working papers

RESEARCH IN ECONOMICS IN SPAIN: RANKINGS OF INSTITUTIONS AND AUTHORS *

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Abstract

In this paper we analyse the research in Economics in Spain during the 1990s considering the contributions of both Spanish and foreign economist who have worked in Spain during that period. To do so, we use different bibliometric indicators in order to elaborate rankings for both institutions and researchers. These rankings can be useful for several potentials users such as: a) Evaluation Agencies and Funding Bodies to help them in grant-allocation decisions; b) Graduate students who whish to choose the right institution to complete their postgraduate education, and c) Young Ph Ds who have entered the academic job market and need information about the research perfomance of different institutions.

Keywords: Rankings, economics, bibliometric indicators.

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1 Introduction

The recent history of scientific research in Spain dates back to the promulgation of the so-called "Ley de la Ciencia" in 1986 that provided a legal framework for the creation of a Spanish R&D National Plan that let to develop specific policies in order to promote R&D activities in all scientific fields and disciplines. As a consequence, a growing competition emerged involving some universities and other research centers that were interested in attracting: (i) graduate students for their doctoral programs, (ii) young Ph.D. graduates for their faculties, and (iii) high- skilled undergraduates interested in obtaining a degree in the best universities. Specifically, the recent regulation of the so-called "*Distrito Abierto*" that lifts barriers to students in order to choose their preferred university, irrespectively of their geographical location, should intensify this competition .

Measurement of the scientific output following the R&D National Plans can be of major interest in order to improve the efficiency of future research policies. For example, decision makers can use this information to allocate funds among high- research performance groups and to guide talented Ph.D. students to the best universities. In this respect, some studies and evaluations of policies, scientific disciplines or institutions, have been carried out in Spain since the 1980s. One of the main conclusions is a significant increase in scientific output (measured in terms of scientific papers) that has grown from a share of 1.55% of the total world scientific production to 2.75% during the 1990-1999 period. This increase could be partly, due to the important contribution of the National Evaluation and Prospective Agency (ANEP) that fosters the adoption of merit-based criteria to allocate research funds and earning incentives ("*Tramos de Investigación*") among the best researchers.

In view of the previous discussion, the goal of this paper is threefold: (i) to provide empirical evidence about the Spanish research in Economics during the 1990s; (ii) to construct new indicators which help to ascertain different aspects of scientific productivity; and (iii) to check the robustness of the rankings of departments and researchers constructed from different indicators.

In particular,this paper tries to address the following two questions: (i) *Which are the most productive Spanish institutions in terms of publications in the field of Economics?* and (ii) *Which are the most relevant researchers in that field in Spain?*. According to the previous discussion, providing answers to these questions can be useful for a few potential users amongst which we can identify: fund-allocating institutions, students seeking for good uni-

versities where to do an Economics degree, and young researchers interested in being hired by the best departments where to pursue future research[4].

During the last two decades, Spanish research in Economics has evolved in a very positive way, both in quantitative (number of papers) as in qualitative terms (citations) (see, e.g., Urrutia, 1993). This trend has been identified in international-scope studies (see, e.g., Kalaitzidakis *et al.*, 1999 and 2001, Bauwens *et al,* 2002, and Coupé, 2000) where some Spanish universities appear in very prominent positions.

The bibliometric indicators used in this study are based on the number papers published by each researcher or institution, weighted by number of authors in each paper and by the journal's quality, according to the information gathered from the *Econlit* data base. Additionally, we consider some further indicators based on citation analysis, such as the ranking of the ten authors who have received more citations, or the ten most-cited papers written by Spanish economists during the 1990s. The citation data have been collected using *"Web of Science"* of the Institute for Scientific Information.

Once the goals of this study have been outlined, it is interesting to emphasize which are the main methodological differences between this paper and other similar studies carried out in Spain in the recent past. A key difference is that the latter have only focused on institutional rankings, yet no attempt has been made to construct individual ones, as we do here. Further, the period considered in our study is longer than that used in previous ones. For instance, García *et al.*(1999a) provide a ranking of Spanish institutions quite similar to one of ours based on the KMS criterion (See Section 2), yet they consider only the 1992-1997 period. Likewise, García *et al.* (1999b) restricted their analysis to scientific output published in Spanish journals during the same period (1992-1997). Sanz *et al.* (1999) examine the evolution of the scientific production in Economics during the first half of 1990s. Finally, Bergantiños *et al* (2002) focuses on the second half of the 1990s (1995-1999) and use indicators based on the Journals' Impact Factors from Institute for Scientific Information. In general, all of these studies identify a group of 5 or 6 institutions that are clearly differentiated from the rest. These are four public universities: Alicante, Autónoma de Barcelona, Carlos III de Madrid and Pompeu Fabra, and two research centers: IAE (Instituto de Análisis Económico) and CEMFI (Centro de Estudios Monetarios y Financieros).

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[4]There is a long tradition of ranking Economics Departments in the US (see, e.g., Dusansky and Vernon, 1998, Graves *et al.*, 1982, Medoff, 1996, and Scott and Mitias, 1996).

The rest of the paper is organized as follows. Section 2 is devoted to describe the database, as well as to justify the criteria and indicators used to measure scientific output. Section 3 presents the rankings by institutions and individual authors. Section 4 presents citation- based rankings including the list of ten most-cited papers in the 1990s. Finally, Section 4 draws some conclusions.

2   Data and Methodology

2.1   Data

There are several data sources that can be used to elaborate this type of rankings, being *Econlit* and the *Social Science Citation Index* (SSCI), the two most frequently used for research in Economics. Besides them, some recent studies draw on the publications contained in a limited range of scientific journals, generally those considered to be the most relevant for academic economists (see, Kalaitzidakis *et al.*, 1999). Finally, a third data source can be drawn from researchers' CVs or Institutional Research Summaries. Usually this source is mainly considered to gather complementary information.

In this paper, we have chosen *Econlit* as the main data source, discarding the SSCI which has been used in others studies that consider the impact factors associated to different journals (see, for example, Bergantiños *et al.*, 2002). The main reason for our choice is that *Econlit* provides a wide coverage of Economics and Econometrics journals (around 650), together with its accessibility through Ovid Technologies. Moreover, *Econlit* is the database most frequently used in this type of studies (see, e.g.,Coupé, 2000 and Bergantiños *et al.*, 2002).The main problem with the impact factors provided by ISI is that it contains specialized magazines or divulgation journals, for example *The Economist*, which have impact factors at least four times higher than those of top scientific journals like *American Economic Review*, *Econometrica* or *Journal of Political Economy*.

In short, for the elaboration of the rankings in this study we have considered all papers included *Econlit* with authors (nationals or foreigners) whose affiliation is any Spanish institution over the period 1990-1999, as well as those papers authored by Spanish researchers who work in foreign universities or research centers. From this data base, we initially elaborated extensive rankings for researchers and institutions which served us to identify the first 120 authors and 50 institutions. With that information, we further elaborated two data bases, one for researchers and another for institutions

with 1065 and 2215 papers, respectively, that gather articles published in 236 different journals. The coverage of this second database was significantly better than the original one and helped us to elaborate the final rankings of the top 30 institutions and 40 researchers. Among the top 30 institutions with larger scientific production there are universities and non-university research centers (research departments, foundations, institutes, etc.). In the first group we gathered data from both public and private universities.

For each record (paper) we have the following information: Title, authors, institution, journal, volume and issue, number of pages and year of publication. In Box 1, we summarize the main limitations of Econlit database emphasizing the absence of journals in some scientific fields like Statistics or Applied Mathematics journals (where some econometricians publish most of their work); Business Economics (Accounting, Theory of Organization, etc.) that in some Spanish universities are integrated in Economics Departments. In this sense, we can expect to have an important bias for researchers in the above-mentioned areas. We plan to correct these problems in future work using supplementary data sources like Business Elite for Business Economics or the SSCI.

Box 1.Main deficiencies of Econlit	
1	Omission of authors who sign in fourth or further place.
2	Omission or errors in affiliation field. There can also be errors in dates of publication and page numbers.
3	Confusion with the existence of homonyms in departments/institutions or author's names. Thus for example, "Banco de España" can appear as "Bank of Spain" or "Banco de Espana".
4	Omission of papers published in an issue of a journal. This problem can be a source of bias for authors who publish in journals with low coverage.
5	Reduced coverage of Spanish journals (only 6 journals are included).
6	Omission of journals where econometricians often publish like, for example, Annals of Statistics, Biometrika, Journal of the American Statistical Association, Journal of the Royal Statistical Society, Journal of Time Series Analysis, etc. Similar omissions take place for some of the most prestigious journals in Business Economics.

2.2 Methodology

2.2.1 Indicators used to elaborate the rankings

To construct productivity indicators we have only considered those papers published in scientific journals with peer- review system. We have discarded any other kind of publication such as working papers, books, chapters in books, theses, etc. Since the journals have different quality level, it is necessary to use weighting criteria. We have used four different criteria labelled as UC3, BAU, TC3 and KMS, respectively.

The first two criteria are general since they include the majority of the journals in *Econlit*. Thus, the UC3 criterion is based on the cardinal ranking used by the Department of Economics of Universidad Carlos III de Madrid, which relies on the ordinal rankings of *Econlit* journals by Laband and Piete (1994). The BAU criterion is a cardinal ranking that takes into account both citations and Impact Factor (Bauwens 1999). This criterion is used by the Department of Economics of the Universitè Catholiquè de Louvaine to measure the scientific productivity of economists in Belgium. The other two criteria are more selective because they are restricted to a limited number of top journals. Thus, the TC3 criterion is restricted to journals included in three top tiers of the UC3 one, while the KMS criterion corresponds to the weights used in Kalaitzidakis *et al.* (1999) for the ten journals that, in these authors' opinion, are the most relevant and representative ones where economists publish their papers. A detailed description of the above criteria can be found in Box 2.

There are other three important factors that usually are considered in this kind of studies. These are: (i) the number of authors of each paper (N), (ii) the paper's length, measured in number of AER standardized- pages (see, e.g., Baltagi, 1998, and Kalaitzidakis *et al.*, 1999), and (iii) the number of affiliations (A) of each author. Regarding the number of authors, we have used two weighting criteria. First, we have used a proportional weight (1/N) and, secondly, we have considered a lineal weight given by $P(N) = \frac{1.8}{N}$. As for the length of the paper, it is important to stress that it can only be taken into account for those journals whose adjustment coefficients are available. These are the ten journals considered in the study of Kalaitzidakis *et al.* (1999). In order to make comparisons with the rankings in that study, we only use this criterion for those authors who have published in that set of journals. Hence, for the remaining journals, we only consider the number of authors and the weight for each journal, but not the paper's length. Finally, when an author has signed a paper using several affiliations, we have divided by their

number (A) to assign the paper proportionally to each of the institutions.

It is important to emphasize that the use of different criteria to elaborate the scientific output indicators is highly advisable in this kind of study due to the partial and complementary nature of each of the indicators (Martin, 1996). Further, the use of different rankings obtained from different indicators makes it possible to obtain an *average ranking* that somewhat integrates the available individual information.

Box 2. Description of criteria used to elaborate rankings.
(i) UC3 Criterion
Description: This is a criterion based on Labband and Piette (1994), and extended to a larger set of journals. The Department of Economics of Universidad Carlos III has elaborated a cardinal score for those journals with the aim of implementing criteria for internal promotion and recruitment. **Included journals:** 170 journals in Economics, Econometrics and Financial Economics. **Weights**: Journals are classified in seven groups, acording to the following scoring: Group A (30 points), Group B+ (20 points), Group B (15 points), Group C (8 points), Group D (4 points), Group E (1 point), Group F (0,5 points). Group A journals are American Economic Review, Econometrica and Journal of Political Economy.
(ii) BAU Criterion
Description: This criterion is based on a ranking of Belgian institutions and economists for the 1992-1997 period. **Included journals.** Articles published in journals where authors are afiliated to at least one Belgian university. Books and chapters are excluded. The journals are those included in Econlit excluding Annals of Public and Cooperative Economics, Cahiers Economiques de Bruxelles, Economisch en Sociaal Tijdschrift, and Tijdschrift voor Economie en Management. Overall, data from approximately 600 journals were gathered. **Weights.** The weights are obtained as the product of the total number of citations and the impact factor (C x IF) (Citation Reports 1996 data, Social Science Edition). According to this procedure, a score between 1 and 5 is assigned to each journal in the following way: 5 if C x IF > 5000; 4 if 450 < C x IF < 5000; 3 if 120 < C x IF < 450; 2 if 25 < C x IF < 120; and 1 if C x IF < 25 or if there is no data. Journals with 5 points are: American Economic Review, Econometrica, Harvard Business Review, Journal of Economic Literature, Journal of Finance, Journal of Financial Economics, Journal of Political Economy and Quarterly Journal of Economics.

Box 2. (cont)
(iii) KMS Criterion
Description: This criterion is based on Kalaitzidakis *et al* (1999) who elaborate a ranking of European institutions. **Included journals**. The ten journals that the authors consider to be most relevant in Economics (AER, ECTCA, EER, EJ, JET, JME, JPE, QJE, REStud, REStat). **Weigths.** It includes an adjustment factor for the size of the pages. This is the reason why the number of pages and not the number of articles is considered. The weights are AER=1.0, ECTCA=0.890, EJ=0.128, JET=0.511, JME=0.593, JPE=0.791, QJE=0.645, REStud=0.476, REStat=0.145, EER=0.036.
(iv) TC3 Criterion
Description: This criterion is based on the journals included in groups A, B+ and B of the UC3 criterion. **Included journals and weights:** See UC3 criterion.

2.2.2 Rankings according other indicators: Mean-value publication and timing.

Additionally, two further indicators have been considered. The first one is related to the average quality of the publications in each institution and serves to identify those institutions which get a high position due to their large size via-á-vis those which, being smaller, get a lower number of publications but of a high quality. To do so, we use the indicator $\overline{UC3} = \frac{TUC3}{N}$ where $TUC3$ is the total amount of points achieved by a given institution according to the $UC3$ criterion and N is the number of papers of that institution. As for the second one, it provides a measure of the evolution of research productivity over time by distinguishing those institutions whose researchers published at the beginning of the 1990s from those who did so at the end of the decade. For that, we use a weighted $UC3$, denoted as $UC3(t)$, where the discount factor $t(i) = 1 - (0.05 \cdot i)$, with $i = 1999 - year\ of\ publication$, is used. This indicator serves to distinguish between institutions where research is expanding from those where it is lagging over time. Finally, we should notice that no correction for the size of the different institutions has been made. This caveat is due to the difficulties related to identifying the correct size over a decade, and to the existence of different departments in different universities where research in Economics is undertaken. For instance, there are universities where the areas of Economics, Applied Economics, Business or Econometrics belong to the same department whereas they are in different

departments in other universities. Moreover, there are universities which were only created in the late 1980s and whose departments have widely varied in size along the 1990s.

3   Results

Next, we present the rankings of institutions and researchers elaborated with the above-mentioned bibliometric indicators

3.1   Rankings of Institutions

Concerning the institutions, Table 1 shows the ranking of the 30 top universities and research centres obtained from the general indicators UC3 and BAU, as well as the number of articles for each institution. Table 2, in turn, displays the ranking obtained from the TC3 and KMS selection criteria. In all cases we present the results obtained with the weight $1/N$, given that the use of the weighing $p(N)$ hardly changes the classification. As it can be observed, Carlos III, Pompeu Fabra, UAB, Alicante and Pais Vasco, as well as the Instituto de Análisis Económico (IAE/CSIC), are in the top positions. If we were to consider UAB and IAE as a single institution (labelled as "Campus de Bellaterra" by Bergantiños *et al.*, 2000) due to the strong relationship among the researchers in both institutions, then this group becomes the top one according to the UC3, BAU and TC3 criteria, while Pompeu Fabra is clearly the leader when the KMS criterion is used. Regarding the research centres that are not universities, the top ones, besides IAE, are CEMFI, FEDEA and IVIE. The absence of private universities in these rankings is noteworthy. This, in some cases, may be due to their recent creation and, in many others, to the fact that these centres give much more importance to teaching than to research duties. Broadly speaking, one could define these centers as *colleges*, rather than genuine university departments.

Table 1. Ranking of institutions (UC3 and BAU criteria, weight = 1/N)

	Institution	N	UC3		Institution	N	BAU
1	U. Carlos III	259	100	1	U. Carlos III	231	100
2	U. Pompeu Fabra	247	82.23	2	U. Pompeu Fabra	216	82.73
3	U. Alicante	172	57.11	3	U. Autónoma Barcelona	155	56.99
4	U. Autónoma Barcelona	180	52.84	4	U. Alicante	148	54.06
5	IAE	104	50.22	5	U. País Vasco	163	52.74
6	U. País Vaco	179	46.63	6	U. Valencia	230	52.42
7	U. Valencia	310	35.13	7	Banco de España	215	50.20
8	Banco de España	224	30.74	8	U. Complutense	196	50.08
9	CEMFI	75	29.84	9	IAE	100	46.48
10	U. Complutense	242	28.72	10	U. Zaragoza	142	35.09
11	U. Zaragoza	186	25.11	11	CEMFI	69	28.48
12	U. Pública Navarra	80	13.84	12	U. Barcelona	83	24.70
13	U. Barcelona	122	12.03	13	U. Alcalá Henares	60	16.38
14	U. Santiago Compostela	25	9.39	14	U. Pública Navarra	62	14.56
15	IVIE	50	9.31	15	U. Oviedo	66	13.11
16	U. Vigo	41	9.13	16	FEDEA	58	11.55
17	U. Alcalá Henares	71	8.91	17	U. Autónoma Madrid	35	9.95
18	FEDEA	65	7.90	18	IVIE	44	9.66
19	U. Oviedo	81	7.59	19	U. Vigo	33	9.23
20	U. Cantabria	36	7.45	19	U. Salamanca	31	9.23
21	U. Salamanca	41	5.62	21	U. Cantabria	30	7.72
22	U. Murcia	51	4.65	21	U. Santiago Compostela	25	7.62
23	U. Valladolid	46	4.10	23	U. Valladolid	31	7.62
24	U. Las Palmas	45	4.09	24	U. Murcia	32	6.69
25	U. Autónoma Madrid	43	3.98	25	U. Las Palmas	31	5.84
26	U. A Coruña	26	3.70	26	Ministerio Economía	26	5.64
27	U. Málaga	30	3.46	27	U. La Laguna	22	5.52
28	Fund. Empresa Pública	32	3.20	28	U. Málaga	22	5.18
29	Ministerio Economía	36	3.01	29	U. Extremadura	13	4.51
30	U. Jaume I	40	2.74	30	U. Jaume I	27	4.41

Source: Econlit (OVID Technologies) and own elaboration.

Table 2. Ranking of institutions (TC3 and KMS criteria, weight = 1/N)

	Institution	N	TC3		Institution	N	KMS
1	U. Carlos III	85	100	1	U. Pompeu i Fabra	55	100
2	U. Pompeu Fabra	105	89.41	2	U. Carlos III	27	56.26
3	IAE	61	64.19	3	U. Autónoma Barcelona	17	43.55
4	U. Alicante	52	51.51	4	IAE	17	38.94
5	U. Autónoma Barcelona	53	48.27	5	U. Alicante	8	24.82
6	U. País Vaco	45	36.57	6	CEMFI	10	15.46
7	CEMFI	35	32.94	7	Banco de España	8	6.16
8	Banco de España	20	19.86	8	FEDEA	5	4.01
9	U. Zaragoza	17	12.35	9	U. País Vasco	1	3.93
10	U. Pública Navarra	17	11.74	10	U. Salamanca	1	3.47
11	U. Valencia	14	10.98	11	U. Zaragoza	9	2.38
12	U. Santiago Compostela	11	10.88	12	U. Complutense	2	2.25
13	IVIE	13	8.94	13	U. Vigo	2	1.88
14	U. Complutense	7	8.29	14	U. Valencia	3	1.55
15	U. Vigo	9	7.25	15	U. Pública Navarra	2	1.25
16	U. Cantabria	4	6.04	16	U. Alcalá Henares	3	1.09
17	U. Barcelona	5	4.27	17	Ministerio Economía	3	0.21
18	FEDEA	6	3.67	18	IVIE	1	0.13
19	U. Salamanca	3	3.02	19	U. Oviedo	1	0.03
20	U. Alcalá Henares	4	2.63	20			
21	U. A Coruña	2	2.07	21			
22	U. Oviedo	3	1.94	22			
23	Ministerio Economía	4	1.62	23			
24	U. Girona	2	1.55	24			
24	U. Extremadura	1	1.55	25			
24	U. Sevilla	1	1.55	26			
24	INE	1	1.55	27			
28	ESADE	2	1.04	28			
29	U. Valladolid	1	0.78	29			
29	Fund. Empresa Pública	1	0.78	30			

Source: Econlit (OVID Technologies) and own elaboration.

As for the use of the $\overline{UC3}$ indicator, Table 3 shows that the institutions which publish the best papers on average are IAE (6.73), CEMFI (5.54), Carlos III (5.38), Santiago de Compostela (5.23), Pompeu Fabra (4.64), Alicante (4.63), UAB (4.09) and UPV (3.63).

Table 3. Ranking of institutions ($\overline{UC3}$ criterion, weight = 1/N)

Pos	Institution	$\overline{UC3}$	Pos	Institution	$\overline{UC3}$
1	IAE	6.73	16	U. Zaragoza	1.88
2	CEMFI	5.54	17	U. Alcalá Henares	1.75
3	U. Carlos III	5.38	18	FEDEA	1.69
4	U. Santiago Compostela	5.23	19	U. Complutense	1.65
5	U. Pompeu Fabra	4.64	20	U. Málaga	1.61
6	U. Alicante	4.63	21	U. Valencia	1.58
7	U. Autónoma Barcelona	4.09	22	F. Empresa Pública	1.39
8	U. País Vasco	3.63	23	U. Barcelona	1.37
9	U. Vigo	3.10	24	U. Oviedo	1.31
10	U. Cantabria	2.88	25	U. Autónoma Madrid	1.29
11	IVIE	2.60	26	U. Murcia	1.27
12	U. Pública Navarra	2.41	27	U. Las Palmas	1.27
13	U. A Coruña	1.98	28	U. Valladolid	1.24
14	Banco de España	1.91	29	Ministerio Economía	1.17
14	U. Salamanca	1.91	30	U. Jaume I	0.96

Source: Econlit (OVID Technologies) and own elaboration.

Finally, Table 4 displays the results obtained from using the $UC3(t)$ indicator. When compared with Table 1, it can be observed that Carlos III and UPF still occupy the two top positions. Yet, the relative differences among the institutions are lower with the time-weighted indicator than with the unweighted one. Indeed, there are several institutions (País Vasco, UAB, IAE, Alicante, Banco de España, Valencia, Complutense, Zaragoza, CEMFI, UPN and Santiago de Compostela) which experience a large reduction in their differences vis-á-vis the top ones.

Table 4. Ranking of institutions (UC3(t) criterion, weight = 1/N)

Pos	Institution	UC3(t)	Pos	Institution	UC3(t)
1	U. Carlos III	100.00	16	IVIE	11.43
2	U. Pompeu - Fabra	82.39	17	FEDEA	10.58
3	U. País Vasco	71.43	18	U. Oviedo	7.50
4	U. Autónoma Barcelona	70.32	19	U. Cantabria	7.49
5	IAE	67.96	20	U. Málaga	6.21
6	U. Alicante	61.78	21	F. Empresa Pública	6.17
7	Banco de España	52.46	22	U. Vigo	5.55
8	U. Valencia	49.29	23	U. Murcia	4.74
9	U. Complutense	43.74	24	UNED	4.68
10	U. Zaragoza	38.12	24	U. Las Palmas	4.68
11	CEMFI	36.65	26	U. Salamanca	3.82
12	U. Pública Navarra	21.88	27	U. Extremadura	3.80
13	U. Santiago Compostela	16.00	28	U. Valladolid	3.67
14	U. Barcelona	14.21	29	IEF	3.62
15	U. Alcalá Henares	11.64	30	U. Autónoma Madrid	3.54

Source: Econlit (OVID Technologies) and own elaboration.

3.2 Rankings of Researchers

Regarding the ranking of researchers, Tables 5 and 6 show the classifications obtained for the 40 most productive researchers by using the UC3 and BAU indicators with weights (1/N) and P(N), respectively. Tables 7 and 8, in turn, present the rankings obtained using the TC3 and KMS indicators (with the above-mentioned weights). According to those criteria, Jordi Galí (UPF and NYU), Fabio Canova (UPF), Xavier Vives (IAE), Manuel Santos (Arizona State), Xavier Sala-i-Martin (UPF and Columbia), J. Victor Ríos-Rull (Penn) and Fernando Vega-Redondo (Alicante) are in the top five positions, depending on which indicator is used in each instance. It should be pointed out that, with the exception of F. Vega-Redondo and X. Vives, a large number of those in the top positions have developed their research careers in foreign universities. It is also noteworthy that some of the best-known Spanish academic economists occupy a slightly lower positions. This could be due to the concentration of a large share of their research before the 1990s, or to having their publications in journals of the areas of Statistics or Corporate/Business Economics, that are not registered in *Econlit*. Another interesting fact to highlight is that, even though researchers of Pompeu Fabra occupy three of the five first positions of the ranking of researchers, this university is only second in the ranking of institutions according to the

UC3 and BAU criteria. This may be caused by having a high concentration of publications among a small selected group of researchers. By contrast, the fact that Carlos III comes the first in these rankings, in spite of having less researchers in the main group, can be due to the higher dispersion of their scientific production among its researchers.

Table 5. Ranking of researchers (UC3 and BAU criteria, weight = 1/N)

	Author	N	UC3		Author	N	BAU
1	Galí, J	27	100	1	Galí, J	27	100
2	Vives, X	24	73.71	2	Canova, F	26	98.63
3	Canova, F	26	71.68	3	Vives, X	24	81.51
4	Vega-Redondo, F	21	55.74	4	Sala-i-Martin, X	25	68.26
5	Santos, M	17	54.29	5	Santos, M	17	51.82
6	Sala-i-Martín, X	25	51.29	6	Dolado, JJ	37	49.08
7	Dolado, JJ	37	47.27	7	Sentana, E	18	45.89
8	Serrano, R	19	45.62	8	Vega-Redondo, F	21	45.66
9	Sentana, E	18	41.51	9	Silvestre, J	15	45.44
10	Mas Colell, A	18	36.72	10	Serrano, R	20	44.75
11	Motta, M	17	34.82	11	Motta, M	17	36.75
12	Rios Rull, JV	13	33.83	12	Rios-Rull, JV	13	36.07
13	Arellano, M	14	32.07	13	Campa, JM	17	35.62
14	Silvestre, J	15	31.17	14	Mas-Colell, A	14	34.89
15	Campa, JM	17	30.53	15	Arellano, M	14	34.70
16	Boldrin, M	13	29.99	16	Boldrin, M	12	31.51
17	Brusco, S	9	29.54	17	Padilla, J	13	29.68
18	Matutes, C	15	29.31	18	Caminal, R	11	28.08
19	Kranich, L	6	29.13	19	Caballé, J	11	28.08
20	Padilla, J	13	28.18	20	Ley, E	12	28.08
21	Marimon, R	12	25.63	21	Brusco, S	8	27.40
22	Barbera, S	13	24.48	22	Barbera, S	13	26.78
23	Pérez Castrillo, D	18	24.34	23	Alba, A	9	26.71
24	Delgado, M	13	23.62	24	Kranich, L	6	26.03
25	Caminal, R	11	23.58	25	Marimon, R	11	25.79
26	Maravall, A	7	22.40	26	Delgado, M	13	25.58
27	Caballé, J	11	22.22	27	Pérez-Castrillo, D	15	24.89
28	Bentolila, S	13	21.91	28	Faig, M	7	24.66
29	Moreno, D	10	21.52	29	Goerlich, F	12	23.97
30	Khun, KU	6	21.14	30	Mármol, F	6	23.97
(Cont.)							

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Table 5 (Cont)

	Author	N	UC3		Author	N	BAU
31	Sakovics, J	10	20.64	31	Matutes, C	15	22.60
32	Candeal, R	15	20.51	32	Zilibotti, F	8	22.60
32	Indurain, E	15	20.51	33	Corchón, L	10	22.37
34	Esteban, J	10	20.28	34	Usategui, JM	11	21.92
35	Hidalgo, J	7	20.10	35	Fatás, A	8	21.23
36	Corchón, L	13	19.47	36	Burguet, R	9	21.23
37	Masso, J	8	19.38	37	Maravall, A	7	21.00
38	Zilibotti, F	9	19.11	38	Esteban, JM	9	21.00
39	Espinosa, MP	10	19.04	39	Gonzalo, J	8	20.55
40	Fatás, JM	8	18.70	40	Hidalgo, J	7	20.32

Source: Econlit (OVID Technologies) and own elaboration.

Table 6. Ranking of researchers (TC3 and KMS criteria, weight = 1/N)

	Author	N	TC3		Author	N	KMS
1	Gali, J	23	100	1	Gali, J	15	100
2	Vives, X	20	74.13	2	Ríos Rull, JV	8	71.35
3	Canova, F	18	62.24	3	Santos, M	9	70.10
4	Santos, M	13	50.82	4	Canova, F	9	44.12
5	Vega-Redondo, F	13	50.82	5	Sala-i-Martín, X	10	43.06
6	Sala-i-Martin, X	13	44.76	6	Boldrin, M	6	33.59
7	Serrano, R	14	43.36	7	Esteban, JM	6	31.93
8	Dolado, JJ	14	38.46	8	Marimon, R	8	31.30
9	Sentana, E	12	37.53	9	Brusco, S	4	29.73
10	Rios-Rull, JV	9	32.87	10	Vives, X	8	27.56
11	Motta, M	11	32.87	11	Barbera, S	4	26.23
12	Arellano, M	8	30.07	12	Ortigueira, S	3	26.07
13	Kranich, L	6	30.07	13	Serrano, R	6	24.93
14	Boldrin, M	8	28.67	14	Sentana, E	4	20.89
15	Mas Colell, A	11	27.97	15	Mas Colell, A	4	19.67
16	Brusco, S	6	27.97	16	Caballé, J	4	19.32
17	Matutes, C	11	27.74	17	Vega Redondo, F	3	18.43
18	Padilla, J	10	27.27	18	Zilibotti, F	5	18.27
19	Campa, JM	9	26.57	19	Kranich, L	3	17.28
20	Marimon, R	10	25.64	20	Ciccone, A	2	16.15
21	Barbera, S	11	24.24	21	De Frutos, MA	2	15.74
22	Silvestre, J	8	23.78	22	Arellano, M	4	15.27
23	Moreno, D	9	22.15	23	Dolado, JJ	5	14.97
24	Hidalgo, J	7	20.75	24	Celentani, M	2	14.93
24	Khun, KU	5	19.58	25	Marhuenda, F	1	14.47
24	Caminal, R	6	19.58	26	Zapatero, F	2	14.38
24	Esteban, JM	7	19.35	27	Novales, A	1	13.71
28	Sakovics, A	7	18.88	28	Cabrales, A	2	13.55
29	Masso, J	7	18.88	29	Ferreira, JL	1	12.24
29	Bentolila, S	7	18.88	30	Sakovics, A	2	10.93

Table 6 (Cont)

	Author	N	TC3		Author	N	KMS
31	Espinosa, MP	7	18.88	31	Calsamiglia, X	1	9.52
32	Delgado, M	5	17.48	32	Marcet, A	3	9.48
33	Candeal, JM	10	17.25	33	Khun, KU	1	9.14
34	Induráin, E	10	17.25	34	Silvestre, J	5	8.82
35	Zilibotti, F	5	16.78	35	Campa, JM	4	8.52
36	Fatás, A	5	16.78	36	De la Fuente, A	1	8.12
37	Velilla, S	2	16.78	37	Marín, JM.	1	8.12
38	Pérez-Castrillo, D	7	15.85	38	Alcalde, J	2	7.73
39	Caballé, J	4	15.38	39	Masso, J	2	7.44
40	Lobato, I	5	15.38	40	Ahn, N	1	7.33

Source: Econlit (OVID Technologies) and own elaboration.

Table 7. Ranking of researchers (UC3 and BAU criteria, weight = P(N))

	Author	UC3		Author	BAU
1	Gali, J	100	1	Canova, F	100
2	Vives, X	79.05	2	Gali, J	94.05
3	Canova, F	76.78	3	Vives, X	79.05
4	Santos, M	67.14	4	Sala-i-Martin, X	76.43
5	Sala-i-Martin, X	63.07	5	Dolado, JJ	60.95
6	Vega Redondo, F	57.39	6	Santos, M	59.76
7	Dolado, JJ	57.31	7	Sentana, E	51.67
8	Serrano, R	55.08	8	Silvestre, J	50.00
9	Sentana, E	50.05	9	Serrano, R	49.29
10	Rios Rull, JV	41.16	10	Vega Redondo, F	44.52
11	Mas-Colell, A	40.75	11	Campa, JM	43.33
12	Motta, M	40.00	12	Rios Rull, JV	41.90
13	Campa, JM	39.45	13	Motta, M	39.29
14	Arellano, M	37.94	14	Arellano, M	39.05
15	Barbera, S	37.89	15	Mas- Colell, A	38.33
16	Boldrin, M	37.19	16	Padilla, J	36.67
17	Marimon, R	36.98	17	Boldrin, M	36.19
18	Matutes, C	36.93	18	Marimon, R	34.29
19	Silvestre, J	36.68	19	Pérez Castrillo, D	32.62
20	Padilla, J	36.43	20	Caballe, J	31.19
21	Pérez Castrillo, D	32.76	21	Barbera, S	30.95
22	Candeal, JC	32.01	22	Delgado, M	30.71
23	Induráin, F	32.01	23	Esteban, JM	29.76
24	Esteban, JM	30.40	24	Matutes, C	29.29
24	Delgado, M	29.45	25	Candeal, JC	28.57
24	Brusco, S	28.89	26	Indurain, E	28.57
24	Moreno, D	28.24	27	Ley, E	27.62
28	Kranich, L	28.14	28	Caminal, R	26.43
29	Sakovics, J	27.74	29	Alba, A	23.57

Table 7. (Cont)

	Author	UC3		Auhtor	BAU
30	Caballe, J	27.54	30	Brusco, S	25.24
31	Caminal, R	26.23	30	Gonzalo, J	25.24
32	Bentolila, S	25.83	32	Sakovics, J	25.00
33	Khun, KU	24.87	32	Zilibotti, F	25.00
34	Macho, I	24.55	34	Bentolila, S	24.52
35	Masso, J	24.12	34	Macho, I	24.52
36	Hidalgo, J	23.62	36	Corchón, L	24.29
37	Corchón, L	23.47	37	Faig, M	23.81
38	Zilibotti, F	23.14	38	Jimeno, JF	23.57
39	Espinosa, MP	22.66	39	Kranich, L	23.33
40	Peris, JE	20.75	39	Mármol, F	23.33

Source: Econlit (OVID Technologies) and own elaboration.

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Table 8. Ranking of researchers (TC3 and KMS criteria, weight = P(N))

	Author	TC3		Author	KMS
1	Gali, J	100	1	Gali, J	100
2	Vives, X	79.74	2	Santos, M	96.02
3	Canova, F	65.97	3	Rios Rull, JV	86.80
4	Santos, M	63.38	4	Sala-i-Martin, X	61.42
5	Sala-i-Martin, X	55.84	5	Marimon, R	48.28
6	Serrano, R	54.03	6	Esteban, JM	48.01
7	Vega-Redondo, F	52.47	7	Canova, F	45.47
8	Sentana, E	46.49	8	Boldrin, M	45.06
9	Dolado, JJ	44.42	9	Barberá, S	40.45
10	Mas Colell, A	39.74	10	Ortigueira, S	30.31
11	Rios Rull, JV	39.22	11	Vives, X	29.86
12	Barbera, S	37.66	12	Serrano, R	29.65
13	Motta, M	37.40	13	Mas Colell, A	29.29
14	Marimon, R	36.88	14	Brusco, S	28.16
15	Padilla, J	35.58	15	Caballé, J	28.04
16	Arellano, M	35.32	16	Sentana, E	27.62
17	Boldrin, M	35.06	17	Zilibotti, F	25.96
18	Matutes, C	35.06	18	Ciccone, A	24.93
19	Campa, JM	34.29	19	Vega Redondo, F	24.67
20	Esteban, JM	29.09	20	Zapatero, F	21.42
21	Moreno, D	29.09	21	Arellano, M	21.15
22	Kranich, L	29.09	22	Dolado, JJ	17.80
23	Silvestre, J	28.57	23	Celentani, M	16.70
24	Brusco, S	27.53	24	de Frutos, MA	16.12
24	Candeal, JC	27.27	25	Kranich, L	16.09
24	Induráin, E	27.27	26	Calsamiglia, X	14.18
24	Sakovics, J	24.94	27	Marcet, A	14.14
28	Hidalgo, J	24.42	28	Cabrales, D	14.08
29	Masso, J	23.90	29	Khun, KU	13.61
30	Bentolila, S	23.64	30	Marhuenda, F	13.47

Table 8. (Cont)

	Author	TC3		Author	KMS
31	Khun, KU	23.64	31	Novales, A	12.76
32	Espinosa, MP	23.12	32	Silvestre, J	12.21
33	Caminal, R	22.08	33	Campa, JM	12.15
34	Pérez Castrillo, D	21.82	34	Sakovics, J	12.13
35	Delgado, M	21.30	35	de la Fuente, A	12.09
36	Caballe, J	20.52	36	Marín, JM	12.09
37	Zilibotti, F	20.26	37	Ferreira, JL	11.40
38	Lobato, I	19.74	38	Masso, J	11.07
39	Peña, D	18.70	39	Díaz Jimenez, J	10.99
40	Fatás, A	17.92	40	Faig, M	10.58

Source: Econlit (OVID Technologies) and own elaboration.

Finally, we analyze the degree of correlation among the different criteria so far used. Table 9 shows the Spearman range-correlation coefficients among the eight criteria that we have considered (UC3, BAU, TC3 and KMS with weights (1/N) and P(N), respectively) for the top 30 institutions. The most striking result is that the most selective criterion (KMS) is less correlated with BAU than with any other criterion, for both sets of weights The intuition behind this result is that the range of points between the best journals and those which are less credited is very small (from 5 points to 1 point; see Box 2). Thus this indicator is favorable to those researchers who have a large amount of articles, irrespectively of their quality, in contrast with the rest of criteria that either have a larger range of variation in their scores or focus on a limited number of journals, therefore favoring the quality of the publications. Thus, if the purpose of a criterion is to combine quantity and quality, the BAU criterion seems to be the least appropriate.

Table 9. Rank correlation matrix of different criteria for top 30 institutions.

	UC3	BAU	TC3	KMS	UC3(P)	BAU(P)	TC3(P)	KMS(P)
UC3	1.000							
BAU	.866	1.000						
TC3	.932	.760	1.000					
KMS	.640	.599	.648	1.000				
UC3(P)	.954	.800	.895	.644	1.000			
BAU(P)	.880	.901	.772	.592	.992	1.000		
TC3(P)	.920	.729	.966	.680	.947	.826	1.000	
KMS(P)	.638	.546	.642	.995	.650	.592	.685	1.000

Note: All correlations are significant at 1% level (two-sided test).

3.3 Distribution of publications by journals

Besides the rankings of institutions and researchers, we have also analyzed the distribution of publications by journal with the aim of identifying those journals which contain more publications. Although we will not report detailed evidence in this respect, in order to save space, the following conclusions were reached from the analysis of the distribution of publications (1065) by journals for the first 120 authors[5]. *Investigaciones Económicas*, *Economics Letters* and *Journal of Economic Theory* are the journals with the largest number of published articles. Moreover, the number of articles in the second half of the 1990s (661) has increased by 64% with respect to the number of articles in the first half of that decade. When considering the distribution of publications restricted to the group of the 10 top journals considered in the KMS criterion, the growth rate in the number of publications is 22%. Overall, 193 articles were published in those journals, being *JET* (52) and *EER*(39) those that have more publications, and *JPE* (5) and *QJE*(3) the ones that have the least.

Further, we have also studied the evolution over time of the number of co-authored articles, which is an indicator of the degree of collaboration among researchers. It was found that there has been a progressive increase, from 1.56 to 1.89, in the average of the number of authors by article and an upward trend, with the exception of 1999, in the total number of joint publications during the decade.

4 Citation-based rankings.

In this section we measure the impact of the publications in terms of the number of citations subsequently generated in the research of other authors In Economics, as in other sciences, it is a well- known fact that there is a core of prestigious authors that do not publish frequently but whose research cause a great impact. Those authors, will not necessarily be placed in top positions in the previous rankings in spite of the existence of a general consensus about the importance of their publications. In order to measure this impact we use the number of citations weighted by author for those articles published and cited during the 1990s. The number of citations corresponds to the times that a publication appears in the list of references of an article. For example, according to the impact indicator, if an article with three

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[5] Detailed evidence can be found in the working paper version of this study (see Dolado *et al.*, 2000)

authors has had 60 citations during the 1990s, the indicator will assign 20 citations for each author. The search of the number of citations has been undertaken with the help of the on-line access to the source of data Web of Science from the Institute of Scientific Information. Table 10 shows the ranking of the 10 most cited researchers obtained through this indicator. The outstanding position obtained by Xavier Sala-i-Martín, whose papers on Growth Theory have had a strong impact on the literature, may be highlighted. Alternatively, another indicator of citations during the 1990s has been calculated. This indicator, presented in Table 11, shows the impact during the 1990s of articles published at any moment of time. In this case, the first position is occupied by Andreu Mas-Colell, whose citations almost double those of the following researchers. Finally, Table 12 displays a list of the 10 articles written during the 1990s that have been most quoted during that decade. In this classification, as it happened with Table 11, the article "Convergence" (JPE, 1992) by Xavier Sala-i-Martín, co-authored with Robert Barro, has a number of citations that almost doubles those of the second most cited article.

Table 10. Ten most cited authors
(papers published and cited in the 1990s)

Pos	Author	Citations[a]
1	Sala-i-Martin, X	397.5
2	Galí, J	191.3
3	Vives, X	123.0
4	Saint-Paul, G	121.5
5	Arellano, M	105.5
6	Canova, F	83.8
7	Boldrin, M	79.2
8	Motta, M	71.5
9	Dolado, J	65.6
10	Barberá, S	62.2

Source: Web of Science (ISI)

(a) Citations weighted by number of authors

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Table 11. Ten most cited authors

(papers published any time and cited in the 1990s)

Pos	Author	Citations
1	Mas Colell, A	1087
2	Sala-i-Martin, X	653
3	Dolado, J	505
4	Vives, X	455
5	Arellano, M	325
6	Marcet, A	285
7	Canova, F	283
8	Gali, J	258
9	Barberá, S	219
10	Bentolila, S	180

Source: Web of Science (ISI)

Table 12. Ten most cited papers published in the 1990s

Pos	Author	Article	Citations
1	Sala-i- Martin, X	"Convergence" JPE 1992 (Joint with R. Barro)	293
2	Arellano, M.	"Some tests of specification for panel data: Monte-Carlo evidence and an application to employment equations",. Rev Econ Stud 1991. (Joint with S.Bond)	156
3	Dolado, JJ	"The power of cointegration tests", Oxford B Econ Stats,1992 (Joint with J.Kremers and N. Ericsson)	130
4	Bentolila,S. J.	"Firing costs and labor demand : How bad is eurosclerosis?" Rev Econ Stud 1990 (Joint with G.Bertola)	92
5	Galí, J	"How well does the IS/LM model fit post war US data?" QJE,1992	63
6	Sala-i-Martin, X.	"Public Finance in models of endogenous growth" Rev Econ Stud 1992 (Joint with R. Barro)	60
6	Boldrin, M.	"Equilibrium models displaying endogenous fluctuations and chaos: A survey" JME, 1990 (Joint with M. Woodford)	60
8	García-Milá, T.	"The contribution of publicly provided inputs to states economies" Regional Science and Urban Economics, 1992, (joint with T. McGuire)	49
9	Vives, X.	"Nash equilibrium with strategic complementarities" , J. Math Econ, 1990	48
10	Sala-i-Martin, X	"Capital Mobility in Neoclassical Models of Growth" AER 1995, (Joint with R.Barro and N.G.Mankiw)	48

Source: Web of Science (ISI)

5 Conclusions

In this paper we have elaborated rankings about research in Economics of institutions and researchers during the 1990-1999 period by using several bibliometric indicators that try to measure the quality of those scientific journals where economists publish their works. The main conclusions stemming from those rankings (bearing in mind the existing biases in the database that we used) may be summarized as follows:

- Concerning institutions, we found that, irrespectively of the criterion used, UAB, Alicante, Carlos III and Pompeu -Fabra, as well as the Instituto de Análisis Económico (IAE), are the top five institutions with larger and better scientific production. When considering the publications included in *Econlit*, the "Campus de Bellaterra" (UAB and IAE) is in the first position, whereas, when considering a limited number of top journals, Pompeu Fabra comes first.

- Concerning researchers, Jordi Galí (UPF and NYU) was the most outstanding researcher during the last decade, followed by Fabio Canova (UPF), Xavier Vives (IAE) , Manuel Santos (Arizona), Xavier Sala-i-Martin (UPF and Columbia) , J. Victor Rios-Rull (Penn) and Fernando Vega-Redondo (Alicante), depending on the criterion being used.

- Concerning the impact of the publications, measured by the number of citations weighted by the number of authors, we found that Xavier Sala-i-Martín is the most influential reasearcher, and his article "Convergence" (JPE, 1992, with R. Barro) was the most cited paper during the last decade. If we extend the index of citations to include references to articles published during or before the 1990s, the most quoted author turns out to be Andreu Mas-Colell (UPF).

Regarding issues that may be dealt with in future research, we may highlight the following: (i) analysing the link between the Ministry of Education's financing and the quality of scientific production of those research institutions that receive funding; (ii) elaborating rankings of institutions that consider the size of institutions, therefore obtaining average or per capita indicators ; (iii) studying the dependence of the scientific productivity of each institution on its most prolific researchers, and (iv) extending the sample period beyond 1999.

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