Sociedad de Estadística e Investigación Operativa
Test (2000) *Vol.* **9**, *No.* 1, pp. 000–000

Statistical research in Europe: 1985–1997

Juan A. Gil, Daniel Peña and Julio Rodríguez*
Departamento de Estadística y Econometría
Universidad Carlos III de Madrid, Spain.

Abstract

This work presents a descriptive analysis of statistical research in Europe in the period 1985–1997. Research productivity is measured by using the volume of articles published in a set of journals with high impact index. We present a comparison of the research productivity of the different countries in this period, and study their dynamic evolution by comparing the research productivity in the first and the last five years in the sample. This type of analysis is also applied to compare the statistical research institutions in Europe.

Key Words: Bibliometrics, productivity rankings, quality indices, trends of countries, trends of institutions.
AMS subject classification: 62-00

1 Introduction

The analysis of objective measures of research productivity is important in order to evaluate the relative position of each institution and to establish strategies for improvement. This analysis is also important at the country level in order to identify the strengths and weakness of different scientific fields and to evaluate the resource allocation efficiency. For instance, Caballero and Peña (1987) analyzed the relative efficiency of funds allocation in Spain and found that this efficiency has been very high. Analyzing research productivity is becoming standard practice in many scientific fields. In the field of statistics, Phillips, Choi and Schochet (1988) present the

*Correspondence to: Julio Rodríguez, Departamento de Estadística y Econometría, Universidad Carlos III de Madrid, C/Madrid 126, 28903 Getafe, Madrid, Spain. Email: puerta@est-econ.uc3m.es

This research has been sponsored by DGES (Spain) under project PB-96-0111 and by the Cátedra BBV de Calidad.

Received: October 1999; Accepted: December 1999

first study of countries and institutions research productivity by using a worldwide sample of refereed journals over the period 1980–1986. Genest (1997) updates the study of Phillips, Choi and Schochet by comparing the countries and institutions statistical research output between 1985 and 1995. Genest (1999) compares research productivity and publication habits in probability and statistics in the period 1986–1995, and detects significant cultural differences between the two fields. Finally, Gil, Peña and Rodríguez (1999) compare the trends in statistical research productivity in the most productive institutions in the world in the period 1985-1997. In this article we will use this last data base to analyze statistical research in Europe.

As indicated in the previous references, measuring the research productivity of an institution in a given period of time is not an easy task, because of the many dimensions that should be taken into account. First, we have to define the research output of the members of the institution, second, we have to decide the relative weight of each piece of research and third, we have to decide how to combine these different contributions. The normal measures of research output in the field of statistics are based on the number of articles published in refereed statistical journals. This choice can be criticized, because this variable clearly does not represent the total research contribution. It does not include books, PhD. theses, or articles published in subject matter journals. However, it is generally accepted that, although incomplete, the number of articles in the key journals of the field is the single most important variable to evaluate the research excellence of an institution and we will use this measure in this study. In order to apply this measure, we have to decide the relative weight of each article. There are three key variables to be considered: (1) number of authors, (2) article length and (3) publishing journal. The usual procedure is to weight each article by a factor

$$F = \frac{P}{A} I,$$

where P is the number of adjusted pages of the article, A is the number of authors and I is an indicator variable that takes the value 1 if the journal is included in the data base used and 0 otherwise. Again this weighting can be criticized in a number of ways. First, the contribution of an article is not in general related to its length. Second, this method penalizes articles written by several authors. Third, the final results could be strongly influenced by the journals included in the data base. However, it is not

easy to overcome these limitations. Some authors have proposed weighting each article by its impact factor, defined as the number of references it has received in a period of time (see section 2), but there are also some objections to this option: the result will depend very much on the period considered and some important papers are only recognized as such after several years. Also, theoretical papers are usually referenced more than practical papers in statistical journals but the situation may be reversed if we include journals in the subject matter field. Also, some people disagree with dividing the pages by the number of authors. Finally, with respect to the variable I some people have suggested weighting the journals by their impact factor. For instance, Dusansky and Vernon (1998) use this criterion to produce rankings of U.S. Economics Departments. Again there is no general agreement on this approach, because in many fields, and in particular in statistics, journals that publish survey papers will be possibly overweighted with respect to top research journals.

Given the previous problems we have decided to follow the most standard practice and use as measure of research productivity of a given author, the number of proportional adjusted pages published by this author (PAG as defined by Genest, 1997). This measure, widely used by previous workers in the field, has the advantage of allowing comparison with previous works and preventing us from introducing our personal biases into this analysis. To illustrate the computation of PAG, suppose that a member of an institution has written three articles, the first one on his own, (23 adjusted pages), the second one in collaboration with another author (18 adjusted pages) and the third one in collaboration with two other authors (21 adjusted pages). Then the value of PAG for this author will be PAG=23+18/2+21/3=39.

Other measures used in this study are:

ART: The number of articles published by an author, where each article is divided by the number of coauthors. Thus a joint paper by two coauthors is counted as 0.5 ART for each one.

AUT: The number of persons in a given institution that appear as authors or coauthors of any paper.

DIS: The number of distinct individuals in a given institution having authored or coauthored at least one article in the Data Base.

INST: The number of distinct institutions which have at least one author

Abbrev	Journals	Impact Factor
AS	The Annals of Statistics	**.978**
ASM	Annals of the Institute of Statistical Mathematics	**.287**
BIOICS	Biometrics	**1.051**
BIOIKA	Biometrika	**.989**
ISR	International Statistical Review	.698
JASA	Journal of the American Statistical Association	**1.403**
JMA	Journal of Multivariate Analysis	.333
JSPI	Journal of Statistical Planning and Inference	.262
CJS	The Canadian Journal of Statistics	.305
JRSSB	Journal of the Royal Statistical Society, Series B	**2.108**
SCJST	Scandinavian Journal of Statistics	**.467**
STSIN	Statistica Sinica	.398
TECHNO	Technometrics	**1.384**

Table 1: Averaged Impact Factor (1992–1996) of Journals included in the database. Bold numbers indicate journals with a half life bigger than 10.

or coauthor in the Data Base.

The rest of this article is organized as follows. In section 2, we define the data base used in this study. In section 3, we analyze the productivity of European Countries. In section 4, we analyze the productivity of the main European statistical research institutions. Section 5 includes some final remarks. Appendix A shows a table with the top 150 European institutions ranked by their productivity in period 1993–1997. Finally, Appendix B gives a brief analysis of statistical research institutions in Spain.

2 The Data Base

The data base is a subset of the one used by Gil, Peña and Rodríguez (1999). This main data set consists of all research articles on statistical theory published in the period 1985-1997, both years included, in 13 journals which can be considered as the core of the methodological contribution to statistical research. Table 1 presents these journals and their average impact factors in the last five years of the sample. The *impact factor* of a journal in a given year is defined as *the number of current citations to articles published in a specific journal in a two year period divided by the total number of articles published in the same journal in the corresponding two year period.* The *half life* is defined as *the number of journal publication*

Journal	Perc. of Journal over World	Perc. of Journal over Europe	Index of European participation	Perc. of Europe over journal
AS	15.75	16.80	1.07	25.33
ASM	5.30	4.35	.82	19.47
BIOICS	10.93	8.99	.82	19.53
BIOIKA	7.56	8.87	1.17	27.87
ISR	3.15	5.69	1.81	42.86
JASA	18.28	8.75	.48	11.37
JMA	8.06	9.98	1.24	29.38
JSPI	11.82	14.10	1.19	28.31
CJS	3.65	1.48	.41	9.64
JRSSB	5.00	8.83	1.77	41.95
SCJST	3.10	8.77	2.83	67.16
STSIN	3.37	1.72	.51	12.10
TECHNO	4.03	1.66	.41	9.79
	100	100		

Table 2: *Relative contribution of journals to the European countries output in the period 1985–1997.*

years going back from the current year which account for 50% of the total citations given by the citing journal in the current year. This data have been taken from *SCI Journal Citation Report.* Although this set of journals may underestimate the statistical contributions in some fields, as for instance, in the important field of computational statistics or in the interface between statistics and econometrics, a set of similar journals has been used by previous authors and we believe it is broadly reasonable. Also comparing Genest (1997) and Genest (1999) it seems that this type of analysis is fairly robust to moderate changes in the set of journals chosen.

The pages of the journals have been adjusted following the suggestion by Phillips, Choi and Schochet (1988) and Genest (1997). We have used the factors proposed by Genest (1997), that are calculated using the printed surface of journals, choosing *The Annals of Statistics* as the reference journal, and multiplying the number of pages of an article by the corresponding journal factor to obtain the number of adjusted pages. The productivity of an institution is the sum of the proportional adjusted pages of all the authors that sign papers under the name of that institution. The productivity of a Country is the sum of those of all their institutions.

Gil, Peña and Rodríguez (1999) analyze the trend of this set of jour-

Country	AS	ASM	BIOICS	BIOIKA	ISR	JASA	JMA	JSP	CJS	JRSSB	SCJST	STSIN	TECH	χ^2
Belgium	19.5	4.7	4.0	2.6	3.1	18.1	11.1	20.3	2.1	5.8	2.4	5.9	.6	.22
Switzerland	17.2	3.7	4.0	5.9	8.6	18.7	11.9	17.6	1.5	3.6	3.3	1.9	2.1	.23
Italy	12.8	8.3	3.8	13.8	8.3	17.6	7.7	12.5	1.6	4.3	6.0	.5	2.9	.27
Ireland	24.0	—	9.1	17.4	—	22.8	3.7	11.1	—	8.1	—	—	3.7	.41
Germany	29.7	6.2	4.9	5.5	2.1	7.3	15.2	19.3	.8	1.7	4.9	1.5	.8	.44
Spain	10.0	5.5	5.6	5.7	3.9	14.4	19.2	26.1	1.8	2.0	.6	1.7	3.7	.45
France	16.5	4.2	15.2	4.4	2.4	3.4	17.0	15.9	3.0	4.7	11.5	1.8	—	.54
Netherlands	31.0	1.7	10.0	1.9	7.4	8.3	12.9	12.8	1.6	.8	9.7	.4	1.5	.59
Austria	10.6	—	8.2	12.2	—	9.1	20.7	33.9	—	2.6	—	2.7	—	.92
U.K	8.5	1.7	13.4	17.8	8.5	9.0	2.2	7.2	1.2	23.0	2.1	2.4	2.9	1.08
Russia	27.8	1.9	—	2.4	—	4.5	16.2	36.1	—	—	6.7	4.4	—	1.15
Hungary	30.7	4.2	—	1.1	2.2	—	26.1	21.7	10.0	1.5	2.4	—	—	1.19
Poland	18.9	7.1	1.2	1.5	—	3.5	27.6	30.8	2.3	—	5.6	.8	.7	1.20
Bulgaria	29.3	8.7	—	5.9	—	—	6.3	30.7	4.7	—	14.2	—	—	1.30
Czechoslovakia	20.7	22.4	—	4.2	—	3.9	10.5	38.4	—	—	—	—	—	1.63
USSR	39.5	—	3.4	2.6	14.3	1.4	14.2	4.5	—	20.1	—	—	—	1.74
Lithuania	27.8	—	—	—	—	—	24.8	36.4	—	—	11.0	—	—	1.77
Finland	2.2	1.6	11.0	7.9	—	19.0	8.5	8.8	1.3	5.8	25.7	4.3	3.9	1.85
Portugal	—	—	17.3	5.1	—	7.8	—	47.2	—	11.2	11.4	—	—	1.90
Greece	1.3	34.0	3.2	.9	1.2	3.4	10.9	32.5	7.2	—	1.9	2.7	.9	2.42
Sweden	6.5	4.9	4.6	4.6	12.8	8.8	7.9	13.8	.8	1.7	30.2	1.6	1.9	2.88
Denmark	16.0	4.6	11.8	7.7	11.1	3.1	1.0	2.0	.6	9.2	32.4	—	.6	3.37
Norway	11.0	.2	9.2	8.2	4.8	15.3	3.2	5.4	—	3.0	37.9	—	1.7	4.15
Slovenia	—	—	—	—	—	100	—	—	—	—	—	—	—	4.47
Yugoslavia	—	—	—	—	19.7	9.6	61.5	9.2	—	—	—	—	—	5.05
Rumania	—	54.1	—	—	—	—	24.2	21.7	—	—	—	—	—	5.66
Estonia	—	35.9	—	—	—	—	64.1	—	—	—	—	—	—	6.53
Iceland	—	—	21.0	—	—	—	—	—	—	—	79.0	—	—	19.6
Luxembourg	—	—	—	—	100	—	—	—	—	—	—	—	—	30.8
World	15.8	5.3	10.9	7.6	3.2	18.3	8.1	11.8	3.7	5.0	3.1	3.4	4.0	0

Table 3: Percentage of adjusted pages which have been published by each country in the thirteen listed journals of Table 1.

nals. They show that all the journals increase their number of adjusted pages per year, but there is a clear change over time in the contributions that each journal represents to the total output. The percentage contribution increases the most in the *Journal of Statistical Planning Inference*, where this variable goes from 8% in 1985 to 18% in 1997. *Statistica Sinica* appears in 1991 and in 1997 has reached the fifth position in the percentage contribution to this data base. Two journals have a clear decreasing output: *Biometrika*, that moves from around 9% in 1985 to 6% in 1997, and *Technometrics*, that moves from 6% in 1985 to 3.3% in 1997.

Table 2 shows in its first two columns how World and European productivity is distributed over the thirteen journals contained in our data base. The third column shows the index of European participation, defined as the ratio of the second column with respect to the first one. The last column presents the percentage of pages in each journal that are published by authors from institutions in Europe. We can conclude that *Technometrics* and *The Canadian Journal of Statistics* are the least "European" of this list of journals, whereas *Scandinavian Journal of Statistics*, *International Statistical Review* and *Journal of the Royal Statistical Society B* have a clear influence.

Table 3 presents the distribution of European countries' productivity over the thirteen journals in the period 1985–1997 and compares it with the distribution of the World productivity of these journals (last row of the table). As a measure of comparison we use the χ^2 distance: $\sum_i (p_i - \hat{p}_{i,j})^2/p_i$, where p_i is the percentage of the World output published in the i-th journal and $\hat{p}_{i,j}$ is the same but for the j-th European country. The countries have been ordered using this χ^2 distance. The larger the value of this χ^2 distance, the larger the deviation from the World distribution. This table confirms and clarifies some of the previous comments. It is interesting to note that journals linked to a country or group of countries show a clear bias in the direction of the sponsoring country. For instance, the U.K. output is very concentrated in the *Journal of the Royal Statistical Society B* and *Biometrika*, while the Scandinavian countries are overweighted in the *Scandinavian Journal of Statistics*. Also the output of each country is usually concentrated in a few journals. On the other hand, Belgium, Switzerland and Italy have a journal output distribution similar to that of the World.

Country	Average	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
U.S.	52.9	54.6	53.6	53.0	52.2	55.3	55.9	56.1	55.5	53.1	53.7	51.5	46.2	50.8
Canada	8.3	7.0	8.4	7.0	9.9	9.1	7.7	7.4	10.0	9.8	7.6	7.8	9.3	6.5
U.K.	6.7	9.2	8.3	6.2	7.2	5.4	6.4	7.0	5.7	6.3	6.0	7.2	6.3	7.1
Australia	3.8	3.5	3.9	5.2	4.2	3.6	2.9	2.6	3.6	4.1	4.6	2.8	4.0	3.9
New Zealand	.6	.5	.8	.7	.4	.2	.6	.8	.9	.4	.5	.7	.4	.6
Hong Kong	.5	.4	.2	—	.4	.2	.3	.4	.0	.2	.4	.7	1.2	1.2
Total	72.7	75.2	75.3	72.1	74.4	73.9	73.7	74.3	75.7	73.8	72.7	70.6	67.4	70.2

Table 4: *Relative contribution of the English speaking countries to the output productivity of our data base.*

3 Trends in Productivity in European Countries

In this section we will analyze the trends in productivity of European Countries. As most journals included in the data base are published only in English, a bias towards English speaking countries is expected. In fact, as shown in Table 4, U.S., U.K., Canada, Australia, New Zealand and Hong Kong account for 73% of the total statistical research output in these journals.

Table 5 shows the relative contribution of each European country to the World output (number of adjusted pages published by authors of the country divided by total number of adjusted pages in the year), in the thirteen years considered in our analysis. This table shows a clear trend in the contribution of some countries. For instance, the U.K. and Denmark, have a downward trend, whereas Germany and the Mediterranean countries have a clear upward trend. In order to analyze the dynamic evolution in these thirteen years we have compared productivity in the first five years in the sample to productivity in the last five years. Table 6 shows the productivity of the European countries in these two periods, as measured by PAG of each country, and the percentage of their contribution with respect to the total European output (%). Countries have been sorted in decreasing order of their productivity in the last period, 1993–1997. To make the comparison easier, the fifth column presents the position of the countries in the period 1985–1989. The last column shows the relative change in the percentage of contribution between both periods. The countries with

Country	Average	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
U.K	6.70	9.17	8.30	6.23	7.19	5.42	6.38	6.99	5.69	6.28	5.97	7.18	6.28	7.11
Germany	4.37	3.57	3.65	4.27	2.96	3.58	4.35	3.72	4.24	4.91	5.08	4.67	4.70	5.68
France	2.08	.61	1.26	1.48	.99	1.87	2.41	2.17	2.20	1.80	1.82	3.34	2.68	2.87
Netherlands	1.71	1.93	.75	1.61	1.45	2.42	1.98	1.97	1.72	1.22	1.29	1.86	2.00	1.82
Denmark	1.34	1.62	2.33	1.85	.98	2.91	2.11	1.89	1.24	.89	1.34	.61	.45	.59
Norway	.86	1.51	.82	.91	1.36	.45	1.30	.44	.69	.37	1.81	1.03	.56	.41
Sweden	.85	1.09	1.24	1.31	.66	1.01	.64	.93	.07	.80	.83	.63	1.01	1.06
Belgium	.77	.61	.07	.07	.66	.62	.50	.55	.85	.39	1.34	1.30	1.02	1.18
Spain	.76	—	.27	.15	.62	.66	.45	.42	.60	.92	.99	1.65	.85	1.36
Poland	.70	.53	.54	.77	1.02	.97	.72	.40	1.22	.58	.51	.82	.48	.62
Italy	.66	.17	.18	1.04	—	.31	.54	.50	.53	.83	1.08	.71	.94	1.12
Switzerland	.56	.49	.33	.46	.36	.54	.17	.46	.21	.58	1.15	.47	.59	1.10
Finland	.48	.66	.60	.64	.77	.76	.17	.38	.57	.59	.28	.45	.25	.39
Greece	.43	.32	.61	.38	.44	.58	.12	.43	.23	.38	.33	.47	.67	.53
Austria	.27	—	.08	.23	.33	.23	.15	.22	.26	.28	.54	.36	.52	.04
Hungary	.26	.61	.59	.25	.54	.35	.06	.59	—	.16	.29	—	.22	.08
USSR	.19	.33	.05	—	.47	.20	.45	.56	.09	.39	.10	—	—	—
Ireland	.19	.24	.49	.21	.14	—	.24	.07	.07	.33	.15	.19	.34	.04
Czechoslovakia	.14	.13	.19	.09	.15	.15	.17	—	.28	.05	.08	.12	.19	.16
Russia	.13	—	—	—	—	—	—	—	—	—	.09	.20	.52	.50
Bulgaria	.07	—	.06	—	.11	.13	—	.23	—	.04	.08	.19	.06	—
Portugal	.06	—	.11	—	—	.09	—	—	.09	—	.05	.32	.02	—
Yugoslavia	.04	—	.03	—	—	.16	.11	—	—	.20	—	—	—	—
Lithuania	.03	—	—	—	—	—	—	.10	.11	—	—	—	.05	.13
Iceland	.02	—	—	—	—	—	—	.05	—	—	—	.17	—	—
Rumania	.02	—	.07	.07	—	—	—	—	.09	—	—	—	—	—
Estonia	.01	—	—	—	—	—	—	—	—	.05	—	.10	—	—
Luxembourg	.01	—	—	—	—	—	—	—	—	—	.09	—	—	—
Slovenia	.00	—	—	—	—	—	—	—	—	—	—	.03	—	—
Europe	23.7	23.6	22.6	22.0	21.2	23.4	23.0	23.0	21.1	22.1	25.3	26.9	24.6	26.8

Table 5: *Contribution of the European countries to the World output in the period 1985–1997.*

Country	93-97			85-89			Change
	Pos	PAG	%	Pos	PAG	%	%
U.K	1	5159.9	26.15	1	3649.6	31.81	-17.8
Germany	2	3946.3	20.00	2	1828.7	15.94	25.5
France	3	1993.2	10.10	5	642.9	5.60	80.3
Netherlands	4	1302.0	6.60	4	840.7	7.33	-9.9
Spain	5	905.4	4.59	14	183.4	1.60	187.1
Belgium	6	825.9	4.19	13	211.9	1.85	126.6
Italy	7	737.2	3.74	15	172.2	1.50	149.0
Sweden	8	684.8	3.47	6	533.4	4.65	-25.3
Norway	9	638.3	3.23	7	509.6	4.44	-27.2
Switzerland	10	611.3	3.10	12	222.7	1.94	59.6
Denmark	11	594.1	3.01	3	986.7	8.60	-65.0
Poland	12	471.3	2.39	8	398.4	3.47	-31.2
Greece	13	380.0	1.93	10	239.4	2.09	-7.7
Finland	14	302.9	1.54	9	352.4	3.07	-50.0
Austria	15	270.9	1.37	18	93.2	.81	69.1
Russia	16	220.1	1.12	—	—	—	—
Ireland	17	163.7	.83	17	103.5	.90	-8.1
Hungary	18	117.9	.60	11	234.6	2.04	-70.8
Czechoslovakia	19	97.6	.49	19	71.5	.62	-20.6
USSR	20	69.7	.35	16	110.7	.96	-63.4
Portugal	21	59.8	.30	21	21.0	.18	65.9
Bulgaria	22	56.3	.29	20	33.3	.29	-1.8
Lithuania	23	31.1	.16	—	—	—	—
Yugoslavia	24	28.6	.14	22	20.8	.18	-20.0
Iceland	25	25.4	.13	—	—	—	—
Estonia	26	22.3	.11	—	—	—	—
Luxembourg	27	13.3	.07	—	—	—	—
Slovenia	28	4.6	.02	—	—	—	—
Rumania	—	—	—	23	14.1	.12	—

Table 6: *Evolution of position, adjusted pages and percentage of contribution in European countries between the first and the second sample periods.*

the biggest relative increases are Spain, Italy, Belgium and France. Spain almost triples its percentage contribution, and goes up nine positions in the ranking: from 14th to 5th. A similar pattern of growth is observed in Italy and Belgium. France doubles its percentage of contribution and goes from fifth to third position. The countries with the biggest relative decrease are Hungary, Denmark and Finland. Hungary goes down seven position and Denmark moves from third position, in the period 1985–1989, to eleventh position, in the period 1993–1997. The U.K. is first in both periods but suffers, in relative terms, a slight decrease (around 17.8%) which in absolute terms is a loss of 5% of its percentage of contribution between both periods. The decrease of U.K. and the increase of Germany have reduced the difference between both countries from 16% in 1985–1989 to 6% in 1993–1997, what would imply, if this trend does not change, that the U.K. will move to a second position behind Germany in the near future.

Table 7 shows the number of different institutions (INST) and different authors (DIS) that appear in the Data Base for each European country in the first and last five years. Columns six and seven present the relative increases in the number of institutions and authors in the second period with respect to the first period. The last two columns are the average productivity for institutions (PAG/INST) and authors (PAG/DIS) from each country. It can be seen that there is a negative correlation between increasing the number of different authors and the average productivity per author (PAG/DIS). This may be due to the entrance of many young statisticians that have initially a lower productivity than more senior people (see Spain, Italy, Austria and France). On the opposite side, Sweden, Norway and Denmark have a decrease in the number of different authors but a large productivity per author. Note that the average number of adjusted pages published by european author in the last five years is 15.2 (see Table 7). As the average length of a statistics paper is about 15 pages (see Genest, 1999), this average productivity may correspond, for instance, to two papers of average length, jointly with one co-author, or to one single author paper, in a period of five years. It is interesting to stress that this average productivity is fairly stable among European countries, and goes (for countries with at least two authors) from a minimum of 10 (Portugal) to a maximum of 23.4 (Ireland).

Finally, Table 8 compares the percentage of contribution to statistics and the percentage of contribution to science (*all fields combined*) for each country. The latter has been taken from the *Second European Report on*

Country	93-97		85-89		Change (%)		93-97	
	INST	DIS	INST	DIS	INST	DIS	$\frac{PAG}{INST}$	$\frac{PAG}{DIS}$
U.K	96	321	85	245	13	31	53.7	16.1
Germany	84	197	56	109	50	81	47.0	20.0
France	56	174	27	74	107	135	35.6	11.5
Netherlands	28	96	21	51	33	88	46.5	13.6
Spain	23	79	14	21	64	276	39.4	11.5
Belgium	15	42	9	18	67	133	55.1	19.7
Italy	35	66	14	18	150	267	21.1	11.2
Sweden	14	39	20	43	-30	-9	48.9	17.6
Norway	13	38	16	39	-19	-3	49.1	16.8
Switzerland	14	39	11	19	27	105	43.7	15.7
Denmark	12	37	13	40	-8	-8	49.5	16.1
Poland	16	33	14	40	14	-18	29.5	14.3
Greece	9	30	6	23	50	30	42.2	12.7
Finland	10	23	12	27	-17	-15	30.3	13.2
Austria	5	21	5	8	0	163	54.2	12.9
Russia	9	19	—	—	—	—	24.5	11.6
Ireland	4	7	4	8	0	-13	40.9	23.4
Hungary	5	10	4	13	25	-23	23.6	11.8
Czechoslovakia	4	7	4	7	0	0	24.4	13.9
USSR	3	4	8	12	-63	-67	23.2	17.4
Portugal	6	6	1	4	500	50	10.0	10.0
Bulgaria	3	5	3	4	0	25	18.8	11.3
Lithuania	2	3	—	—	—	—	15.6	10.4
Yugoslavia	1	1	3	4	-67	-75	28.6	28.6
Iceland	1	1	—	—	—	—	25.4	25.4
Estonia	1	1	—	—	—	—	22.3	22.3
Luxembourg	1	1	—	—	—	—	13.3	13.3
Slovenia	1	1	—	—	—	—	4.6	4.6
Rumania	—	—	1	1	—	—	—	—
Europe	**471**	**1301**	**351**	**828**	**34.2**	**57.1**	41.9	15.2

Table 7: Number of institutions and authors in European countries.

	Statistics			Science			
Country	85-89	93-97	Change	84-89	90-95	Change	Rate
	%	% (1)	%	%	% (2)	%	(1)/(2)
U.K	31.81	26.15	-17.8	21.22	19.85	-6.5	1.3
Germany	15.94	20.00	25.5	14.33	15.94	11.2	1.3
France	5.60	10.10	80.3	11.91	12.63	6.0	0.8
Netherlands	7.33	6.60	-9.9	4.63	5.15	11.3	1.3
Spain	1.60	4.59	187.1	2.79	4.47	60.3	1.0
Belgium	1.85	4.19	126.6	2.21	2.36	6.8	1.8
Italy	1.50	3.74	149.0	6.20	7.50	21.0	0.5
Sweden	4.65	3.47	-25.3	4.24	4.08	-3.7	0.9
Norway	4.44	3.23	-27.2	1.22	1.22	0.3	2.6
Switzerland	1.94	3.10	59.6	3.32	3.59	8.1	0.9
Denmark	8.60	3.01	-65.0	2.05	2.04	-0.5	1.5
Poland	3.47	2.39	-31.2	2.23	2.08	-6.8	1.1
Greece	2.09	1.93	-7.7	0.69	0.86	24.3	2.2
Finland	3.07	1.54	-50.0	1.54	1.68	8.5	0.9
Austria	0.81	1.37	69.1	1.36	1.52	12.2	0.9
Russia	—	1.12	—	15.78	10.65	-32.5	0.1
Ireland	0.90	0.83	-8.1	0.46	0.49	7.2	1.7
Hungary	2.04	0.60	-70.8	1.11	0.95	-14.5	0.6
Czechoslovakia	0.62	0.49	-20.6	1.54	1.63	5.8	0.3
USSR	0.96	0.35	-63.4	—	—	—	—
Portugal	0.18	0.30	65.9	0.23	0.41	77.1	0.7
Bulgaria	0.29	0.29	-1.8	0.62	0.56	-10.2	0.5
Lithuania	—	0.16	—	—	—	—	—
Yugoslavia	0.18	0.14	-20.0	—	—	—	—
Iceland	—	0.13	—	0.05	0.06	39.9	2.0
Estonia	—	0.11	—	—	—	—	—
Luxembourg	—	0.07	—	—	0.02	—	3.1
Slovenia	—	0.02	—	—	—	—	—
Rumania	0.12	—	—	0.28	0.26	-6.8	—

Table 8: Comparison between the percentage of contribution to statistics and the percentage of contribution to science.

S & T Indicators 1997, which includes data until 1995 of the contribution in the following fields: clinical medicine, biomedical research, biology chemistry, physics, mathematics, engineering and earth & spaces sciences. As the data for the comparison are only available until 1995, Table 8 compares the periods, 1984-1989 and 1990-1995. The columns entitled *change* show the relative increase of the percentage of contribution in the second period, with respect to the first period. The last column, *Rate*, shows the rate between the contribution to statistic and the contribution to science in the last period. Firstly, it can be observed that the increase in the contribution to statistics is correlated to the increase in the contribution to science. The countries with the biggest relative increases in their contributions to science are Portugal and Spain, which also has the largest increase in its contribution to statistics. The three countries with the largest bias towards statistics are Norway, Greece and Belgium. On the other hand, Russia, Italy, France, Hungary and Czechoslovakia have a contribution in statistics less than in science in general.

4 Trends in Institutions

In this section we will analyze trends in productivity of institutions in European countries. Before presenting this analysis we have to make two comments. Firstly this analysis may have a bias towards the biggest institutions. Secondly a decrease in the percentage of contribution may not imply a decrease in productivity, but a smaller growth than the other European institutions. It must be taken into account that a reduction in the relative contribution can also be due to the incorporation, in the second period, of 120 new European institutions that did not appear in the first period 1985–1989.

Table 9 shows the 50 European institutions with the biggest productivity in the period 1985–1989. For each of them, we include the percentage of contribution over the total of Europe (%) and the position that the institution occupies in the ranking of European institutions in this period. The last column gives the positions in the period 1993–1997, so that we may observe the evolution of each institution in the ranking. Imperial College is in the first position in both periods, but in the last one (see Table 10) it moved from 3.37% to 2.09%, losing about a 38% of its relative contribution. The next two institutions in Table 9 belong to Denmark, and in the

Country	Institution	85-89		93-97
		%	Pos	Pos
U.K.	Imperial College	3.37	1	1
Denmark	Univ. of Aarhus	3.17	2	4
Denmark	Univ. of Copenhagen	1.95	3	49
Norway	Univ. of Oslo	1.81	4	11
Germany	Univ. of Heidelberg	1.52	5	3
Sweden	Univ. of Stockholm	1.49	6	102
U.K.	Univ. of Surrey	1.38	7	22
U.K.	Univ. of Warwick	1.30	8	38
U.K.	Univ. of Southampton	1.20	9	7
U.K.	Univ. of Bath	1.20	10	58
U.K.	Univ. of Birmingham	1.18	11	160
Denmark	Univ. of Aalborg	1.17	12	110
U.K.	Univ. of Durham	1.17	13	158
U.K.	Univ. of Oxford	1.10	14	50
Hungary	Univ. of Szeged	1.09	15	—
U.K.	Univ. of StAndrews	1.06	16	132
U.K.	Univ. of Glasgow	1.05	17	31
U.K.	Univ. of Reading	1.04	18	272
Germany	Univ. of Cologne	1.04	19	20
Netherlands	Univ. of Leiden	0.94	20	17
Finland	Univ. of Oulu	0.94	21	54
U.K.	Univ. of Sheffield	0.92	22	57
Poland	Academy of Agriculture in Poznan	0.91	23	95
U.K.	Univ. of Leeds	0.91	24	25
U.K.	Univ. of Edinburgh	0.88	25	181
Netherlands	Univ. of Utrecht	0.86	26	83
U.K.	Univ. College London	0.85	27	10
U.K.	Rothamsted Experimental Station	0.80	28	—
U.K.	Univ. of Kent	0.79	29	9
U.K.	Univ. of Cambridge	0.79	30	6
Germany	Freie Univ. of Berlin	0.78	31	30
Belgium	Univ. Libre de Bruxelles	0.78	32	37
Netherlands	Centre for Math. and Comp. Science	0.76	33	414
Denmark	Royal Veterinary and Agricul. Univer.	0.74	34	139
France	Université Paris VI	0.72	35	14
Poland	Univ. of Wroclaw	0.71	36	46
Netherlands	Free Univ. Amsterdam	0.70	37	59
Germany	Univ. of Essen	0.70	38	78
France	INRA	0.69	39	8
U.K.	Univ. of Liverpool	0.68	40	72
Hungary	Hungarian Academy of Sciences	0.66	41	97
U.K.	Univ. of London	0.66	42	48
Denmark	Novo Research Institute	0.65	43	—
Sweden	Univ. of Lund	0.65	44	19
Germany	Univ. of Hamburg	0.60	45	111
France	Université Paul Sabatier	0.59	46	5
Greece	Univ. of Athens	0.59	47	15
U.K.	Univ. of Newcastle	0.59	48	62
Netherlands	Univ. of Twente	0.57	49	64
Germany	Univ. of Bonn	0.57	50	179

Table 9: The top 50 European institutions in the period 1985–1989 and their contribution to the total european research output. The symbol (−) means that this institution did not appear with any contribution in the period 93-97.

Country	Institution	93-97		85-89
		%	Pos	Pos
U.K.	Imperial College	2.09	1	1
U.K.	London School of Economics	2.07	2	83
Germany	Univ. of Heidelberg	1.93	3	5
Denmark	Univ. of Aarhus	1.56	4	2
France	Université Paul Sabatier	1.53	5	46
U.K.	Univ. of Cambridge	1.49	6	30
U.K.	Univ. of Southampton	1.35	7	9
France	INRA	1.21	8	39
U.K.	Univ. of Kent	1.21	9	29
U.K.	Univ. College London	1.17	10	27
Norway	Univ. of Oslo	1.16	11	4
Germany	Univ. of Giessen	1.12	12	107
Germany	Humboldt Univ. of Berlin	1.08	13	89
France	Université Paris VI	1.06	14	35
Greece	Univ. of Athens	1.06	15	47
Belgium	Université Catholique de Louvain	0.99	16	321
Netherlands	Univ. of Leiden	0.95	17	20
U.K.	Univ. of Lancaster	0.91	18	76
Sweden	Univ. of Lund	0.90	19	44
Germany	Univ. of Cologne	0.88	20	19
Germany	Univ. of Gottingen	0.84	21	70
U.K.	Univ. of Surrey	0.82	22	7
U.K.	Univ. of Nottingham	0.82	23	175
U.K.	Univ. of Bristol	0.81	24	316
U.K.	Univ. of Leeds	0.81	25	24
Spain	Univ. Carlos III Madrid	0.81	26	—
Netherlands	Erasmus Univ.	0.79	27	96
Norway	Univ. of Bergen	0.78	28	111
Belgium	Limburgs Universitair Centrum	0.76	29	72
Germany	Freie Univ. of Berlin	0.74	30	31
U.K.	Univ. of Glasgow	0.73	31	17
Germany	Katholische Univ. of Eichstatt	0.73	32	—
U.K.	Nuffield College	0.72	33	304
Switzerland	ETH Zurich	0.71	34	53
Germany	Ruhr Univ. of Bochum	0.70	35	212
Switzerland	Univ. of Zurich	0.66	36	277
Belgium	Univ. Libre de Bruxelles	0.66	37	32
U.K.	Univ. of Warwick	0.66	38	8
Germany	Univ. of Dortmund	0.65	39	186
Germany	Univ. of Bielefeld	0.64	40	142
Switzerland	Univ. of Geneve	0.63	41	130
Germany	Technical Univ. of Aachen	0.63	42	125
Spain	Univ. of Cantabria	0.6o	43	227
U.K.	Imperial Cancer Research Fund.	0.59	44	73
Germany	Univ. of Munich	0.57	45	274
Poland	Univ. of Wroclaw	0.57	46	36
Italy	Univ. of Rome	0.55	47	108
U.K.	Univ. of London	0.55	48	42
Denmark	Univ. of Copenhagen	0.54	49	3
U.K.	Univ. of Oxford	0.53	50	14

Table 10: The top 50 European institutions in the period 1993–1997 and their contribution to the total european research output. The symbol (–) means that this institution did not appear with any contribution in the period 85-89.

Country	Institution	85-89				
		AUT	DIS	$\frac{AUT}{DIS}$	PAG	$\frac{PAG}{DIS}$
U.K.	Imperial College	44	20	2.20	386.9	19.35
Denmark	Univ. of Aarhus	34	9	3.78	363.8	40.42
Denmark	Univ. of Copenhagen	22	15	1.47	223.4	14.89
Norway	Univ. of Oslo	26	16	1.63	208.1	13.01
Germany	Univ. of Heidelberg	17	10	1.70	174.7	17.47
Sweden	Univ. of Stockholm	17	8	2.13	170.8	21.35
U.K.	Univ. of Surrey	16	5	3.20	158.7	31.75
U.K.	Univ. of Warwick	17	10	1.70	149.3	14.93
U.K.	Univ. of Southampton	19	7	2.71	138.2	19.74
U.K.	Univ. of Bath	14	6	2.33	137.8	22.97
U.K.	Univ. of Birmingham	15	7	2.14	135.5	19.35
Denmark	Univ. of Aalborg	8	4	2.00	134.4	33.60
U.K.	Univ. of Durham	16	7	2.29	133.9	19.12
U.K.	Univ. of Oxford	15	10	1.50	126.1	12.61
Hungary	Univ. of Szeged	14	3	4.67	124.7	41.58
U.K.	Univ. of StAndrews	14	7	2.00	121.1	17.29
U.K.	Univ. of Glasgow	16	5	3.20	120.1	24.02
U.K.	Univ. of Reading	16	9	1.78	119.9	13.32
Germany	Univ. of Cologne	8	5	1.60	119.6	23.92
Netherlands	Univ. of Leiden	10	5	2.00	107.6	21.52
Finland	Univ. of Oulu	11	4	2.75	107.5	26.87
U.K.	Univ. of Sheffield	9	5	1.80	105.9	21.18
Poland	Academy of Agriculture in Poznan	26	9	2.89	105.0	11.66
U.K.	Univ. of Leeds	12	7	1.71	104.7	14.95
U.K.	Univ. of Edinburgh	14	8	1.75	101.1	12.64
Netherlands	Univ. of Utrecht	8	4	2.00	98.7	24.68
U.K.	Univ. College London	9	7	1.29	97.0	13.86
U.K.	Rothamsted Experimental Station	10	4	2.50	92.3	23.08
U.K.	Univ. of Kent	12	8	1.50	91.1	11.38
U.K.	Univ. of Cambridge	10	6	1.67	90.6	15.10
Germany	Freie Univ. of Berlin	10	6	1.67	90.0	15.00
Belgium	Univ. Libre de Bruxelles	10	5	2.00	89.8	17.97
Netherlands	Centre for Math. and Comp. Science	9	6	1.50	87.7	14.62
Denmark	Royal Veterinary and Agricul. Univer.	8	3	2.67	84.8	28.28
France	Université Paris VI	14	7	2.00	82.3	11.76
Poland	Univ. of Wroclaw	12	8	1.50	81.9	10.24
Netherlands	Free Univ. Amsterdam	7	5	1.40	80.2	16.04
Germany	Univ. of Essen	5	2	2.50	80.0	40.01
France	INRA	10	6	1.67	79.6	13.26
U.K.	Univ. of Liverpool	8	2	4.00	78.5	39.25
Hungary	Hungarian Academy of Sciences	11	8	1.38	75.9	9.49
U.K.	Univ. of London	10	8	1.25	75.2	9.40
Denmark	Novo Research Institute	8	4	2.00	74.9	18.73
Sweden	Univ. of Lund	7	7	1.00	74.3	10.62
Germany	Univ. of Hamburg	5	3	1.67	68.5	22.83
France	Université Paul Sabatier	15	12	1.25	68.0	5.67
Greece	Univ. of Athens	8	5	1.60	67.7	13.54
U.K.	Univ. of Newcastle	8	7	1.14	67.3	9.61
Netherlands	Univ. of Twente	6	2	3.00	65.7	32.87
Germany	Univ. of Bonn	9	4	2.25	65.6	16.40

Table 11: Number of authors (AUT), number of distinct authors (DIS), and other measures of research output in the top 50 European institutions in 1985-1989.

Country	Institution	93-97				
		AUT	DIS	$\frac{AUT}{DIS}$	PAG	$\frac{PAG}{DIS}$
U.K.	Imperial College	50	22	2.27	412.1	18.73
U.K.	London School of Economics	31	11	2.82	409.2	37.20
Germany	Univ. of Heidelberg	27	12	2.25	381.6	31.80
Denmark	Univ. of Aarhus	29	6	4.83	308.5	51.41
France	Université Paul Sabatier	34	24	1.42	301.8	12.57
U.K.	Univ. of Cambridge	28	17	1.65	294.4	17.32
U.K.	Univ. of Southampton	37	16	2.31	267.0	16.69
France	INRA	41	26	1.58	238.1	9.16
U.K.	Univ. of Kent	26	11	2.36	238.0	21.63
U.K.	Univ. College London	26	12	2.17	231.1	19.25
Norway	Univ. of Oslo	22	12	1.83	228.5	19.04
Germany	Univ. of Giessen	17	2	8.50	220.9	110.44
Germany	Humboldt Univ. of Berlin	22	8	2.75	212.6	26.58
France	Université Paris VI	21	12	1.75	210.1	17.51
Greece	Univ. of Athens	27	13	2.08	208.2	16.02
Belgium	Université Catholique de Louvain	18	7	2.57	194.7	27.81
Netherlands	Univ. of Leiden	22	14	1.57	186.8	13.35
U.K.	Univ. of Lancaster	22	11	2.00	178.6	16.24
Sweden	Univ. of Lund	18	8	2.25	178.1	22.26
Germany	Univ. of Cologne	18	10	1.80	173.6	17.36
Germany	Univ. of Gottingen	17	7	2.43	166.4	23.77
U.K.	Univ. of Surrey	15	6	2.50	162.5	27.08
U.K.	Univ. of Nottingham	13	10	1.30	162.0	16.20
U.K.	Univ. of Bristol	12	6	2.00	159.9	26.65
U.K.	Univ. of Leeds	20	7	2.86	159.4	22.78
Spain	Univ. Carlos III Madrid	19	7	2.71	159.1	22.73
Netherlands	Erasmus Univ.	15	9	1.67	156.3	17.36
Norway	Univ. of Bergen	14	8	1.75	153.1	19.14
Belgium	Limburgs Universitair Centrum	18	9	2.00	150.7	16.74
Germany	Freie Univ. of Berlin	18	10	1.80	146.3	14.63
U.K.	Univ. of Glasgow	18	10	1.80	144.6	14.46
Germany	Katholische Univ. of Eichstatt	8	2	4.00	143.3	71.65
U.K.	Nuffield College	14	5	2.80	142.3	28.47
Switzerland	ETH Zurich	12	8	1.50	140.4	17.55
Germany	Ruhr Univ. of Bochum	16	3	5.33	137.4	45.79
Switzerland	Univ. of Zurich	18	7	2.57	130.8	18.69
Belgium	Univ. Libre de Bruxelles	12	4	3.00	130.8	32.69
U.K.	Univ. of Warwick	14	9	1.56	130.0	14.44
Germany	Univ. of Dortmund	20	11	1.82	127.8	11.61
Germany	Univ. of Bielefeld	10	3	3.33	126.3	42.11
Switzerland	Univ. of Geneve	17	6	2.83	123.6	20.60
Germany	Technical Univ. of Aachen	14	8	1.75	123.5	15.44
Spain	Univ. of Cantabria	13	4	3.25	117.7	29.44
U.K.	Imperial Cancer Research Fund.	7	2	3.50	117.0	58.50
Germany	Univ. of Munich	10	7	1.43	113.1	16.16
Poland	Univ. of Wroclaw	14	4	3.50	111.8	27.96
Italy	Univ. of Rome	11	10	1.10	109.4	10.94
U.K.	Univ. of London	13	7	1.86	107.7	15.39
Denmark	Univ. of Copenhagen	17	14	1.21	107.3	7.67
U.K.	Univ. of Oxford	11	11	1.00	105.0	9.55

Table 12: Number of authors (AUT), number of distinct authors (DIS), and other measures of research output in the top 50 European institutions in 1993–1997.

last period both suffer a clear decrease in their positions: the University of Aarhus moved from second to fourth, and the University of Copenhagen moved from third to the 49th position. It is worth noting that the clear difference that exists in the period 1985–1989 between the two best institutions and the rest disappears in the period 1993–1997, as shown in Table 10. An interesting feature of this table is that half of the 50 top institutions in 1993–1997 did not appear as such in Table 9. This implies a very dynamic and changing situation among European institutions. For instance, some of the institutions that occupy the first 20 positions in the ranking in Table 10, such as the London School of Economics, the University of Giessen and Université Catholique de Louvain, were in low positions in the first period. This pattern is similar if we take some other top institutions: only four of the top 10 institutions in 1985–1989 have remained among the ten best institutions in 1993–1997; only seven among the top 20; only twelve among the top 30; etc. In the last period, the first two institutions in Table 10 are from the U.K. and the third from Germany, and all of them have a similar percentage contribution.

Now, we look at the dynamic evolution of the countries to which these institutions belong. U.K. goes down from 21 institutions in Table 9 to only 17 in Table 10 and The Netherlands and Denmark go down from 5 to 2 institutions, whereas Germany moves up from 6 institutions to 12 institutions. The institutions that belong to Hungary (2 institutions) and Finland (1) disappear. They are replaced by new institutions from Switzerland (3), Spain (2) and Italy (1).

In order to compensate for biases dues to size we have compared the research output of an institution to the size of the research group. This analysis is presented in Tables 11 and 12. In the first of these two tables we present the 50 top European institutions in the first period (85-89) but now the ratio PAG/DIS has also been computed. As expected, small institutions in the top 50 must have a larger output per person than large institutions. In the first period it is to be noted the high per person productivity of the University of Szeged, the University of Aarhus, the University of Essen and the University of Liverpool. In the second period (Table 12) the differences in per person productivity are larger than in the first. The University of Giessen, shows an amazing productivity of 110.44 pages by person, compared to an average value of this measure in Europe in this period of 15.2 (see Table 7). Also the University of Aarhus, three German universities (Eichstatt, Bochum, Bielefeld) and one U.K. instituttion (Imperial Cancer

Research Foundation) have more than 40 pages by person in this period. The largest groups of researchers (more than 10) were located in the first period in the Imperial College, the University of Oslo, the University of Copenhagen and the Université Paul Sabatier, whereas in the second period the number of institutions with more than 10 active researchers goes up from 4 to 17. The largest groups are at INRA, Université Paul Sabatier and Imperial College.

5 Conclusions

The analyses we have presented indicate a very dynamic situation in statistical research in Europe in the last 12 years. As far as countries are concerned, the U.K., The Netherlands, and the Scandinavian countries decrease their relative contributions whereas Spain, Italy, Belgium, France and Austria have a big increase in their contributions. As far as institutions are concerned, the changes are very profound. Only half of the institutions that were among the top 50 in the first period, 1985-1989, remain in this category in the last period, 1993-1997.

Acknowledgments

We are very grateful to Christian Genest for providing us with his Data Base and for his help in this research, to Irwin Guttman for many useful comments to a first draft of this article, and to Mike Wiper for his help with the final draft. The comments of a referee have been very useful in improving the presentation of a previous version of the paper.

Appendix A - Extended research output analysis of European Institutions

Table 13 presents the research output, measured by PAG and percentage of contribution to European research statistical output (%) of institutions having rankings 51 to 150 in Europe in the last period.

Country	Institution	93-97			85-89		
		Pos	PAG	%	Pos	PAG	%
Belgium	Univ. of Antwerpen	51	104	.53	–	–	–
Netherlands	Statistics Netherlands	52	102	.52	92	37	.32
Norway	Norwegian Institute of Technology	53	101	.51	98	34	.30
Finland	Univ. of Oulu	54	100	.51	21	108	.94
France	INSERM	55	100	.51	52	64	.56
U.K.	Open Univ.	56	98	.50	155	20	.17
U.K.	Univ. of Sheffield	57	98	.50	22	106	.92
U.K.	Univ. of Bath	58	98	.49	10	138	1.20
Netherlands	Free Univ. Amsterdam	59	97	.49	37	80	.70
Germany	Univ. of Dusseldorf	60	96	.49	–	–	–
Austria	Univ. of Vienna	61	95	.48	183	15	.13
U.K.	Univ. of Newcastle	62	92	.47	48	67	.59
Belgium	Catholic Univ. of Leuven	63	90	.46	105	29	.25
Netherlands	Univ. of Twente	64	89	.45	49	66	.57
Germany	Univ. of Karlsruhe	65	88	.45	–	–	–
Russia	Academy of Sciences of Russia	66	88	.44	–	–	–
Austria	Univ. of Economics Vienna	67	87	.44	–	–	–
Spain	Univ. of Barcelona	68	87	.44	86	39	.34
France	Univ. of Rouen	69	86	.44	213	12	.10
Poland	Polish Academy of Sciences	70	84	.43	66	55	.48
Finland	Univ. of Tampere	71	84	.42	54	62	.54
U.K.	Univ. of Liverpool	72	84	.42	40	79	.68
Spain	Univ. Complutense Madrid	73	82	.42	151	21	.18
Sweden	Univ. of Uppsala	74	82	.41	149	21	.18
Sweden	Statistics Sweden	75	81	.41	205	12	.11
Germany	Univ. of Freiburg	76	80	.40	62	59	.51
France	Univ. of Grenoble	77	78	.40	106	29	.25
Germany	Univ. of Essen	78	77	.39	38	80	.70
Italy	Univ. of Padua	79	75	.38	121	26	.23
Germany	Univ. of Siegen	80	75	.38	56	62	.54
Ireland	Univ. College Dublin	81	74	.38	303	6	.05
Netherlands	Catholic Univ. of Nijmegen	82	73	.37	77	48	.42
Netherlands	Univ. of Utrecht	83	73	.37	26	99	.86
Germany	Technical Univ. of Dresden	84	71	.36	–	–	–
Germany	Univ. of Trier	85	70	.35	68	55	.48
Germany	Univ. of Augsburg	86	69	.35	64	57	.50
Netherlands	Eindhoven Univ. of Technology	87	68	.34	71	51	.45
Germany	Karl Weierstrass Inst. of Math.	88	68	.34	–	–	–
Italy	Univ. of Pavia	89	66	.34	–	–	–
Netherlands	Univ. of Tilburg	90	65	.33	124	26	.23
France	Université Paris Sud	91	65	.33	168	17	.15
Germany	Univ. of Rostock	92	65	.33	–	–	–
Netherlands	Agricultural Univ. Wageningen	93	64	.33	220	11	.10
France	Université Montpellier II	94	64	.32	–	–	–
Poland	Academy of Agriculture in Poznan	95	63	.32	23	105	.91
Czechoslovakia	Charles Univ.	96	62	.31	146	21	.18
Hungary	Hungarian Academy of Sciences	97	62	.31	41	76	.66
U.K.	Medical Research Council (MRC)	98	61	.31	117	27	.24
Spain	Univ. Autónoma Madrid	99	61	.31	307	5	.04

Country	Institution	93-97			85-89		
		Pos	PAG	%	Pos	PAG	%
Italy	European Univ. Institute	100	60	.30	–	–	–
Spain	Univ. of Valencia	101	60	.30	242	9	.08
Sweden	Univ. of Stockholm	102	60	.30	6	171	1.49
Germany	Univ. of Munster	103	59	.30	81	46	.40
Netherlands	Univ. of Amsterdam	104	59	.30	104	29	.26
Ireland	Univ. College Cork	105	59	.30	85	39	.34
Spain	Univ. of Santiago de Compostela	106	58	.29	275	7	.06
France	CNRS	107	58	.29	163	18	.16
Austria	Technical Univ. of Vienna	108	57	.29	90	38	.33
USSR	Research Council for Cybernetics	109	55	.28	–	–	–
Denmark	Univ. of Aalborg	110	55	.28	12	134	1.17
Germany	Univ. of Hamburg	111	54	.28	45	69	.60
Netherlands	Delft Univ. of Technology	112	54	.28	102	32	.27
Russia	Univ. of Saint Petersburg	113	54	.27	–	–	–
U.K.	Univ. of Leicester	114	53	.27	264	8	.07
France	CREST	115	52	.26	–	–	–
U.K.	Univ. of Manchester	116	50	.26	161	19	.16
Sweden	Univ. of Goteborg	117	50	.25	305	5	.05
France	INSEE	118	50	.25	–	–	–
Germany	Univ. of Stuttgart	119	50	.25	–	–	–
Sweden	Swedish Univ. of Agricult. Sci.	120	49	.25	209	12	.10
Finland	Univ. of Helsinki	121	48	.24	60	60	.52
U.K.	Univ. of Essex	122	48	.24	207	12	.10
Switzerland	Univ. of Neuchatel	123	48	.24	–	–	–
U.K.	Horticulture Research Internat.	124	48	.24	–	–	–
Poland	Nicolas Copernic Univ.	125	47	.24	114	28	.24
France	Inst. Nat. Agron. Paris Grignon	126	47	.24	224	11	.09
Sweden	Stockholm Univ.	127	46	.23	–	–	–
U.K.	City Univ. London	128	46	.23	123	26	.23
U.K.	Univ. of Sussex	129	46	.23	118	27	.24
Germany	Weierstrass Inst. (WIAS)	130	46	.23	–	–	–
Switzerland	Swiss Federal Inst. of Tech.	131	45	.23	190	14	.12
U.K.	Univ. of StAndrews	132	44	.22	16	121	1.06
France	Univ. of Paris VII	133	44	.22	278	7	.06
France	Univ. of Picardie	134	44	.22	–	–	–
U.K.	Univ. of Aberdeen	135	43	.22	65	56	.49
Italy	Univ. Institute of Venice	136	43	.22	–	–	–
France	Univ. des Sci. et Technol. de Lille	137	43	.22	–	–	–
Greece	Univ. of Patras	138	41	.21	84	41	.36
Denmark	Royal Veterinary and Agric. Univ.	139	41	.21	34	85	.74
Norway	Univ. of Tromso	140	41	.21	88	39	.34
Germany	Univ. of Tubingen	141	41	.21	87	39	.34
Bulgaria	Bulgarian Academy of Sciences	142	40	.20	160	19	.16
Greece	Univ. of Thessaloniki	143	40	.20	55	62	.54
Italy	Univ. G d'Annunzio	144	40	.20	–	–	–
France	UdeMarne-La-Vallée	145	39	.20	–	–	–
Hungary	Technical Univ. of Budapest	146	38	.19	245	9	.08
Italy	Universita di Firenze	147	38	.19	261	8	.07

Country	Institution	93-97			85-89		
		Pos	PAG	%	Pos	PAG	%
Germany	Univ. of Konstanz	148	37	.19	–	–	–
Netherlands	Univ. of Groningen	149	37	.19	335	3	.03
Belgium	Global Electronic Finance Manag.	150	36	.18	–	–	–

Table 13: Institutions from 51 to 150 in the last period.

Appendix B - Trends in Spanish Institutions

Table 14 shows the contribution of the main research institutions in Spain. To check the consistency of the results we have used, in addition to the variable PAG, the variable ART. It is to be noticed that the two measures ART and PAG (see columns 1 and 2) lead to similar results. The institutions in this table have been sorted as a function of the output of adjusted pages in the period 1985–1997.

Table 15 compares the first five years (1985–1989) with the last five years (1993–1997) in the sample, in order to illustrate the dynamic evolution of these institutions over time. The first institutions that appear in Table 15 are the University Carlos III of Madrid and the University of Cantabria. These universities have most of their productivity in the later period and they have moved to positions 26 and 43 among the top 50 European institutions in the period 1993–1997 (see Table 10).

The last column of Table 15 shows the relative increase of the percentage of contribution in the second period with respect to the first one. This relative increase has been calculated only for the institutions with some productivity in the first period (13 in our data base). The two institutions with the biggest relative productivity increase are the University Autónoma of Madrid and the University of Cantabria.

Finally, we have compared the research output of an institution to its group size. Table 16 shows that only four institutions have more than five active research people in the last period, whereas in the first period it did not exist any research group of this size. The most productive institutions are the University of Cantabria and the University Carlos III of Madrid. Six universities have a person productivity larger than the European average.

Institution	ART	PAG	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Univ. Carlos III Madrid	11.7	159.1	—	—	—	—	—	—	—	—	39.1	4.6	52.6	43.9	18.8
Univ. of Barcelona	9.2	156.6	—	—	—	5.0	34.0	16.8	—	13.4	—	9.4	61.9	16.0	—
Univ. of Cantabria	9.0	133.5	—	—	—	10.1	—	—	—	5.6	30.8	20.7	21.2	14.2	30.9
Univ. Complutense Madrid	6.3	102.5	—	—	—	12.2	8.3	—	—	—	—	23.4	40.7	—	17.9
Univ. of Santiago de Compostela	6.8	89.6	—	—	7.0	—	—	19.0	6.0	—	20.2	—	9.9	15.6	11.9
Univ. of Valencia	5.0	84.9	—	—	—	—	8.8	—	8.8	7.7	—	5.4	16.7	—	37.6
Univ. of Valladolid	5.8	74.9	—	15.0	—	—	—	—	10.0	18.6	—	—	7.5	—	23.7
Univ. of Oviedo	4.3	68.6	—	—	—	32.0	—	—	—	29.1	—	—	7.5	—	—
Univ. Autónoma Madrid	5.2	65.5	—	—	—	5.0	—	—	—	—	5.2	19.7	11.3	11.3	13.1
Univ. of Granada	4.8	56.1	—	—	—	—	7.3	—	15.0	—	6.1	7.5	4.7	—	15.6
Univ. of Murcia	4.0	41.6	—	—	—	—	7.3	—	—	—	8.5	—	4.7	21.2	—
Univ. Politécnica Madrid	3.3	41.0	—	—	7.8	—	—	—	13.9	—	—	16.0	3.4	—	—
Univ. of La Coruña	2.0	35.9	—	—	—	—	—	—	—	—	—	—	2.5	14.6	18.8
Univ. Autónoma Barcelona	2.3	30.5	—	—	—	—	—	—	—	—	—	9.4	7.9	—	13.2
Univ. of Sevilla	3.0	25.4	—	—	—	5.9	—	14.5	—	—	—	—	—	5.0	—
UNED	1.0	20.6	—	—	—	—	—	—	—	—	20.6	—	—	—	—
INE	.5	13.7	—	—	—	—	—	—	—	—	—	13.7	—	—	—
Univ. Pompeu Fabra	1.0	13.1	—	—	—	—	—	—	—	—	—	—	—	—	13.1
Univ. of Vigo	.8	10.7	—	—	—	—	—	—	—	—	—	—	—	—	10.7
Banco de España	1.0	9.8	—	9.8	—	—	—	—	—	—	—	—	—	—	—
Univ. Politécnica de Cataluña	.8	8.6	—	—	—	—	—	—	—	—	—	3.5	—	—	5.2
Generalidad Valenciana	.5	7.8	—	—	—	—	7.8	—	—	—	—	—	—	—	—
Univ. of Málaga	1.0	7.1	—	—	—	—	—	—	—	—	—	7.1	—	—	—
Univ. of Extremadura	1.7	6.7	—	—	—	—	—	—	—	—	—	—	—	6.7	—
IVIA Apartado Oficial	.5	6.5	—	—	—	—	—	—	—	6.5	—	—	—	—	—
CSIC	1.0	3.5	—	—	—	—	—	—	—	—	—	3.5	—	—	—

Table 14: Contribution of the institutions in Spain. Sum of proportional part of the articles (ART) and number of adjusted pages (PAG).

Institution	93-97			85-89			Change
	Pos	%	PAG	Pos	%	PAG	%
Univ. Carlos III Madrid	1	17.6	159.1	—	—	—	—
Univ. of Cantabria	2	13.0	117.7	5	5.5	10.1	136.6
Univ. of Barcelona	3	9.6	87.3	1	21.3	39.1	-54.7
Univ. Complutense Madrid	4	9.1	82.0	3	11.2	20.5	-18.9
Univ. Autónoma Madrid	5	6.7	60.5	14	2.7	5.0	143.0
Univ. of Valencia	6	6.6	59.6	7	4.8	8.8	36.9
Univ. of Santiago de Compostela	7	6.4	57.6	12	3.8	7.0	66.6
Univ. of La Coruña	8	4.0	35.9	—	—	—	—
Univ. of Murcia	9	3.8	34.3	11	4.0	7.3	-4.3
Univ. of Granada	10	3.7	33.9	10	4.0	7.3	-5.5
Univ. of Valladolid	11	3.5	31.3	4	8.2	15.0	-57.9
Univ. Autónoma Barcelona	12	3.4	30.5	—	—	—	—
UNED	13	2.3	20.6	—	—	—	—
Univ. Politécnica Madrid	14	2.1	19.3	8	4.3	7.8	-50.1
INE	15	1.5	13.7	—	—	—	—
Univ. Pompeu Fabra	16	1.4	13.1	—	—	—	—
Univ. of Vigo	17	1.2	10.7	—	—	—	—
Univ. Politécnica de Cataluña	18	1.0	8.6	—	—	—	—
Univ. of Oviedo	19	0.8	7.5	2	17.4	32.0	-95.2
Univ. of Málaga	20	0.8	7.1	—	—	—	—
Univ. of Extremadura	21	0.7	6.7	—	—	—	—
Univ. of Sevilla	22	0.6	5.0	13	3.2	5.9	-82.6
CSIC	23	0.4	3.5	—	—	—	—
Banco de España	—	—	—	6	5.3	9.8	—
Generalidad Valenciana	—	—	—	9	4.3	7.8	—

Table 15: Evolution of the Spanish institutions.

Institution	93-97				85-89			
	AUT	DIS	$\frac{AUT}{DIS}$	$\frac{PAG}{DIS}$	AUT	DIS	$\frac{AUT}{DIS}$	$\frac{PAG}{DIS}$
Univ. Carlos III Madrid	19	7	2.7	22.7	—	—	—	—
Univ. of Cantabria	13	4	3.3	29.4	2	2	1	5.0
Univ. of Barcelona	12	10	1.2	8.7	4	3	1.3	13.0
Univ. Complutense Madrid	12	4	3.0	20.5	2	2	1	10.2
Univ. Autónoma Madrid	10	3	3.3	20.2	1	1	1	5.0
Univ. of Valencia	9	9	1.0	6.6	1	1	1	8.8
Univ. of Santiago de Compostela	9	5	1.8	11.5	3	3	1	2.3
Univ. of La Coruña	4	2	2.0	17.9	—	—	—	—
Univ. of Murcia	9	5	1.8	6.9	1	1	1	7.3
Univ. of Granada	7	4	1.7	8.5	1	1	1	7.3
Univ. of Valladolid	7	5	1.4	6.3	2	2	1	7.5
Univ. Autónoma Barcelona	4	3	1.3	10.2	—	—	—	—
UNED	1	1	1.0	20.6	—	—	—	—
Univ. Politécnica Madrid	5	3	1.7	6.4	1	1	1	7.8
INE	1	1	1.0	13.7	—	—	—	—
Univ. Pompeu Fabra	2	2	1.0	6.5	—	—	—	—
Univ. of Vigo	2	1	2.0	10.7	—	—	—	—
Univ. Politécnica de Cataluña	2	2	1.0	4.3	—	—	—	—
Univ. of Oviedo	1	1	1.0	7.5	4	3	1.3	10.7
Univ. of Málaga	2	2	1.0	3.5	—	—	—	—
Univ. of Extremadura	4	2	2.0	3.3	—	—	—	—
Univ. of Sevilla	1	1	1.0	5.0	1	1	1	5.9
CSIC	1	1	1.0	3.5	—	—	—	—
Banco de España	—	—	—	—	1	1	1	9.8
Generalidad Valenciana	—	—	—	—	1	1	1	7.8

Table 16: Number of authors (AUT) and number of distinct authors (DIS) in the Spanish institutions.

References

Caballero, B. and D. Peña (1987). Un estudio estadístico de la investigación científica en los países de la OCDE. *Estadística Española*, **29**, 151-178.

Dursansky, R. and C.J. Vernon (1998). Rankings of U.S. Economics Departments. *Journal of Economics Perspectives*, **12**, 157-170.

European Commission (1997). *The European Report on Science and Technology Indicators 1997*, (EUR 17639), Luxembourg.

Garfield, E., Ed. (1985-1997). *SCI Journal Citation Reports: A bibliometrics Analysis of Science Journals in the ISI Data Base.* Institute for Scientific Information, Philadelphia.

Genest, C. (1997). Statistics on statistics: Measuring research productivity by journal publications between 1985 and 1995. *The Canadian Journal of Statistics*, **25**, 427-443.

Genest, C. (1999). Probability and statistics: A tale of two worlds? *The Canadian Journal of Statistics*, **27**, 421-444.

Gil, J.A., D. Peña and J. Rodríguez (1999). Trends in statistical research productivity in the World by journals publications over the period 1985–1997. Working Paper 99-73. Universidad Carlos III de Madrid.

Phillips, P.C.B., L. Choi and P.Z. Schochet (1988). Worldwide institutional and individual rankings in statistical theory by journal publications over the period 1980-1986. *Econometric Theory*, 1-34.