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Assessing the research performance in excellent research groups in a peripheral country

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Abstract

This paper tries to assess the research performance of excellent research groups during the period 1998-2002 in Valencia, a peripheral Spanish region with low-level absorptive capacity. For that purpose, we use a range of qualitative and quantitative indicators to provide a reliable estimate of the contribution to scientific progress and regional scope made by different research groups. In general, we have found that research groups have diversified their performance with different and non-systematic behaviour, according to different research incentives. This later finding shows an important influence on the performance of industry-university collaboration, R&D and innovation activities.

Assessing the research performance in excellent research groups in a peripheral country

1. Introduction

Increasingly, evaluation studies of scientific performance conducted during the past years focus on the identification of research of the "highest quality", "top research", or "scientific excellence". Achieving and maintaining scientific excellence has always been crucial for leading researchers and scholars working at the international frontiers of science. All of them face, for different reasons and goals, the same pervasive evaluative question: how can one define, recognize and compare "science excellence" as objectively as possible? (Hauser & Zettelmeyer, 1997; Werner & Souder, 1997).

Regarding research, it is paradoxically difficult to "scientifically" evaluate it in research-oriented universities and institutes around the world. The peer review process is one of the most widely accepted by the Scientific Community for selecting and assessing excellence (Gillett, 1989; Roberts, 1999; Kuldell, 2004). New developments in the field of quantitative studies of science offer methods to support peer review in order to keep it objective and transparent. Although, not surprisingly, open and fair applications of peer review evaluation may be difficult to achieve (Horrobin, 1990; Moxham & Anderson, 1992).

Scientific literature recommends criteria to assess quality and excellence in groups (Commission of the European Communities, 2002; Commission of the European Communities, 2003; Commission of the European Communities, 2004; Gulbrandsen, 2000; Gulbrandsen & Langfeldt, 2004; CRUE, 2001). Summarizing main criteria we have found:

Size: Being a group comprises a minimum number of members (for instance, four members in our study). The size of the group may vary depending on the areas, subjects and so on. Each group may associate to its research aim a number of members from others institutions. A bigger size could be, in some cases, an indicator of a larger tendency to multidisciplinary, collaboration, flexibility, opening-up, consolidation and strength of the group. In any case, it is necessary to assess and distinguish between possible ad hoc associations and real groups.

Stability: Research groups used to be in continuous development. Most often, they are constituted around a core group, to which new members may join and existing members may quit in accordance with their interests and the needs of the group. Excellence Groups are expected to form a lasting association which will continue beyond the duration (two, three years or more) over which financial support is provided.

Features of Members of the group : Members of excellence groups are integrated into research centres, universities or technology institute. They should dedicate a considerable part, or even the totality, of their activities in a relevant scientific area. Regarding features of the members of the group, important data to consider in order to know their could be: age of members, academic status (PhD, graduate, technical research assistant …), their experience in research activities (as the manager of projects, contracts and/or other activities in R&D and technology transfer), their professional status (civil servant, contract of employment, grant …).

Research features: Research activities of excellence groups, often multidisciplinary and multi-institutional, and oriented toward long-term objectives within: a) priority thematic areas of international, national or regional R&D Programmes, b) research areas that meet the needs arising from the implementation of policies, c) new and emerging areas at the frontiers of knowledge.

Consolidation of Research activities of the group use to involve: The mutual adaptation of members' research activities so as to strengthen their complementarities; the development and use of information, communication, and interactive work methods; short, medium and long term exchange of personnel, by means of various mobility schemes or through the opening of researchers to other group members; the joint management, transfer and dissemination of knowledge and excellence outside of the group could include: communication activities (conferences, seminar); training of young researchers, developing and reading of Doctoral Thesis by members of the group, publications in international congress or journals, patents, analysing how aspects of their research activities involves and influences in "science and society"; management of projects, contracts and/or other activities in R&D and technology transfer; the development and use of joint research infrastructures and the adaptation of existing pieces of equipment for shared use.

This paper contributes to the development of a valid metric measuring quality-related features of research institutions. The paper is organized as followed: section 2 offers an overview of the Spanish scientific and technological policy. Section 3 presents the descriptive analysis; section 4 covers empirical model and presents the empirical findings. Finally section 5 provides a summary and conclusions.

2. Scientific and technological policy in Spain

In Spain, the two key lines of action of Spanish science and technology policy are the National Plan for Scientific Research and Technological Development (National R&D Plan) and the actions by the Ministry of Industry, Tourism and Trade (MITYC). In addition to these are international actions (joint programmes with European or Latin American countries, etc.), regional ones from the different autonomous communities and even some of those established by the central administration itself (Ballesteros & Rico, 2001; Albert & Plaza, 2004).

The National R&D Plan sets the priorities for action, programmes the resources available and integrates action in the field of R&D of the productive sectors, research institutions and universities. The economic efforts of the National Plan are materialised in the provision of the National R&D Fund. They are aimed largely at the enhancement of basic scientific research and the promotion of communication and concerted actions between universities, firms and public research institutions. While the actions of the National R&D plan are oriented towards basic research and the precompetitive development of technology, Spanish technological policy can be included under the action carried out by the MITYC with a view to favouring industrial innovation. The intervention is designed, among other things, to give incentive to the efforts in technological development and the incorporation of advanced technologies in firms and to improve the competitivity of Spanish industry through an improvement in the quality of its products.

Furthermore, it should be noted that in Spain there are 17 autonomous regions. As a result of the regionalisation, all agents involved in R&D activities depend on 18 authorities, one central and 17 regional governments, with different political ideologies and irregular knowledge of what science and technological policy is and what it should be.

In our particular case, Valencia, the third largest city in Spain, is a peripheral region in the context of the European Union (OCDE, 1997) with low-level absorptive capacity (Cohen and Levinthal, 1989, 1990). It is characterized as a small and open economy, based on a number of traditional industrial micro- and small-sized firm structure, where their owners lacking modern business education or research traditions (COTEC, 1999). Moreover, the Valencia level of R&D spending is even lower than the already low Spanish level, 0.6 and 0.9 percent of GNP, respectively (INE, 2002). This region

profile has an important influence on the research performance of research units.

In this context, Valencian Government tries to lead and impel science and technology policy in order to bring the average level of public and private investment up to that of the most advanced regions of the rest of Spain and Europe. Taking as reference the actions planned in the European and National Frameworks, the Valencian Scientific Research, Technological Development and Innovation Plan (PVIDI) was conceived (Generalitat Valenciana, 2001).

The Valencian Administration proposes by means of the PVIDI a number of courses of action to developed its potential, mitigate its deficiencies and establish suitable orientations for the future. Being included in this purpose is the Public Call for Excellence Groups. Main objectives of this call are related with: encouraging creation, consolidation and projection of the research groups in the region of Valencia; linking them to priority lines of research and enabling them to compete on the best possible terms with other international groups in obtaining results, projects and financial resources; and fostering interdisciplinary research. In this sense, regional government allocation criteria of research resources are based on standard of scientific quality. Competitive bidding has become the habitual procedure for the actions, by means of annual public calls that guarantee an objective criterion of excellence in the granting. Thus, the excellence of the group and its ability to reinforce it and spread it beyond its own members was mainly assessed by the regional government using peer review process.

Peer-review is performed by knowledgeable scientists integrated in ANEP reviewers group, who are not directly involved with the research being evaluated. In fact, reviewers are often scientific competitors. To remove any bias from the review process, most manuscripts (projects, articles prior to publication, etc.) used to be independently considered by several reviewers. Reviewers consider the validity of the approach, the significance and originality of the finding, its interest and timeliness to the scientific community, and the clarity of the writing. Reviewers then provide feedback on the manuscript they have read. Administrations, governments and other agents involved in the scientific community rely on peer-review feedback to guide their decisions. During the assessment process, issues related to conflict of interest of reviewers (reviewers' identities are generally not revealed to manuscript authors) must be intended to be resolved, to get reviewers free from financial, institutional, personal, social or scientifical pressures, allowing them to consider only the objective quality of the science (Kuldell, 2004, Gillett, 1989, Roberts, 1999).

Relatively little is publicly known about the decision processes used by the regional government peer review to assess research performance across research groups that apply for the "public call for excellent research groups".

3. Data and methodology

The data used in this paper was taken from the study "Análisis de la Especialización Temática del Entorno Científico y Tecnológico de la Comunidad Valenciana" carried out in 2004 by the Valencian government. The information comes from those research groups inside the Science and Technology Valencian System that applied in January 2003 for the public aids announcement from the regional government. The data based with 227 observations was built up, of which 185 correspond to university research groups, 22 were public organizations in R&D, 12 were part of the R&D foundations and 8 were technological institutes. The subject areas covered included natural sciences, engineering, medical science, agriculture, social science and humanities. Usable responses were obtained from 4.310 staff, representing a total response rate of approximately 20 per cent. This rate leaves open the possibility of a systematically biased sample.

The information collected were divided into two groups: (i) questions on general characteristics of the research groups, in 2002, such as size, organization structure, etc...; (ii) information about the research activity performed by the research group during the period 1998-2002, such as the number of articles published in international refereed journal, papers presented in international conferences,

doctoral degrees produced, number of doctoral students supervised, funds coming from european, national or regional projects and contracts, and number of "sexenios"(National Committees composed of experts for each group of disciplines are in charge of the assessment of individual research activity. For each period of six years, tenured professors and tenured Scientifics can present their most relevant scientific contribution to corresponding Committee in the hope of receiving a positive assessment: a "sexenio", a symbol of prestige, and a pre-requisite for promotion to higher positions).

Table 1 shows general characteristics of the research groups by type of institutions. Excellence was coded 1 for those research groups that peer reviewers and regional government committee – their evaluation process – considered as "excellent" and 0 for those research groups not evaluated as "excellent". Size comprises the number of members. Academic status was coded as 1 if the personnel of the research group got a PhD degree, 2 means personnel with tertiary-type A education degree (ISCED 5A), 3 means personnel with tertiary-type B education degree (ISCED 5B), and 4 means technical research assistant (OECD, 2004). Labour market status is also measured as code 1 if the personnel staff has a permanent contract and code 0 if the contract is temporary. Age of group members was coded in years.

As we can observe in Table 1, universities –with a great difference and 185 cases -, are the most representative institution in our sample, including excellent groups number. Regarding size, a slight difference only exists among institutions, being the avarage between 18 and 20 members per group. Related to academic status, PhD personnel is the most numerous degree type in entities, excepting R& D foundations and specially technological institutes where tertiary-type A education degree has the highest percentage. Technical research assistants are specially important in the configuration of R&D public organizations and R&D foundations, however, tertiary-type B education degree personnel is relevant in technological institutes and public organizations in R&D. Talking about labour status, descriptive outcomes shows that staff with permanent contract is closed to 80 per cent in most entities, but there are different profiles in technological institutes – where temporary contract is the most representative score – and in R&D foundations where both categories are nearly the same. Referring age, the group average is very similar, being the youngest, the average age in technological institutes group staff .

Table 1. Research group's characteristics by type of institution, 2002.

Research groups	Excellence		**Size**	Academic Status*				Labour Status*		**Age** ***
	No**	Yes**		1	2	3	4	Perm.	Temp	
Universities	73	112	18.8	52.5	43.6	1.6	2.2	80.8	19.2	41.2
Tech. Institutes	7	1	20.3	25.5	62.1	2.5	9.8	25.8	74.2	39.5
R&D Foundations	4	8	18.4	42.0	46.1	1.2	10.7	53.5	46.5	42.8
R&D Pub. Organizations	2	20	20.4	45.9	37.9	4.5	11.7	70.7	29.3	41.5
Total	86	141	19.0	50.4	43.8	1.9	3.9	76.5	23.5	41.3

*Note: * rows add 100 percent, ** columns show number of cases, *** columns show the average value*

Table 2 presents the same characteristics as above of the research groups but by subject area. We can see that natural science is most representative in the total sample and the most efficient in getting the excellence group grant. In medical and social sciences, there are not differences in the excellent condition. By size, slight differences are found among the groups, medical science and humanities are the smallest and engineering groups are the biggest ones. On average age is very similar (around 41 years old) through scientific areas, being a little bit older those in medical science (43.7) and humanities (45.5), and the youngest in engineering (40.1). Academic status structure allow us to see the importance of PhD personnel, specially in humanities and social science, and close to this category is placed the tertiary-type A education degree wiht higher percentages in medical and natural science, and engineering. In general, personnel with tertiary-type B education degree and research assistant have their more important representation in engineering and agriculture. Labour status data show a general tendency to permanent contract across areas, nevertheless, the higher tends to hold temporary contracts, those are in agriculture, medical science and engineering.

Table 2. Research groups' characteristics by subject area, 2002.

Research groups	Excellence		**Size** ***	Academic Status*				Labour Status*		**Age** ***
	No**	Yes**		1	2	3	4	Perm.	Temp	
Natural Science	32	75	18.7	49.7	45.9	1.0	3.4	77.6	22.4	41.1
Engineering	19	27	21.7	48.3	44.5	2.1	5.1	76.0	24.0	40.1
Medical Science	16	15	15.4	45.9	48.7	1.9	3.6	74.8	25.2	43.7
Agriculture	5	8	19.5	46.5	37.2	5.3	11.0	69.7	30.3	40.9
Social Science	12	12	20.5	59.6	35.0	4.5	0.8	77.0	23.0	40.6
Humanities	2	4	15.5	74.1	25.9	0.0	0.0	81.6	18.4	45.5
Total	86	141	19.0	50.4	43.8	1.9	3.9	76.5	23.5	41.3

*Note: * rows add 100 percent, ** columns show number of cases, *** columns show the average value*

Table 3 presents the activity research for those excellent groups and for those non-excellent. We can observe that the number of *sexenios,* publications in SCI/SSCI and publications in international congresses were higher in excellent groups than in non-excellent groups. With respect the funding structure coming from regional, national, international project and competitive actions, measured in thousand euros, we found that the main financial resources came from national project, followed by international projects. On average, the amounts were higher in excellent than in non-excellent research groups. Table 3 also shows, for the same period 1998-2002, the funding structure coming from R&D contracts, technical support contracts, and other contracts related to consultancies and other similar services provision, measured in thousand euros. We can see that non-excellent groups got their funds mainly from contracts related to service provision and technical support in contrast to their excellent counterparts.

Table 3. Research activity performed, period 1998-2002.

Research activity	Non-Excel	Excel.	Total
Quality of research			
Sexenios	8.1	10.7	9.7
Pub. in SCI/SSCI	22.7	50.0	39.8
Pub. Inter. Congress	21.2	30.9	27.3
Funds coming from projects (thousand euro)			
Regional	74.5	76.5	75.8
National	272.8	350.9	321.8
International	128.8	172.9	156.5
Competitive actions	48.3	51.0	50.0
Funds coming from collaborations with firms and administrations (thousand euro)			
R&D	132.8	136.3	135.0
Technical support	65.3	42.6	51.0
Service provision	124.1	34.1	67.6

4. Empirical model and results

To clarify the effect of each explanatory variable on the classification of a research group as excellent, we estimate a probit equation in order to assess the effect of publications on scientific excellence. The estimation results for the excellence equation are presented in Table 4.

Table 4. Probit estimates for excellence of research groups.

Variables	Coef.	z-value
General characteristics		
Size	-0.011	-1.042
Temporal staff	-0.001	-0.057
Pre-doctoral grants	-0.005	-0.156
Post-doctoral grants	0.173	1.232
Quality of research		
Sexenios	0.065	2.452
Pub. in SCI/SSCI	0.011	3.543
Pub. Inter. congress	0.001	0.315
Funds coming from projects		
Regional	0.001	0.169
National	-0.001	-0.040
International	0.001	0.374
Competitive actions	0.001	0.660
Funds coming from collaboration with firms and administrations		
R&D	0.001	0.696
Technical support	0.002	1.700
Service provision	-0.001	-2.006
Control variables: subject area (ref. medical science) and type of institution (ref. R&D public organization		
Natural Science	0.504	1.627
Engineering	0.504	1.358
Agriculture	0.365	0.738
Social Science	0.408	0.984
Humanities	0.548	0.942
Universities	-1.283	-2.558
Tech. institutes	-2.005	-2.148
R&D foundations	-0.737	-1.072
Intercept	-0.124	-0.192
Observations	*227*	
LRchi2(22)	*70.66*	
Prob>chi2	*0.000*	
Log Likelihood	*-115.3*	

Regarding general characteristics (size, temporal staff, pre-doctoral and post-doctoral grants) and projects funds (regional, national, international and competitive actions) include in the equation, Table 4 shows that there is not any significant indicator relates to excellence in the groups. On the other hand, considering aspects of research quality, we highlight the great importance of "sexenios" and SCI/SSCI publications to predict excellence (significance at 1 per cent, in both cases). Related with funds coming from collaborations with firms and administrations, the technical support category and, specially but in a negative sense, the service provision one, are relevant variables in the excellence equation. Finally, the effect of scientific area is not statistical significant to predict excellence (comparing to medical science), however, there are differencies according to the type of institution. Considering the R&D public organizations as the reference, we can observe that universities and technical institutes have a negative influence on the excellence prediction.

5. Conclusions

In this paper we assessed the evaluation process of research groups' performance in the region of Valencia over the period 1998-2002, and the efficiency of such groups. The information comes from those research groups inside the scientific and technological Valencian system that applied in 2003 for the "*public call for excellent research group*", a public aid announcement from the regional government.

In general, we have found that mainly, by institutions, our sample comes from universities and, by scientific areas, comes from Natural Science. Excellent research groups profile has higher number of PhD degree and permanent personnel, "sexenios" and publications (SCI/SSCI and international congress) in the five years period of 1998-2002. Size of the group, the average age of the researchers in the group or doctoral thesis that have been read by members of the research group, do not influence significantly in excellence. On the other hand, main way of obtaining financial resources in excellent groups is national and international research project, but in non-excellent ones, contract funding has an important role.

Finally, this paper provides evidence on evolving patterns of excellence in the Valencia Region. This could become a basis for generating and structuring the mass of competence to meet strategic challenges, disseminating good excellence practice throughout our R&D systems.

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