Scientific and Technological Performance Evaluation of the Spanish Council for Scientific Research (CSIC) as Compared with Similar National Research Institutions in France and Italy

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Introduction

An evaluation of the CSIC performance in the field of Biotechnology, as compared with those of the French, Centre National de la Recherche Scientifique (CNRS) and the Italian Consiglio Nationale delle Ricerche (CNR), has been carried out with special attention to the balance between the generation of scientific knowledge and the transfer of technology to the society, and to identify successful cases that could be used as models for new scientific and technology policies in Spain.

Methods

A set of scientific and technological output indicators has been studied to determine the knowledge generation and the contribution of these Institutions to the development of patents. On the other hand, it has been also studied the technology transfer through other mechanisms, generally used by these Institutions, as well as the scientific literature published by researchers of the above mentioned Institutions, that is cited in US patents.
The methodology used is based on the search in SCI database, the US Patent and Trademark Office (USPTO) database, as well as other European information sources (CORDIS database) and the websites and annual reports of the three Institutions.

Results

The three scientific Institutions play in their countries a key role in basic and applied research as it is shown by the contribution during the period 2000-2003, to the national scientific output in all experimental disciplines, of 18.6% by the CSIC, 11.7%, in the case of the CNR, and 34.7% of the CNRS. At the same time their capacity to collaborate whit other public and private R&D Institutions allows to consider them as national reference in scientific research.
The comparative analysis of the results obtained in this study take into account the similarities between the said Institutions (National-scale R&D Centres, Multidisciplinarity, etc) and also the existing differences, such as the number of scientists and technical staff, research budgets, and other factors that might condition the absolute values of the scientific and technological output of each of them.
According to the data included in their corresponding official websites, 2,341 staff scientists were working at the CSIC, 4,403 at the CNR and 11,650 at the CNRS for year 2003. Financial resources indicators show, that the budget available for the same year was 371 M€ for the CSIC, 779 M€ for the CNR and 2,441 M€ for the CNRS. Those figures show a more intensive R&D economical support -per scientist- for the CNRS and similar values for CNR and CSIC.

The national biotechnological scientific output, according to the data obtained from the SCI database in the field of "Biotechnology and Applied Microbiology" (considering the 52 journals with Impact Factor > 1.0), to the world scientific output during 2000-2003 shows a contribution for Spain that represents 4.05 %, (1,421 papers) of the total, 3.68% (1,292 papers) for Italy and 6.32% (2,216) for France. The participation rate to each national research output in this area is, the 28%, in the case of the CSIC, 15.3% for the CNR and 35.8% for the CNRS. These values when compared with the corresponding ones for the contribution in all experimental disciplines for each country, show that in the case of Spain the number of papers of the CSIC in the field of Biotechnology represents 1.5 % of the total output in all disciplines, in the case of Italy the CNR participation is 1.3 % and in the case of France is 1.0% for the CNRS. This indicates that the CSIC is relatively more dedicated to the field of Biotechnology than the other two Institutions.

According to data obtained from CORDIS database, the participation of CSIC, CNR and CNRS research groups in the *Biotech 1* and *2*, and *Quality of Life* Programs of the Third, Fourth and Fifth UE Framework Programmes of the European Commission, show an important participation of both CNRS and CSIC. The CSIC has participated in 228 and CNRS in 343 multinational Research and Technology Development financed projects, with an industrial participation in 47.7% and 46.6% of the

projects respectively. The CNR has participated in 45 research projects but with an industrial participation in 77.5% of the projects .
During the period 1990–2004, according to the USPTO, 510 US patents were assigned to the CNRS, 227 corresponding to the field of Biotechnology (US patent category 435), 78 patents to the CNR, 27 in Biotechnology, and only 50 patents to the CSIC, 18 in Biotechnology.

On the other hand, the knowledge transfer indicators, obtained by the analysis of the number of cites in US patents to published papers by an identical number (63) of CNR, CSIC and CNRS researchers, show that during the same period, the percentage of cited authors is 28.5%, 39.7% and 44.4% respectively. If the total number of cites found (431) for all the scientists studied is considered, 62% of them correspond the CNRS scientists, the CNR (18%) and CSIC (20%) scientists obtain a similar number of cites.
The study of the citing patents also allows to identify the most important/successful Biotechnological fields performed by these three Institutions. So, the CNR scientists are mostly cited in Environmental US patents, the CSIC scientists in Agro-Food and Industrial Processes patents, and those from CNRS mainly in Health related patents as well as in Horizontal Technologies, and less frequently, in Agro-Food and Industrial Processes patents.

Concluding remarks
The main results obtained in this study allow to assess that, despite the lower economic and human resources of the CSIC, its scientific performance in the field of Biotechnology is competitive, according to its output in scientific publications, its participation in EU projects and the significant flow of its published knowledge to the US patents. However, the technological performance of CSIC is too low as shown by its non-competitive position in the generation of US Biotechnology patents.

Nevertheless, the knowledge-base generated by CSIC researchers and the high proportion of its scientists cited in US biotech patents indicate the existence of an important human capital in R&D in Biotechnology. These personnel can hopefully be mobilised through initiatives such as a higher cooperation with the national Biotechnological industry. With this aim, new scientific and technological policies should be implemented in Spain, as it has been the case in France and other European countries, oriented to the generation of patents and to technology transfer from the R&D public system to the productive sectors.
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