysis presented in the preceding paragraph –i.e. the consequences of the commitments made in Lisbon and Barcelona;⁴ the fact that only 1.1% of GDP is invested in R+D (INE data for 2003), although the private commitment is even weaker– it seems clear that research funding by the central government should be considerably increased.

The government's commitment in its election manifesto was to increase research funding by 25% during each year of its term of office. It is only natural and right to insist that this firm commitment be fulfilled. This objective should not be achieved by disproportionate increases in Chapter 8, as was the case in 2005.

PROPOSAL 1

Maintain existing commitments and increase the central government's R+D budget by 25%. Moderate use of Chapter 8.

In addition to increasing public research funds, it is essential that these increases should be allocated and spent correctly. The management, justification, and assessment of R+D investment should be improved. A budget increase would provide a significant opportunity to make reforms regarding the implementation of science policy. It would not be sensible to linearly increase all existing programmes. Instead, new programmes and instruments should be introduced to act as catalysts; these would, by example, give impetus to other aspects of the science and technology system. Extra funds should be put into such programmes. Moreover, such funds should only be invested in genuine R+D projects, not "defence projects".

The main direction of science policy for the short- and long-term should be firmly fixed. This would lead to the definition of specific medium-

term objectives related to the provision of funds and to the design and size of the technology and science system (in particular, the number of researchers needed, which is of prime importance to defining a scientific career). (See the conclusions in the *Human Resources in Research* paper). For further discussion of these points, see the remarks in the sections on the promotion of special programmes and large-scale facilities, National Plans, and the organisation of the State's central government regarding science policy.

To achieve a certain level of stability in science policy, agreements on this subject should be fostered between the political forces of the government and the opposition. These agreements, which could perhaps take the form of widely backed parliamentary motions, would guarantee that science policy does not undergo traumatic transformations with every change of government.

PROPOSAL 2

Bring about comprehensive agreements between the different political forces, which would make science policy more stable.

One aspect of these agreements should refer to increases in public funds, which should have medium-term forecasts and steadily rise. Ideally, an annual increase of 12% in this and the next two terms of office (together with moderate use of Chapter 8 funds) would be most appropriate. As such agreements do not exist, we recommend a 25% increase in funding during this term (proposal 1). It would, however, be a great pity if a trend of increase funding were to be cut short in the next term. A significant, sustained, and steady increase for 12 years is surely better than 4 years of considerable increases followed by a freezing of funds with no foreseeable end.⁵

In parallel with the growth in funds, triennial evaluations should be carried out. These would analyse the efficacy of the public effort and, in particular, whether investments by companies had grown at the same rate.

PROPOSAL 3

Make (triennial) ex-post evaluations of R+D public efforts.

Project policy

Introduction

Policies concerning human resources and projects are the basic instruments for government action in the scientific and technological research sector. The paper *Human Resources in Research* covers general aspects of science policy with respect to human resources, and therefore focuses only on topics related to policies for supporting and promoting projects. The comments in this paper can be extended to all calls for publicly funded research proposals.

Project policy is defined as the policy of generally promoting research activities through public calls for proposals. The introduction of this policy in the 1980s represented a radical change in the Spanish science and technology system. In addition, project policy and the creation of the ANEP—one of the institutional structures arising from this policy—led to the development of a healthy culture of competitive calls for proposals.

These are thoroughly evaluated by the ANEP, and are almost the only option for obtaining public funding for research. No backward steps should be taken in this policy of competitive calls for proposals and rigorous evaluation. The only option is to progress.

A significant increase in funds is needed, as explained in the previous section. However, it should be stressed that the recommended increases are not proposed to justify “mysterious” figures, but have a well-defined objective. In fact,

despite the fact that significant shortfalls can still be detected, an acceptably “buoyant” level of public sector research has been reached in Spain. This was confirmed in the above section, using the standard parameters of scientific publications. Thus, the time has come to take the qualitative leap needed to reach the levels of excellence of leading European countries. At the same time, the contribution of publicly funded research to the production sector should be substantially increased. To achieve this objective, there should be a considerable increase in the budget for project policy, to put it on a level with its counterparts (e.g. Germany and the UK) in the European research area. This is essential to Spain becoming competitive on a European scale.

Whatever the overall state of funding discussed in the previous section, we believe that a minimum increase of 25% per year over the next four years should be allocated to project proposals.

PROPOSAL 4

Increase project funds by a minimum of 25% per year over the next four years.

Necessary improvements

In this section we present a number of suggestions and recommendations aimed at improving the performance of project policy and increasing its efficacy.

Rigour in ex-ante and ex-post evaluations

To guarantee strict control over the use of funds, a rigorous evaluation must be carried out before they are awarded (ex-ante evaluation). Another evaluation should be carried out once the research project has been completed (ex-post evaluation).

ANEP's role and responsibilities should be strengthened to ensure that this objective is achieved (this topic is discussed in the section on the Agencia de Evaluación y Financiación de la Investigación). In particular, evaluations should be more informative than they are at present. Projects should receive more specific, detailed, and constructive criticism than they have received to date.

Stability and publicity of public calls for proposals

Calls for proposals should be stable, with a fixed schedule that is independent of political changes and budget fluctuations. The closing date for paying taxes is fixed, therefore the schedule for calls for project proposals should be too. This idea could be extended to the entire financial aid calendar. Calls for research projects should be held twice a year.

Allocating funds by group

Regarding the implementation of project policy, it is recommended that funds not be divided into miniscule parts or distributed evenly. Instead, we believe that the amount of funding for different projects should depend to a much greater extent than it does now on the size of the research group, the quality of its work, and on its produc-

tivity. In addition, some inflexible aspects of the current system should be removed, such as the restriction of only one project per principal researcher. If the projects are truly independent, researchers should be allowed to present several of them –two or even three. In addition, the career backgrounds of all researchers participating in a project should be acknowledged in the project evaluation, not just the track record of the principal researcher. These actions would prevent research groups from separating, and would encourage (or at least not discourage) the formation of research groups with many members.

Improving overhead policy

It is clear that the amount of money allocated to research projects should be increased (with additional funds). This increase would mainly serve to make universities and research centres fully aware of the importance of relying on extremely high-level research groups, capable of competing on national and international levels. These institutions should promote the formation of such research groups by helping them to overcome initial difficulties and by facilitating and consolidating the work of established groups. Of course, overhead policy should also lead to the establishment of a real commitment by universities and research centres to cover the operating needs of their research teams. They should, for example, take joint responsibility for the teams' maintenance expenses.

Flexibility and greater efficiency of fund management

Recipients of financial aid should have considerably more freedom to manage their funds. This could be done by eliminating fixed items or

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making expenditures more flexible. The current situation is so extremely rigid that it is sometimes difficult to manage expenditures adequately. Of course, increased flexibility must not adversely affect strict supervision of expenditures (preferably ex-post). In addition, we would like to register the scientific community's concerns about the 2003 *Ley de Subvenciones* (Subsidy Law). This law does not appear to be sensitive to the characteristics and needs of scientific and technological research. It should either be altered or extended to address these characteristics with sensitivity, common sense, and openness.⁶

Stimulating interdisciplinarity

It is very important to promote interdisciplinary collaboration. Above all, this should be encouraged in new areas related to science, technology, social science, and the humanities. Both researchers and technical personnel should be participate in collaborations.

Promoting European and international cooperation

Complementarity between the Spanish science and technology system and European programmes should be promoted. This could be achieved by: paying greater attention to the coordination of programmes within the European framework, conducting an in-depth study of the participation of Spanish groups in European programmes, promoting measures to improve the quality of participation, and not just the quantity of the returns. For more information on this topic, see the proposals in the section *Spain in Europe*. Coordination should also be encouraged –by signing international agreements– to facilitate joint projects with

teams outside the European Union (US, Japan, etc), and to analyse plans and funding for Latin American cooperation (CYTED).

PROPOSAL 5

Substantial improvements to project policy should be made by: increasing the rigour of ex-ante and ex-post evaluations, increasing the stability and publicity of calls for proposals, linking funding to the size and quality of groups, increasing overhead, making fund management by groups more flexible, encouraging interdisciplinarity, supporting European and international cooperation.

New types of programmes

As more than 20 year's experience in project policy has now been accumulated, we consider that the policy of public calls for proposals could be extended such that a greater amount of structural funding is allocated.

Strategic funding for highly consolidated groups and centres of excellence

It is clear that funding highly consolidated groups of excellence creates particular problems. It seems appropriate for these groups of excellence to have funding (always through competitive calls for proposals) that enables them to make strategic medium and long-term plans for their activities.

This idea could also be extended to centres of excellence (public centres including those of the CSIC, other public research organisations, universities, and regional governments centres). We are referring to high-quality public research centres of a currently or potentially considerable size. In other words, centres that could play a leading role in Spain's impact on Europe.

Funding obtained by researchers belonging to these groups or centres that is directed at covering project overhead may not be sufficient, or sufficiently conditional to encourage groups or centres to take on this role. Therefore, it would be useful to initiate a policy of calls for proposals requiring medium- and long-term funding (presumably through contracts and programmes) of the research infrastructure of these groups or centres of excellence. Funding could be carried out in collaboration with the regional governments.

An essential aspect of this policy should be its competitive and open nature, combined with a rigorous and demanding evaluation process.

Promoting coordination between research groups

The aim is to expand and improve on recent (in the field of health research) or past (e.g. in the field of physics) experience and to systematically establish thematic networks that would help to publicise the productivity of Spanish groups and to maximise their utilisation. In addition, such networks would allow affinities to be created and increase mobility within Spain (it is absurd that it is sometimes easier to visit a European university or research centre than a Spanish one). These objectives could be attained by, for example, exchanges of personnel, summer schools, grant programmes, and workshops. However, we should add a cautionary note: the development of networks should not be used as an excuse, as is often the case, for ignoring evaluation and selection.

A network's nucleus should be made up of the groups and centres of excellence mentioned in the previous section.

Financial aid for truly emerging or innovative groups and researchers

The above measures do not exclude the fact that newly created (i.e. emerging) groups also stimulate the research process. While the Spanish science and technology system, which is still small, needs to expand, expansion should not be carried out indiscriminately. Instead, attention should be paid to the scientific worth of those researchers with new ideas and projects who have recently joined universities and research centres, due to the introduction of competitive programmes. Therefore, we propose that a specific budget item be created for newly formed groups. This would enable funds for a group's first two years to be allocated immediately. A reasonable level of funding should be provided, although the exact amount would depend on the field of knowledge. This first grant would be less competitive than the other types of funding. It would give a research group the opportunity to start-up efficiently and quickly, and to attain the preliminary data or results needed to obtain more competitive funding in the future.

Financial aid for doctoral education programmes

Doctoral education is essential to promoting research, as discussed in the paper *Human Resources in Research*. Here, we only wish to state that, apart from an indispensable policy of grants, there should also be a decisive policy (more than at present) of infrastructural and strategic support for doctoral programmes. This would provide at least a medium-term strategy, with support allocated to strong doctoral programmes that could have an international impact. Of course, the allocation of aid should be determined by competi-

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ve public calls for proposals. Doctoral programmes in the social sciences and in the humanities are different from those in the experimental sciences. The former are highly dependent on the availability of courses, whilst the latter heavily depends on laboratory work. This distinction should be kept in mind, as it implies that the most important form of infrastructural aid for the social sciences and humanities is that affecting course availability.⁷

PROPOSAL 6

New kinds of more structured programmes should be created: strategic funding for consolidated groups, centres, and networks of excellence, and for highly demanding doctoral programmes.

Additional infrastructure renovation

Shortfalls remain in the funding and, above all, the maintenance of university and public research centre infrastructures. These cannot be overcome by ordinary calls for project proposals.

Instead, the scientific–technological infrastructures of these organisations should be strengthened by introducing an action plan –a kind of *Plan Renove*– that would allow a significant proportion

of scientific and technological facilities to be updated.

PROPOSAL 7

There should be a special programme for updating research infrastructures.

Strengthening research and technological development in economic sectors

Selective actions directed at strengthening the research and technological developments of companies should be promoted by the coordinated efforts of the different ministries and administrations. Such actions should have realistic funding targets, and results should be monitored and evaluated. A firm commitment must be made to combine research with business innovation in strategic sectors (software, proteomics, nanotechnology, sustainable chemistry, etc.). This could be achieved through specific programmes. The section titled: “The relation between central government and regional governments” also deals with this issue.

PROPOSAL 8

Promote specific programmes that combine research with business innovation.

Public institutions undertaking research

General considerations

The two great pillars of research are universities and research centres. There is considerable overlap between the two that is likely to grow in the future. These two types of institutions are also becoming increasingly porous. It is therefore important that the basic principles of science policy are the same for both of them. The old contraposition between universities and research centres should be set aside.

The following are some principles that could be recommended for any type of research institution:

- They should have their own legal status, unless they are very small. In such cases, umbrella foundations could be useful. This frequently occurs in university environments, where the existence of small centres can be both valid and constructive.
- Research institutions should have boards (or councils). These could include many different institutions (e.g. universities) that are responsible for the research institution in question or have an interest in it.
- The institution's director should be appointed by the board after a comprehensive and open selection process. He/she should be responsible for medium-term science policy.
- The institution could have many types of personnel: employees, assigned civil servants, visiting scientists, etc. Of utmost importance is that the institution has a stable core of personnel, which is of an appropriate size to fulfil its objectives.
- The institution's administration should be made more professional by recruiting management professionals (e.g. trained, experienced managers).
- The recruitment of new researchers should be based on open and public selection procedures. Preferably, employment contracts should be offered.
- Periodic external inspections should be a basic requirement for research institutions of a certain size. In fact, all institutions should have an "external scientific council", which can be called on periodically to analyse the institution's situation in relation to international developments in the same field.
- Economic management should be dynamic and not subject to previous intervention. Of course, the statement of accounts should be rigorous.
- The institutions on the board should be in charge of basic funding. (Thus, in turn, any institution contributing to the institution's basic funding should be a member of the

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board.) Basic funding could be subject to incentives (via contracts and programmes). Even if a policy of increasing overhead leaves significant funds in the hands of a scientifically strong institution, basic funding should cover at least all of the costs of the permanent staff. Preferably, it should also extend beyond these costs.

The Spanish Council for Scientific Research (El Consejo Superior de Investigaciones Científicas, CSIC)

Introduction

CSIC is unquestionably the main research organisation in Spain. Moreover, this indispensable and highly valuable organisation is present throughout the country. While, this committee does not intend to carry out a precise evaluation of CSIC or to present a detailed proposal for reforms, it will offer some reflections about the organisation and suggest some measures for improving it and for increasing its coordination with the Spanish science and technology system in general.

CSIC and the universities

As a whole, Spanish universities (including university hospitals) carry out more research than does the CSIC, and their social and political influence are considerable. Consequently, development of the Spanish science and technology system should be based on trust and collaboration between the universities and the CSIC. If subsystems are isolated and shut off from each other, and a mutual lack of trust prevails, opportunities will be lost. This must not be allowed to happen. CSIC, based on its autonomous position and its legal status, should aim to make itself an asset and a source of

opportunities for universities. When universities demand that the strength of the CSIC be increased, optimum conditions for research will be achieved. More specifically, we recommend encouraging programmes for collaboration (or interpenetration) between universities and the CSIC. Some examples of these are the following:

- Allow individual CSIC scientists to also carry out research in universities (departments, institutes, research centres linked to the universities, etc.), with some teaching obligations. This model is based on the *attachés* of the *Centre National pour la Recherche Scientifique*, CNRS (French National Centre for Scientific Research).
- Allow lecturers-researchers to be assigned for short or long periods to institutes linked to the CSIC.
- Facilitate the creation of joint research centres that have legal status and boards. These would take over from the existing model of mixed centres.

All of these programmes would also facilitate the coordination of truly joint careers. Lecturers-researchers would have a double affiliation. Throughout their careers, they would alternate between their dedication to research and their commitment to teaching.

CSIC's human resources

The main goal in this area is to open doors, without reservations, to indefinite employment contracts (also to temporary employment contracts, but the real innovation lies in giving indefinite

contracts). Employment contracts should be high-grade (obviously, this has implications for the salary structure). For more information on human resources, see the corresponding paper.

The need for decentralisation: the role of the centres

To clarify the terminology, the expression “decentralisation” does not in itself have geological implications. In this section, it refers to decentralising the capacity to manage and to take initiatives, giving more power to the centres. We believe that the management and responsibilities of the CSIC’s current centres and institutions are insufficiently autonomous. The idea that CSIC could work well as a single, extremely homogenous organisation is condemned to failure (no matter how much the central organisation is streamlined, which is, of course, necessary). Currently, the organisation and administration of CSIC centres are inflexible and there is a lack of autonomy in their budgets. For example, the CSIC centres do not have funding that would enable them to award contracts to new groups and they tend to lack strategic plans. However, in this respect we have observed significant improvement and we commend the CSIC for this. Nonetheless, CISC centres also frequently lack a clear scientific direction.

Ideally, CSIC centres should have the following characteristics (in this case, the proposal is based on the German model):

- a) Centres should have their own legal status. If this presents insurmountable legal difficulties, centres should be supported by institutions or foundations that already have appropriate legal status. Recently, new research centres have been created in Spain using a model that is

freer and more independent than that of traditional CSIC centres. Most of these new centres are run as foundations, which enables them to hire personnel. They also have clear scientific direction, which is usually personified by a prestigious scientist. We consider that this formula of scientific foundations should be established as a model for creating new research centres, or for restructuring existing centres.

- b) Centres should have management bodies that answer to the board and that have, and exercise, real scientific leadership capacity.
- c) They should be appraised every five years by an international External Scientific Council made up of leading scientists in the research areas of the centres. The conclusions of these appraisals should be taken into account by the board and the management and have a bearing on the centre’s strategic plans and scientific composition.

In many cases, new CSIC centres would be linked to universities. This would surpass the prevailing model of mixed centres in the way suggested in points *a*, *b*, and *c*.

Administrative organisation: ex-post vs ex-ante

The administrative and financial management of the CSIC’s central structures and institutions should be streamlined. If we had to summarise the direction that required reforms should take, we would say that the CISC has to advance towards a system characterised by greater autonomy and more responsibility for itself (e.g. CSIC should be able to take on debt, at least in terms of using Chapter 8). This should be complemented by rigorous control systems and a rendering of

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accounts that is not based on ex-ante evaluations but on ex-post audits.

Relations with the regional governments

The CSIC's collaboration with regional governments should be fluid and mutually advantageous. For the regional government, it should be a source of expert knowledge and open up new, global opportunities. For the CSIC it should represent a source of opportunities for realising its goals. Fortunately, the regional government are becoming increasingly active in promoting research and in allocating larger research budgets. Moreover, a policy of collaborating with the universities necessarily, and more or less automatically, involves dialogue and collaboration with the regional governments. The CSIC is the only research organisation that is established in the different regional government. As a result, it can play an important role with respect to developing and coordinating joint research programmes on a national scale with universities and, if applicable, companies.

PROPOSAL 9

The CSIC should be reformed to increase its scientific strength and its relationships with other agents in the Spanish science and technology system (particularly universities). Administration of the CSIC's central structures has to be streamlined. In addition, its authority and management capacity should be significantly decentralised, giving more responsibility to centres and institutes. Centres and institutes should have their own legal status, boards, strategic plans, and clear, strong scientific direction. They should also be subject to periodic appraisals by external scientific committees. CSIC researchers (of any nationality) should be offered indefinite employment contracts.

Other state organisations recognised as PRO by the *Ley de la Ciencia* (Science Law)

The *Ley de Fomento y Coordinación General de la Ciencia* (law for the promotion and general coordination of science), passed in 1986, confers the status of Public Research Organisations on several technological and scientific organisations that depend on the State government. Clearly, the general principles described above could also be applied to PROs, and, particularly to the research centres that depend on them. However, as this document does not aim to be exhaustive, we have not examined them in detail. We will only state that there is a great diversity between PROs. Although past proposals suggested joining them to the CSIC, we do not consider this to be a good idea. It would considerably distract both parties from their main tasks, and it is not clear whether a calculation of the losses and gains for all involved would come out positive. However, increasing the permeability between the CSIC and the other PROs would be extremely constructive.

Many PROs carry out research that is closely linked to the specific needs of particular sectors, such as fishing or energy. We should ask ourselves whether such PROs should depend administratively on the ministry closest to their research subject or whether all PROs should depend on the ministry responsible for science. Each model has its pros and cons, so that the choice is not obvious. A possible model of double dependency could be the following: each PRO would depend on the ministry that it is thematically closest to, but its budget would be annually approved by the *Comisión Interministerial de Ciencia y Tecnología* (see the section on National Plans and the organisation of the administration), in which the

ministry responsible for science would have a predominant role. This would ensure coordination with other funds, and that an appropriate scientific–technical level was maintained. A tendency has sometimes been observed to shift the centre of gravity of PROs towards a kind of technical cabinet made up of the ministries they depend on. The above model would prevent such a shift. One particular case is that of PROs related to health. These have always been part of the Ministry of Health and Consumer Affairs. The double dependency model (and supervision) suggested above should also include these PROs.

Other public research centres

There are a variety of public research centres in Spain, formalised under different legal statuses. These depend on the State, the regional governments, and even the provincial councils. Their presence in the system is recorded in the Science Plan that is currently in force. They appear under the name *Centro Público de Investigación* (Public Research Centres) (CPI).⁸ These centres contribute significantly to the system. Under no circumstances (e.g. regarding calls for proposals) should they be treated any differently from the universities and PROs included in the *Ley de la Ciencia*.

Hospitals

Biomedical research in hospitals is of enormous importance, and is a fundamental aspect of the Spanish science and technology system. Of course, the mission of large public hospitals' is to provide the population with high-quality health care. However, their mission is also to be centres for knowledge generation. These two tasks are inseparable. Research should be viewed as an integral

part of the activity of hospital systems (not necessarily in each hospital, but definitely in, for example, university hospitals).

Research carried out by the international scientific community in the last two decades has shed light on the molecular bases of many pathogenic mechanisms. This knowledge has been used to design drugs directed at specific molecular targets. The next decade will see the development of drugs that will have to be tested on patients. As a result, translational research will expand greatly worldwide. Basic research in large centres has recently been encouraged by the creation of substantial research units. Now, the promotion of translational and clinical research in Spanish hospitals requires urgent attention.⁹

There are, however, reasons to be optimistic. In fact, conditions ensuring that hospitals do not miss the research boat are very good. As shown in a recent report by Camí *et al.* (2002), much of the scientific production in biomedicine and health sciences is carried out in large hospital centres. These results are not surprising, if the medical excellence of many of these centres and the opportunities that a national public health system offer are taken into consideration.

Certainly, research in Spanish hospitals still suffers from serious shortcomings when compared to that in countries in the vanguard of biomedical research, such as the United States, or, within Europe, the United Kingdom, and France. However, we consider that such shortcomings can easily be remedied, if they are overcome, Spain could be at the forefront of European biomedical research.

The organisation of research activity in hospitals should be based on services, departments, and, increasingly, on multidisciplinary programmes. As a result, the research itself will be linked

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to specific services, departments, or clearly-defined programmes, such as cancer, neuroscience, cardiovascular and other medical areas. However, there should be numerous formulae for structuring research activity. For example, hospitals associated with basic research centres might assign scientific personnel to both a basic science unit and a clinical service. Likewise, hospitals offering services with no research tradition could be encouraged to take on personnel with hospital research experience. Such personnel would strengthen research programmes that, in turn, could take advantage of the clinical services' research potential.

In our opinion, a combination of measures related to the budget and to the creation of dynamic administrative tools should be promoted immediately. These measures would optimise resources and support research in hospitals. Specific proposals are outlined below:

a) *Establish a scientific career pathway in hospitals*

This measure will probably do the most to help the development of translational research. The *Instituto de Salud Carlos III* could have an influential role in this process. Currently, many of the best researchers working in hospital environments lack incentives to devote themselves to research, so they orientate their careers purely towards health care, which pays a better salary and, more importantly, is a well-defined the career pathway. Hospital managements have limited resources, which should be devoted to health care. Establishing a research career pathway in hospitals, with the *Instituto de Salud Carlos III* and other institutions contributing financially, would enable quality researchers to be totally or partially freed from health care

tasks. It would also provide full-time researchers with a clearly-defined professional horizon. This would be an unquestionably effective measure.

b) *Public funding of clinical research programmes*

It is widely known that almost all of the clinical trials and studies carried out in Spain are funded by the pharmaceutical industry. This sometimes leads to conflicts of interest, and essential clinical trials may not be funded. The recent *Instituto de Salud Carlos III* programme to create thematic networks for research centres should, in some cases, consider funding such trials. Of course, any funds should be awarded competitively and be subject to a periodic process of external appraisal.

c) *Philanthropy*

One unresolved matter in Spanish hospitals is how to attract philanthropic funds to build physical structures or finance research programmes. These funds make up an important part of project funding in other European countries. In fact, hospitals have the most opportunities to attract funds. We consider that government departments should consider how to establish incentive mechanisms that surpass existing ones (for example, co-financing using public and private funds).

d) *Creating thematic research institutes in hospitals*

It should be possible to establish thematic research institutes in hospitals, such as: cardiovascular institutes, institutes of neuroscience, oncology, medicine, etc. Such institutes should have their own legal status and capacity. Smaller hospitals should contain specific foundations that oversee all of their research. This

structure's merit is that it provides a tool that enables research funds to be managed independently from the hospital's health care funds. Thus, research programmes could be encouraged and research personnel contracted. These institutes or foundations should have a board to approve their strategies and establish their research direction.

e) Increasing the university's role

University presence in university hospitals is frequently limited to teaching undergraduates. We consider that universities should go beyond this, strengthening medical–scientific careers and encouraging the creation of university qualifications, such as the Anglo-Saxon MD or PhD. In particular, doctoral programmes should be created within research institutes –obviously with the participation of the universities.

f) Linking institutes and the pharmaceutical industry

As in the great US and Asian research centres, we should strengthen collaboration with industry and create institutes for undertaking joint projects. Thus, in Spain, projects could be designed to research the preclinical development of new compounds, and to create facilities for the initial phases of clinical trials. Again, this opportunity is only open to hospital research.

PROPOSAL 10

Encourage research, and in particular clinical research, in the national health system's large university hospitals. A scientific career in hospitals should be defined and established. Funding programmes for clinical research should be developed and philanthropy encouraged. Thematic research institutes should be created,

as should research institutes in conjunction with the pharmaceutical industry. The role of the university should be increased, especially in postgraduate and doctoral education.

Universities

Universities as a group are a vital research institution. It is therefore paradoxical that often, in the very heart of universities, research is challenged by teaching. Teaching is considered to be the true task of universities, but this idea should be reconsidered. The task of research is as essential as that of teaching, and the two are not in contraposition. Scientific research is an essential and inseparable aspect of the educational process. A second paradox is that insistence on the primacy of teaching is not always accompanied by an increase in teaching quality.

Below are some comments on the organisation of research in universities.

a) Teaching and research are complementary

As mentioned above, teaching and research are complementary university activities. All university lecturers (or researchers) should carry out research and teach (though not necessarily both year after year).¹⁰ Rigorous evaluation mechanisms should be established for both teaching and university research.

b) A wide variety of organisational forms

Naturally, university research is organised in many different ways. However, the organisation of teaching and research in natural sciences has progressed in the last 10–15 years. In many cases, the current structure (independent faculties of biology, physics, chemistry, etc., each with their own departments based

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on specific areas of knowledge) could be complemented by improved interdisciplinarity. This would bring together research professors with complementary knowledge and training. Similar circumstances also arise in disciplines that require collaboration between the humanities and technology, such as: Natural Language Processing, digital libraries, etc.

c) *Increasing overhead*

The overhead of research contracts should be doubled over a reasonable period. In return, universities should acknowledge that stimulating and supporting research is one of their essential tasks.

d) *Consultancy contracts*

Consultancy contracts are not in themselves R+D, although they can occasionally involve this activity. In any case, they have a clear social use. Their presence in universities is acceptable (and given the financial shortfalls they are likely to be welcomed), but they must be carefully selected. Contracts should not amount to low-price offers that are implicitly subsidised by the university and have limited performance. In other words, universities should not provide routine consulting services that are already available in the market.

e) *Intellectual property*

Universities, regional governments, and the State should concern themselves, with a certain degree of urgency, about intellectual property issues. They should also promote the creation of companies from university environments. The idea is to make it as easy as possible for universities and their lecturers–researchers to make use of the value of their assets (or those they could have, with minimal extra effort) , for the benefit of all.

f) *Associated research institutes*

The most robust formula for organising university research would be an associated research institute. This would ensure the necessary degree of autonomy and management flexibility. It would also mean that institutes would have responsible boards (the university could serve on the board, with a proportional degree of influence).

PROPUESTA 11

Regarding research in a university context: teaching and research should be combined more efficiently; organisational structures should be made more flexible; overhead should be increased; and attention paid to the specificities of consultancy activities and issues related to intellectual property.

Science parks

Science parks are one of several institutional innovations of the last 15 years. They have opened up a promising new way to create environments where universities, research centres, and government departments can interact. Existing science parks have still not adequately resolved one essential factor: a stable level of funding. While financial instability is a problem in itself, it also makes it difficult to attract and consolidate quality. It is therefore vital to maintain, from the beginning, a stable level of funding for the parks (the State, the regional governments and the private sector could perhaps contribute to this).

PROPUESTA 12

Aspects of funding science parks should be taken into consideration.

The promotion of special programmes and large-scale facilities

Special programmes

The time has come for Spanish science policy to take an important and decisive step in the European context: to launch special programmes in well-defined subjects that have a wide scope. Such programmes would enable quality research to be undertaken in the public sphere. They would also allow companies to become involved and/or crucial problems to be solved in areas such as health, the environment, or the information society. To achieve this, the budget has to increase beyond the “water mark”. Future National Plans should devote particular attention to this matter. The idea is not to prescribe “more of the same”, but to take advantage of the existing critical mass to mobilise the scientific community and to tackle well-defined objectives that require complex organisational structures (such as problems related to speech processing and language).

These special programmes should not be confined to merely announcing calls for applications and soliciting proposals (although this should also occur). In addition, shortcomings and priorities in the subject area should be identified. Adequate mechanisms (which must be open and competitive) should then be established to eliminate the shortcomings and develop the priorities. Companies should participate in these programmes from the moment they are defined, so that business needs can be incorporated from the out-

set. Funds allocated to basic, non-specific research should not be used for these programmes. Instead, programmes should be developed progressively in accordance with the increase in budget funds for R+D.

PROPOSAL 13

A long-term policy of special programmes addressing scientific and technological subjects should be defined and developed. Such subjects should be of strategic importance and have complex management.

Large-scale facilities

Some of these special programmes would be associated with the promotion of large-scale scientific and technological facilities that would enable even more ambitious objectives to be reached. Research today, in some areas in particular, notably physics, requires facilities of such large magnitude that they cannot be situated in only one country. “Magnitude” refers to the cost (which is sometimes enormous) of investing in such facilities and maintaining them. However, it also refers to what is sometimes more important: the highly specialised team needed to effectively operate such facilities. Large-scale research facilities are an excellent vehicle for expanding R+D activities and a revitalising agent on a technological level for the associated industries. Let us take CERN (the European

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Organisation for Nuclear Research) as an example. CERN's role in the development of high-energy physics is universally recognised (and a great example of the power of European collaboration). Nonetheless, many people are unaware of the extraordinary influence that CERN has also had on furthering technological developments, a result derived from the special instruments created to satisfy the laboratory's demanding requirements. An example of this is the omnipresent internet. This was invented by Berners-Lee in CERN as a medium for IT communication between high-energy physics research groups.

Regarding large-scale facilities in Europe, we could point out as an example the *Instituto Astrofísico de Canarias*. The most important astronomical facilities in the northern hemisphere (after Hawaii) are located in this Institute. A crucial step was taken with construction of the new large telescope Grantecán. Instead of simply providing the land and benefiting from the astronomical facilities, Spain participated actively in over 60% of the design and construction of this new telescope, with all the technological consequences created by this involvement. A second facility, the *Plataforma Solar de Almería*, has an enormous influence on the research and development of an energy source, i.e. solar energy, that is of interest to a country with climatic conditions such as those in Spain. The results obtained in the first phase of the Platform's operation have provided a solid base with which to analyse realistic approaches to solar energy in the future. The reactor *TJ-II*, a thermonuclear fusion pre-reactor installed in CIEMAT, has enabled important expert knowledge to be generated in this field. This knowledge will be of great use when the ITER programme begins. Finally, the synchrotron ALBA, in Vallés, is an important step for the development of the

Spanish scientific community of synchrotron radiation users and for the high-technology companies participating in its construction.

The policy of large-scale facilities sometimes causes suspicion in the scientific community for fear that funding will be diverted from other, more modest projects. We consider that large-scale facilities should have their own budget heading (either within or outside the National Plan) which would help to clarify and pacify this sentiment.

PROPOSAL 14

There should be a budget heading for the general programme of large-scale facilities.

For more than 10 years, Spain, like other countries in Europe, has had a Large-Scale Facilities Committee. This Committee is responsible for analysing the operation of existing facilities in Spain and the effectiveness of Spanish contributions to international large-scale facilities located in other countries. Likewise, it examines proposals for new facilities. This Committee should be revitalised and strengthened, and receive specific instructions for future activities. For example, it may perhaps be a good idea to carry out an analysis of current needs on a European level¹¹ and to examine the viability and appropriateness of locating new facilities in Spain. The Committee should also have a permanent organisational structure, which would enable it to effectively carry out advisory tasks on topics such as ways of managing large-scale facilities. To sum up, the Large-Scale Facilities Committee should be revitalised and given more organisational strength.

PROPOSAL 15

The Comité de Grandes Instalaciones (Large-Scale Facilities Committee) should be revitalised and supported.

The relation between the central and regional governments

In recent years, the regional governments, which are healthily heterogeneous, have increasingly facilitated the work of their most notable research groups. They have strengthened both the development of their research centres and technological development. They have also made a firm commitment to those priority research areas that are in keeping with their particular characteristics, natural resources, or other specific interests. The growing interest of the regional governments in research and their assumption of responsibilities in this area marks the beginning of a positive trend, which should be consolidated and expanded.

The relation between central and regional governments should be shaped by two basic principles: *collaboration* and *complementarity*.

a) *The principle of collaboration*

Central and regional governments should strive to reach agreements on coordinating the use of their respective R+D funds. Thus, they could try to jointly define objectives on a European, state, and regional scale. In addition, both central and regional governments should be represented –to an appropriate degree– on the boards of research centres, large-scale facilities, large installations. and projects that are of importance to the state

but located in an regional government's territory.

b) *The principle of complementarity*

When an regional government duplicates state programmes, all kinds of dysfunctions arise. For example, regions funding ends up being concentrated on second class research, as it is incapable of competing with more extensive funds. In addition, one type of funding may be reduced in the presence of the other. It is better to reach a full agreement and specialise in complementary programmes. Regarding doctoral grants for example, it would be logical for the central government to award packets of grants to high-level doctoral and research programmes as an additional resource for carrying out these activities (i.e. the final selection and allocation of grants/contracts would be carried out in the recipient institutions). The regional government would focus on awarding grants to individuals. To give another example: in programmes for recruiting researchers, the state could focus in the first instance on fostering initial recruitment (along the lines of the Ramón y Cajal programme), and the regional government on permanent recruitment. Of course, all of this should be done with flexibility and without dogmatism.

National Plans and the organisation of the State's central government regarding science policy

With regard to the State's central government, the promotion of science cannot be the exclusive responsibility of one ministry alone. Instead, all ministries should be involved, as they are today (the budget specifies this in its "famous" *Función 54*). The ministries of the different sectors (the Department of Health and the Environment Ministry are obvious examples) have specific tasks requiring solutions that frequently involve research activity. Ministries should therefore be able to directly promote research. As mentioned above, many ministries have their own PROs, although some of these are now dependent on the Ministry of Education and Science.

The wide variety of public agents undertaking research creates at least two problems: (1) drawing up the main points of a state policy that is consistent and has clear objectives, and (2) coordinating activities.

As regards the first problem, National Plans have been used as an instrument for defining the political authorities' strategic decisions. Moreover, they provide a framework in which agents involved in research can periodically meet, reflect on, and coordinate activities. They have functioned adequately in this role to date, and should be maintained. However, extensive experience with National Plans indicates that they require substantial external appraisals with international participation.

As far as the second problem is concerned, coordination between the different ministries in any country's science and technology system is an arduous assignment. A coordinating organisation is needed to prevent redundant research from being carried out, and to ensure that only high-quality research is promoted by the ministries. The alleged results of poor-quality research cannot be used. In this respect, it should be perhaps noted with concern that in the past some sector's ministries have demonstrated a certain tendency to use some of their PROs, despite the letter "R" in the acronym, as a kind of cabinet to give the ministry technical support rather than as true research centres (see the section on public institutions).

Broadly speaking, we consider that an Interministerial Commission of Science and Technology (CICYT), like the one currently in force in Spain, is a good solution. This organisation is responsible for the two above-mentioned tasks (drawing up National Plans and basic coordination). By Royal Decree 1864/2004 of September 6, 2004, the chairperson of this committee, which is attached to the Ministry of Education and Science, is the president of the government. The deputy chairperson is the vice president of the government and is in charge of the financial aspect (R+D has a significant financial impact). Committee members include ministers and high-ranking officials from those ministries involved in

research (and high-ranking officials from the President's Office). The secretary is the Ministry of Education and Science's secretary of state for Universities and Research.

Clearly this Committee, which has an excellent design on paper, has to be more active and take more of a leading role in formulating science policy. We consider that it should be supported by an auxiliary committee, which would meet frequently and be chaired by the secretary of the CICYT. It would be made up of directors-general from the ministries involved and the director-general of the Budget. This Auxiliary Committee would have its own secretariat (like the current secretary-general of the National Plan for R+D). Another possible improvement is outlined below:

PROPOSAL 16

Consider attaching the Interministerial Commission of Science and Technology (CICYT) to the President's Office. At the same time, a vice presidency occupied by the Minister of Education and Science (i.e. the ministry that has the predominant responsibility for research) could be introduced.

Moreover, corporate presence in the decision-making mechanisms of the National Plan for R+D should be increased. Currently, the existing CICYT is supported by an Advisory Board, which includes representatives from the business sector. However, both the composition of this board and the way it is run can clearly be improved. The way such improvements could be made requires serious consideration in the future.

An important issue is how to assign the central and most basic research responsibilities to the different ministries. There is no universally accepted model for situating support to science, and conse-

quently science policy, within governmental structures. Within Europe alone, different countries can be seen to have different solutions. There are even various solutions within one country, as models may change repeatedly over time. France changed the position of its science system several times in the 1980s—from a Ministry of Education and Science, to a Ministry of Universities and Research, and finally to a Ministry of Science and Technology. Other countries, like the UK, do not have a specific ministry for this area.

Two approaches to this subject are described below:

- a) The current assignment of responsibilities does not require many changes. In particular, it appears to be both important and preferable for the central government's jurisdiction over universities and research to be situated in the same ministry, as it is now.
- b) A Ministry of Science and Technology should be given renewed consideration. The division of Science and Technology into two ministries does not help the science and application systems to converge, as they should. A ministry of this type would help to resolve the long-standing problem of where to situate innovation and how to coordinate it with supporting research. One operating advantage of having a Ministry of Science and Technology is that it would be easier to support those companies choosing to carry out real innovation (with all the risks this involves). This contrasts with the past tendency of ministries in charge of industry to subsidise companies mainly according to their financial needs and their impact on employment or the region. Moreover, if the most important PROs and the programmes for subsidising the rese-

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arch and development activities of companies were included in the same ministry, it would also be easier to organise and carry out projects that both parties agree on. In addition, the concerns of a Ministry of Education tend to be dominated by compulsory education.

A possible synthesis of approaches *a* and *b* would be to create a Ministry of Science, Technology, and Universities (which would include part of the current Ministry of Education and Science and part of the Ministry of Industry). This is our proposal for the future.

PROPOSAL 17

In the medium-term, the creation of a Ministry of Science, Technology, and Universities should be tried out.

Another proposal would be to create a Science and Technology Advisory Office in Parliament.

There are many precedents in other countries, where such offices contribute significantly to enriching the level of parliamentary analysis and discussion on legislative topics related to science and technology.

PROPOSAL 18

An Advisory Parliamentary Office for Science and Technology could be created.

As we have repeatedly shown, the structure of regional governments has a notable bearing on political science and funding ability. The Science Council is the arena where central and regional governments meet and coordinate activities. Therefore, the Council be functional and much more than an authority, established by protocol, that deals with formalities.

Another highly significant structural innovation is proposed in the following pages.

Research Funding and Evaluation Agency (AEFI)

The creation of an Agency (or Committee) for Evaluating and Funding Research (AEFI) is an urgent necessity for several good reasons: It would stop the administration and management of the Spanish public funding system for science from becoming stifled, and its launch would be an important sign of the maturity of the system. Moreover, it is also something that the Spanish scientific and technology community have fought for, and creating such an agency would fulfil the present government's election pledge to do so. The AEFI's function would be to manage the distribution of all or part of the resources allocated to implementing aspects of the National Plan. These include: projects, human resources, and, in general, any funding requiring public calls for applications (which should be the majority of cases).

There are already important European precedents for such an agency. Some agencies are already well-established, like those in the UK and Germany. Others, such as the *European Research Council*, are in the process of being set up. The design of such an agency should combine the following two requirements in the best possible way:

a) The AEFI should be autonomous, dynamic, impartial, stable, and rigorous. While it is not for us to declare what precise legal structure best suits the agency, it must allow it to have all of the above characteristics. In particular, we believe that the AEFI should render accounts ex-post, through ministerial audits and the National Audit Office. It should not be subject to ex-ante evaluations. Of course, it should also have the necessary personnel and

means to operate effectively. It should not have its own centres for carrying out research (and probably no large-scale facilities). This would greatly help it to develop a reputation for impartiality.

b) The Agency's administration should not be strongly dependent on the corresponding ministry (this is what the term "autonomous" refers to). Neither should it have close ties with the science and technology sector, which benefits from it. To guarantee these requirements, special attention must be paid to the design of the management bodies. This topic will be dealt with shortly.

One important question is the initial scope of the AEFI. Should it deal with all funds allocated to calls for applications and human resources? Or only those that are currently the Ministry of Education and Science's responsibility? Or all funds except those of the Health Ministry (and the *Instituto Carlos III* takes on the role of a Health Research Council)? Or all funds except those of the Health and Industry Ministries (and the CDTI adopts the role of an Industry Research Council)? We believe it would be sensible for the AEFI to initially take charge of programmes that are the responsibility of the Ministry of Education and Science. Its contact with the government would therefore be through this Ministry.¹² Of course, the AEFI should carry out the task of evaluation, and should include the *Agencia Nacional de Evaluación y Prospectiva* (ANEP; National Evaluation and Long-Range Planning Agency) and

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the *Comisión Nacional Evaluadora de la Actividad Investigadora* (CNEAI; National Committee for the Evaluation of Research Activities). The *Fundación Española para la Ciencia y la Tecnología* (FECYT; the Spanish Foundation for Science and Technology), which would almost certainly specialise in areas of communication and long-range planning, should also be accountable to the AEFI. It is also important to maintain diverse sources of funds. However, similar levels of requirements and evaluation methodology should be used. As a result, the ANEP should continue to carry out high-quality evaluations and to maintain its own legal status within the AEFI. It should offer services that go beyond the AEFI's sphere of activity.

Clearly, as the AEFI's administration becomes consolidated, the incorporation of other activities and programmes could be considered. This would be particularly relevant if a Ministry of Science, Technology, and Universities were created in the medium-term, as recommended in the previous section. The required concordance between the AEFI's objectives and the State's science policy would be guaranteed through contract-funding programmes with the Ministry of Education and Science, and by the participation of government representatives in the AEFI's bodies, as established by the its statutes and regulations. However, AEFI decisions on funding would be final (though there would, of course, be guarantees and appeal mechanisms).

Finally, we turn to the design of the AEFI's management bodies. This topic is essential to assuring that the agency maintains its dual autonomy. The following is one possible proposal:

- The highest management body would be a "Research Commission" –a name inspired by the Energy Commission or the Stock Market Commission, among others. This commission would be made up of 12 members, appointed by the government at the suggestion of the respective minister for 6 years with a turnover of two members per year. Appointment of new

members should include a process of consultation and public calls for applicants. The appointment process would be organised by the Commission itself, and the President of the Commission would pass on the names of selected candidates to the respective minister. Most of the members of the commission would be highly prominent scientists and technologists. The Commission could also consist of additional members (no more than two or three) who are representatives of the administration. Of course, the Commission would put forward a director and a management structure.

- The Commission's president would also be appointed by the government for a given period, after a process of public and regulated consultations (call for candidates, etc). The position should be occupied by a widely respected scientist (from any discipline) with great scientific prestige. The successful candidate should also have experience in research management.
- The AEFI could also have an advisory body (the "Commission's Advisory Board") made up of representatives from the regional governments, universities, scientific organisations, etc.

PROPOSAL 19

Develop an Agency (or Commission) for Evaluating and Funding Research as soon as possible. This agency would be dependent on the Ministry of Education and Science and include: the National Evaluation and Long-Range Planning Agency (ANEP), the National Committee for the Evaluation of Research Activities (CNEAI), the Spanish Foundation for Science and Technology (FECYT). It would be responsible for all of the National Plan's project and human resources policies that are currently directly managed by the Ministry of Education and Science. In addition, it would include any new initiatives in these fields.

Notes

- ¹ In general, the "family" of OECD manuals are used to measure R+D activities: the *Frascati Manual* (2002a); the *Technology Balance of Payments Manual* (1990); the *Patent Manual* (1994); the *Oslo Manual* (1997) and the *Canberra Manual* (1995), describing human resources devoted to R+D. The recommendations of other institutions such as Unesco should also be born in mind (UNESCO 1979a, 1979b; UNESCO 1984). However, the use of this kind of indicators could lead to some methodological problems. For example, the distinction between input and output indicators is not always clear. There are also more indicators of scientific production than scientific dissemination. Finally, there are countable calculation problems and problems in making international comparisons between the different indicators' magnitudes.
- ² According to the last edition of the *Frascati Manual* (2003), PNPs include private non-profit organisations that are off-market. In general, they are funded by: taxes, contributions, their members' or patrons' donations, or by subsidies awarded by companies and government departments. They include professional associations, cultural societies, charitable organizations, aid organisations, unions, consumer associations, etc.
- ³ See: GRILICHES (1992), FAGERBERG (1994). Different papers by JONES & WILLIAMS (1998) and (2000) give the most recent estimates of the long-term effects of R+D.
- ⁴ European Council, Lisbon, 23-24 March, 2000; European Council, Barcelona, 15-16 March, 2002.
- ⁵ If companies grew by another certain amount, it would enable them to reach the average European expenditure in a 12 year period, even accounting for 3% annual inflation.
- ⁶ The following ideas could be included in the regulations developed: Subsidies awarded to universities and research centres should be justified by a report of the work undertaken and a certificate issued by the university manager or centre director. This certificate would state that the subsidy had been registered in the accounts of the university or centre; that the funds received had been used to undertake the activity they were awarded for; and that the original documents confirming the expenditure were filed in the office of the university or centre.
- ⁷ Another specific initiative that would help to boost the Social Sciences and the Humanities would be a programme of encouraging the publication and dissemination of Spanish scientific activity in these fields in foreign languages, and particularly in English. This would help to break the isolation of these disciplines, and make the abundant, quality Spanish production more visible.
- ⁸ CICYT (2003a) vol. I, p. 115.
- ⁹ This kind of research has its own characteristics and requires specific organisation: ethical committees; epidemiology units; tissue banks; cryopreservation units; databases with confidentiality requirements; trial units; animal houses for larger species, etc.
- ¹⁰ In particular, periods abroad for university lecturers should be encouraged. This is often impossible, simply because departments do not have enough resources to cover teaching positions. This matter is closely related to the way university teaching staff are assigned. The unit of measure is exclusively related to teaching; by number of students/subject.
- ¹¹ There should be a close relation between this committee and transnational institutes dealing with this topic. In particular such a relation should be formed with the European Commission and the European Science Foundation (ESF).
- ¹² We believe that there are seven Research Councils in the UK.

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