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TREND IN STATISTICAL RESEARCH PRODUCTIVITY BY JOURNAL PUBLICATIONS OVER THE PERIOD 1985-1997

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Key Words

Bibliometrics; productivity rankings; statistical research; time series; trend of institutions.

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Trends in statistical research productivity by journal publications over the period 1985–1997

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1 Introduction

Measuring research productivity of countries and institutions is a standard practice in many scientific fields. The usual measure of research productivity is some function of the number of pages published in the top journals of the field. Studies about the performance of economics departments are particularly abundant (e.g., Moore, 1973; Niemi, 1975; Smith and Gold, 1976; Graves et al., 1982; Hirsch et al., 1984; Hall, 1987, 1990; Baltagi, 1998; Dusansky and Vernon, 1998). In statistics, Phillips et al. (1988) produce national, institutional and even individual Rankings based on a worldwide survey of

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refereed journals over the period 1980-1986. Genest (1997) updates the study of Phillips et al. (1988) by comparing the statistical research output of countries and establishments between 1985 and 1995.

There are different ways for measuring the research productivity of a scientist in a given period of time. For instance, Genest (1997) defines the following criteria to obtain the productivity of a given author:

PAG^* sum of the pages of all the articles in which she/he appears as author.

PAG sum of the proportional part of pages all the articles in which she/he appears as author, where this proportion is defined by the number of pages of the article divided by the number of authors.

ART^* number of articles in which she/he has participated.

ART sum of the proportional part of the articles in which she/he appears as author, where this proportion is defined as before by the number of pages of the article divided by the number of authors.

For instance, assume that an author 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). The values of these criteria for this author will be: $PAG^* = 23 + 18 + 21 = 62$, $PAG = 23 + 18/2 + 21/3 = 39$, $ART^* = 3$ and $ART = 1 + 1/2 + 1/3 = 11/6$.

Of course more sophisticated criteria can be used. Instead of counting articles or pages we can weight each article by its impact factor, defined as the number of references that the paper has received in a period of time. This option is more difficult to implement and has also some objections: the result can depend very much on the period considered; some important papers are only recognised as such after several years; theoretical papers can have advantage over practical papers in statistical journals but the situation can be reversed including the impact in the subject matter field; it is impossible to evaluate new papers; etc. Other possibility is to weight the journals, for example using its impact factor, and Dusansky and Vernon (1998) have used this criterion to produce a ranking of U.S. Economics Departments.

The purpose of the article is to present a descriptive analysis of the dynamic evolution of statistical research productivity over the period 1985–1997. This objective makes more difficult to choose a weighting function as the impact factor of the journals have changed over time. Therefore we have chosen as measure of research productivity a simple and possible robust

criterion as the PAG criterion: proportional articles published in a set of journals with high impact index.

The rest of the article is organised as follows. In section 2 we define the data base and analyze the contribution to the data base over time of the journals considered. In section 3 we analyze the productivity trend in the thirty top countries in the world. In section 4 we show the trends of productivity contributions in the twenty top institutions of United States, Europe and Rest of the World

2 Data Base and trends of the journals

The data base consists of all research articles published from 1985 until 1997, both years included, in the 13 journals listed in Table 1. This selection is obviously subjective and far from being comprehensive, but it is felt to provide an adequate coverage of the variety of outlets currently available for publishing theoretical and applied statistical research. This data base is an updated modification from the data base used by Genest (1997). It has been updated by adding the papers published in years 1996 and 1997. It has been modified by trying to obtain a set as homogeneous as possible without including more journals. This objective has led to eliminate three journals: (1) Two journals with very small citation index (*Australian Journal of Statistics* and *Statistica Neerlandica*) and (2) A high impact journal that mostly publishes review papers (*Statistical Science*).

As the pages of the journals in the data base are very different, we follow the suggestion by Phillips et al. (1988) and Genest (1997). These authors proposed multiplying the number of pages of each journal by a factor F that takes into account the page size with respect to a reference journal, so that all journals have an equivalent page size. We take the factors proposed by Genest (1997), that are calculated using the printed surface of journals and choosing as reference journal *The Annals of Statistics* that has a factor $F = 1$. Multiplying the nominal number of pages of a paper by the corresponding factor, we obtain the number of adjusted pages. Finally, we divide the adjusted pages of a paper by the number of authors and call it *proportional adjusted pages*. Thus, we define the productivity of a country or institution as the sum of the proportional adjusted pages of every author that sign a paper under the name of this country or institution.

With these modifications the data base includes 11,687 articles, 166,637 adjusted pages and 7,570 different authors affiliated with 1,939 institutions from 86 countries worldwide.

Table 1 shows, in the third column the average number of adjusted pages

Abbrev	Journals	pag. per art.	number of art.	Percentage
AS	Ann. Statist.	17.65	1487	15.75
ASM	Ann. Inst. Statist. Math.	12.66	698	5.30
BIOICS	Biometrics	12.67	1438	10.93
BIOIKA	Biometrika	10.14	1243	7.56
ISR	Intern. Statist. Review	19.51	269	3.15
JASA	J. Amer. Statist. Assoc.	16.80	1813	18.28
JMA	J. Multivariate. Anal	13.99	960	8.06
JSPI	J. Statist. Plann. Inf.	12.46	1581	11.82
RCS	Canad. J. Statist.	12.02	506	3.65
RSS	J. Royal Statist. Soc., B	15.00	555	5.00
SCJST	Scand. J. Statist.	14.44	358	3.10
STSIN	Statistica Sinica	16.82	334	3.37
TECHNO	Technometrics	15.10	445	4.03

Table 1: Journals including in the database

Years	Pag. per art.	Number of art.	Pag.Ann.Std.
1985	11.88	761	9044
1986	12.27	762	9349
1987	12.85	782	10050
1988	13.14	860	11295
1989	13.47	829	11167
1990	13.99	794	11106
1991	14.49	886	12837
1992	14.75	912	13455
1993	14.28	992	14165
1994	15.54	933	14493
1995	15.42	992	15303
1996	15.66	1111	17400
1997	15.81	1074	16976

Table 2: Years including in the database

per article in the journals of the data base. The range goes between a minimum value of 10.14 pages by article in *Biometrika* to 19.51 in *International Statistical Review*. In the fourth column, we show the number of articles published by each of the journals in the period considered. The difference among journals are very high, with a minimum for *International Statistical Review*, that has published 269 articles, to a maximum for the *Journal of American Statistical Association*, that has published almost seven times more articles. In the fifth column, we show the percentage of adjusted pages that each journal has published in the period considered. There is a moderate concentration of the research output and four out of the thirteen journals include around 57% of the total productivity in the data base.

In Table 2 we show the evolution in the period 1985–1997 of three quantities: the averaged number of adjusted pages per article, that increase around 33%; the number of articles published in the thirteen journals, that increase around 41%; and the productivity measured in adjusted pages, that is near to double (increase around 88%) in this period.

In Table 3 we show the contribution to the annual productivity of the

Journal	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AS	16.6	16.1	16.6	15.0	16.5	16.6	17.2	16.3	15.3	14.2	14.9	16.0	14.8
ASM	5.5	5.7	6.0	6.5	6.8	6.6	5.4	5.3	5.0	5.0	4.7	4.2	4.1
BIOICS	11.5	10.8	10.7	11.2	13.0	11.5	13.3	10.6	9.6	9.4	11.8	10.2	9.8
BIOIKA	8.9	9.1	10.0	8.1	8.3	9.1	8.2	7.1	7.4	6.4	6.4	6.3	6.0
ISR	4.2	3.5	3.7	3.1	3.1	2.9	3.6	3.2	3.9	3.4	2.7	2.2	2.4
JASA	19.5	20.8	18.3	19.4	17.4	18.9	15.0	16.2	18.7	20.0	17.5	18.7	18.2
JMA	7.3	8.9	8.3	10.3	9.9	9.7	8.9	8.6	8.2	8.0	7.6	5.8	5.7
JSPI	8.0	8.9	9.8	10.0	9.5	9.8	8.1	11.0	10.9	12.6	14.1	16.2	17.6
RCS	3.4	4.1	3.8	5.4	4.0	3.5	3.4	3.8	3.2	3.8	2.9	3.5	3.3
RSS	6.2	3.9	3.4	4.2	3.9	4.8	5.4	6.4	6.7	5.1	4.9	4.8	4.6
SCJST	2.8	3.1	3.2	2.5	2.9	2.9	2.5	2.8	2.7	3.5	3.5	3.7	3.5
STSIN	—	—	—	—	—	—	4.5	4.8	4.5	5.4	5.6	5.7	6.7
TECHNO	6.0	5.1	6.1	4.3	4.7	3.7	4.5	3.9	3.8	3.3	3.4	2.6	3.3

Table 3: Contribution of journals

thirteen journals. All the journals increase their number of adjusted pages per year, but there is a clear change over time in the distribution of the number of adjusted pages that each journal contributes to the total output. The largest growth corresponds to the *Journal of Statistical Planning Inference:* its percentage of contribution 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 of contribution. On the other hand, two journals have clear decreasing output : *Biometrika*, that goes from around 9% in 1985 to 6% in 1997; and *Technometrics*, that goes from 6% in 1985 to 3.3% in 1997.

3 Trends in Countries

The statistic research productivity measured by the number of adjusted pages published per year shows an increasing trend in almost every country. This effect is a consequence of the general increasing trend in output shown in Table 2. In order to correct for this global increasing trend, we will study the evolution in the relative contribution (in percentage over the total per year) of each country.

Table 4 shows the thirty countries with the biggest percentage of contribution in the period 1985–1997. In the first column we show the rank position of these countries based in this percentage of contribution. The third column presents the percentage of adjusted pages over the whole period and the following columns show this percentage by years. This Table indicates the huge output from the United States that accounts for about 50% of the total production. This is in agreement with the large number of statistical research institutions (685 in our data base) many of them with a high productivity. Twenty four US institutions are responsible for around 24% of the total world output. The two next most productive countries are Canada and

	Country	Total	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	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
2	Canada	8.30	7.04	8.44	6.97	9.95	9.12	7.71	7.42	9.98	9.78	7.60	7.77	9.33	6.55
3	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
4	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
5	Australia	3.75	3.49	3.92	5.24	4.18	3.57	2.87	2.64	3.58	4.06	4.57	2.83	4.00	3.91
6	Japan	3.18	4.34	4.40	4.84	5.43	3.43	3.18	4.10	2.93	2.66	1.75	1.55	2.96	2.12
7	France	2.08	0.61	1.26	1.48	0.99	1.87	2.41	2.17	2.20	1.80	1.82	3.34	2.68	2.87
8	Netherlands	1.71	1.93	0.75	1.61	1.45	2.42	1.98	1.97	1.72	1.22	1.29	1.86	2.00	1.82
9	India	1.55	2.52	1.41	1.97	1.78	1.53	1.84	1.00	1.32	1.42	1.17	1.80	1.53	1.39
10	Denmark	1.34	1.62	2.33	1.85	0.98	2.91	2.11	1.89	1.24	0.89	1.34	0.61	0.45	0.59
11	Taiwan	1.31	0.26	0.08	0.76	0.59	0.57	0.61	0.68	0.93	1.81	2.00	2.24	2.38	2.16
12	Israel	1.00	1.75	1.61	1.37	1.30	0.63	1.08	1.24	0.56	0.77	0.90	0.76	1.01	0.71
13	Norway	0.86	1.51	0.82	0.91	1.36	0.45	1.30	0.44	0.69	0.37	1.81	1.03	0.56	0.41
14	Sweden	0.85	1.09	1.24	1.31	0.66	1.01	0.64	0.93	0.07	0.80	0.83	0.63	1.01	1.06
15	Belgium	0.77	0.61	0.07	0.07	0.66	0.62	0.50	0.55	0.85	0.39	1.34	1.30	1.02	1.18
16	Spain	0.76	—	0.27	0.15	0.62	0.66	0.45	0.42	0.60	0.92	0.99	1.65	0.85	1.36
17	China	0.73	0.42	0.43	0.04	0.21	0.63	0.70	0.59	0.58	0.82	0.29	0.81	2.01	1.00
18	Poland	0.70	0.53	0.54	0.77	1.02	0.97	0.72	0.40	1.22	0.58	0.51	0.82	0.48	0.62
19	Italy	0.66	0.17	0.18	1.04	—	0.31	0.54	0.50	0.53	0.83	1.08	0.71	0.94	1.12
20	New Zealand	0.57	0.53	0.78	0.67	0.43	0.23	0.60	0.84	0.94	0.37	0.46	0.65	0.40	0.59
21	Switzerland	0.56	0.49	0.33	0.46	0.36	0.54	0.17	0.46	0.21	0.58	1.15	0.47	0.59	1.10
22	Hong Kong	0.49	0.37	0.20	—	0.44	0.24	0.25	0.40	0.03	0.22	0.36	0.66	1.23	1.21
23	Finland	0.48	0.66	0.60	0.64	0.77	0.76	0.17	0.38	0.57	0.59	0.28	0.45	0.25	0.39
24	Greece	0.43	0.32	0.61	0.38	0.44	0.58	0.12	0.43	0.23	0.38	0.33	0.47	0.67	0.53
25	South Africa	0.37	0.25	0.61	1.17	0.71	0.27	0.34	0.13	0.37	0.32	0.08	0.42	0.30	0.15
26	South Korea	0.35	—	0.13	0.08	0.09	0.16	0.16	0.14	0.25	0.48	0.39	0.41	0.84	0.74
27	Brazil	0.29	0.41	0.26	0.63	0.09	0.15	0.38	0.39	0.51	0.29	0.30	0.19	0.23	0.08
28	Austria	0.27	—	0.08	0.23	0.33	0.23	0.15	0.22	0.26	0.28	0.54	0.36	0.52	0.04
29	Hungary	0.26	0.61	0.59	0.25	0.54	0.35	0.06	0.59	—	0.16	0.29	—	0.22	0.08
30	Argentina	0.23	—	0.35	0.52	0.27	0.35	0.20	0.32	0.09	0.25	0.05	0.29	0.07	0.34
	Rest	2.22	1.15	2.14	1.06	2.03	1.10	2.15	2.01	2.09	2.65	1.70	2.59	4.33	2.30

Table 4: Contribution of the 30 top countries (% over Output World)

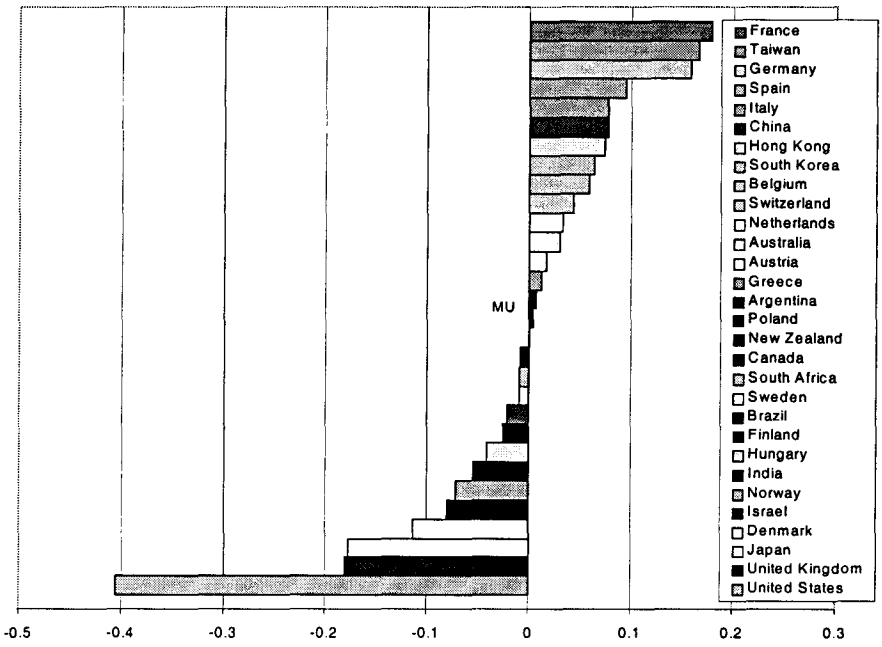

Figure 1: Top 30 most productive countries in statistical research. Estimated value of the average growth

United Kingdom that account jointly for 15% of the world output.

In this table it can be observed a clear decreasing trend in the last years in Japan, Denmark, Israel and Norway. These countries reduce their percentage of contribution to less than half. The increasing trend appear in France, Taiwan, Spain, Italy, Germany and Hong Kong, that have a clear growing in their contribution.

The time series plot and the autocorrelation function of the output from the thirty countries in Table 4 show that all these time series can be approximated by the ARIMA model

$$(1 - \phi B)\nabla Z_t = \mu + a_t \tag{1}$$

We have chosen the same model for all countries in order to compare the observed trends. Note that in model 1, μ captures the mean trend in the percentage of contribution in the period considered. When this model is estimated in these short time series (only thirteen observations) the parameter estimates are not significant at the 5% level in several cases. This is not a serious problem as we are not trying to make inference with these models but only use them to compare the descriptive trend in the period. The model parameters have been estimated by exact maximum likelihood

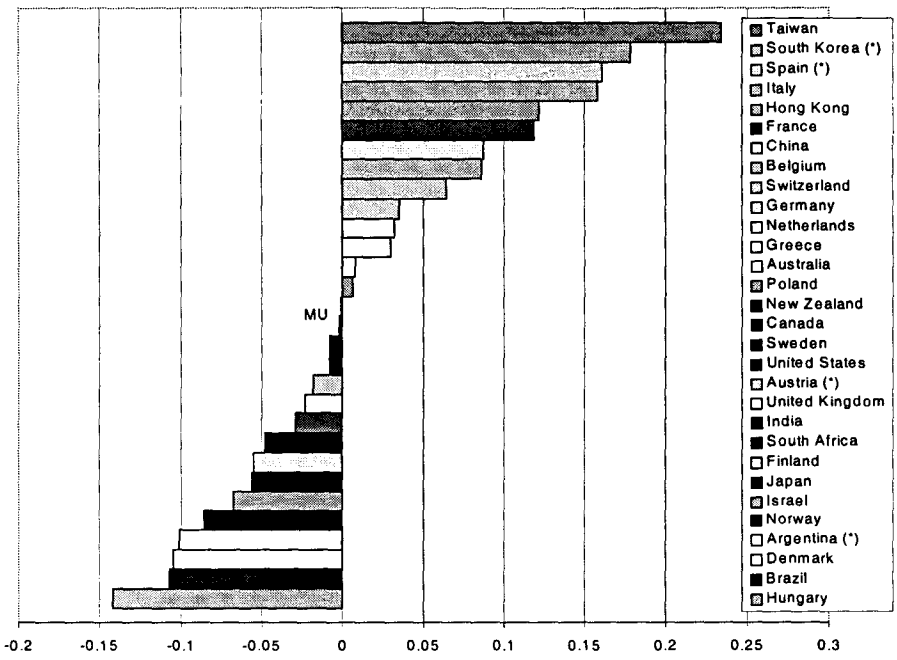

Figure 2: Top 20 most productive countries. Estimated value of the average relative growth

with the program TRAMO (Gómez and Maravall, 1996).

In figure 1 we present the estimated values of μ for the thirty countries sorted in ascending form. The largest decreasing trend corresponds to the United States, (-.4) indicating that the relative contribution decreases by an average of .4% every year. The next decreasing countries are United Kingdom and Japan that have a similar value of μ and around half of this of United States. On the other hand, the countries with the biggest positive value of μ are France, Taiwan, Germany and Spain, with a yearly contribution increase in the range (.1, .2).

In order to make a comparison in relative terms, we analyze the series of percentage of contribution in logarithms. The model used for this is

$$(1 - \phi B)\nabla \log(Z_t) = c + a_t \tag{2}$$

In order to apply this model when the series has a zero value in some year we have: (1) if it appears only in the first year we have fitted the model to the rest of the observations; (2) Otherwise we have changed the zero value to a small positive constant (0.01 in our case).

Figure 2 shows the values of c estimated with the model 2, sorted in ascending form. The country with the biggest relative increasing is Taiwan

	Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	U.S.	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Canada	3	2	2	2	2	2	2	2	2	2	2	2	3
3	U.K.	2	3	3	3	3	3	3	3	3	3	3	3	2
4	Germany	5	6	6	6	4	4	5	4	4	4	4	4	4
5	Australia	6	5	4	5	5	6	6	5	5	5	6	5	5
6	Japan	4	4	5	4	6	5	4	6	6	9	11	6	8
7	France	14	10	10	12	9	7	7	7	8	7	5	7	6
8	Netherlands	8	14	9	8	8	9	8	8	10	12	8	10	9
9	India	7	9	7	7	10	10	11	9	9	13	9	11	10
10	Denmark	10	7	8	13	7	8	9	10	12	11	21	27	21
11	Taiwan	25	35	17	19	19	16	14	13	7	6	7	8	7
12	Israel	9	8	11	10	16	12	10	19	16	17	16	15	19
13	Norway	11	12	15	9	21	11	22	15	25	8	13	23	25
14	Sweden	12	11	12	16	11	15	12	40	15	18	20	16	16
15	Belgium	16	38	34	17	17	19	18	14	22	10	12	14	13
16	Spain	—	25	28	18	14	20	24	16	11	16	10	18	11
17	China	20	21	38	29	15	14	15	17	14	27	15	9	17
18	Poland	18	19	16	11	12	13	25	11	19	20	14	26	20
19	Italy	28	30	14	—	24	18	19	20	13	15	17	17	14
20	New Zealand	17	13	18	24	28	17	13	12	24	21	19	28	22
21	Switzerland	19	24	22	25	20	32	20	29	18	14	23	22	15
22	Hong Kong	22	28	—	22	26	25	26	44	34	23	18	13	12
23	Finland	13	17	19	14	13	30	28	18	17	28	25	32	26
24	Greece	24	15	23	23	18	37	23	28	23	24	24	21	23
25	South Africa	26	16	13	15	25	23	33	23	27	40	26	31	31
26	South Korea	—	31	33	37	31	34	32	27	20	22	27	19	18
27	Brazil	21	26	20	39	33	22	27	21	28	25	34	33	41
28	Austria	—	37	25	26	27	35	31	26	30	19	28	25	43
29	Hungary	15	18	24	20	22	40	16	—	37	26	—	34	39
30	Argentina	—	23	21	27	23	27	29	37	32	43	30	42	28

Table 5: Evolution of ranking in the 30 top countries

with an estimated research output of 23% increase per year. Next there are a group of three countries with output increasing of around 17%, South Korea, Spain and Italy. On the other hand, the largest average decrease corresponds to Hungary (-14%), followed by Brazil, Denmark and Argentina, with a mean value of around 10% every year. Note that now Canada, United States and United Kingdom are in the centre of the plot, which imply that in relative terms the changed in the period is small.

Table 5 presents the evolution of the countries according to their position in an annual ranking. This table confirms the results of the relative trends: Taiwan has had an impressive increase from the 25th position up to the 7th, South Korea has gone from the 31th position to the 18th and Spain from the 25th to the 11th. On the opposite side Hungary goes down from the 15th to the 39th position, Brazil from 21th to 41th and Denmark from the 10th to the 21th.

Institutions	Tot	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Stanford University	3222	158	174	160	271	237	287	324	267	193	364	216	232	338
UC Berkeley	2827	114	189	136	289	78	297	292	290	169	248	217	343	165
UofWisconsin Madison	2332	246	151	183	211	139	180	169	116	152	189	165	253	179
UofChicago	2164	142	221	161	86	97	132	192	175	184	178	252	213	132
UofWashington	2146	69	62	104	92	132	125	117	143	234	165	313	295	295
Harvard School of P.H.	1857	53	72	63	78	125	88	98	169	169	240	243	257	202
UofNorth Carolina C.H.	1814	137	159	163	75	104	90	149	263	142	122	131	161	118
Cornell University	1757	145	86	122	90	143	154	109	88	76	199	146	154	246
Pennsylvania St. Univ.	1678	30	66	53	96	75	87	147	157	139	227	168	238	196
UofMichigan	1627	78	101	105	80	86	27	79	128	97	112	246	248	241
AT&T Bell Lab.	1591	123	68	197	208	119	125	125	120	161	104	84	72	86
Purdue University	1519	92	76	38	104	163	96	155	91	192	207	116	143	48
UCLA	1427	98	85	93	60	137	65	128	77	128	163	162	97	136
Rutgers University	1383	86	44	134	27	66	81	90	111	121	187	120	189	127
Johns Hopkins Univ.	1360	76	82	126	98	54	143	93	140	58	116	110	129	136
Texas A&M Univ.	1355	18	32	—	82	109	129	129	116	164	85	145	171	175
UC Davis	1340	59	56	88	83	111	107	107	172	141	138	54	92	133
North Carolina St.Univ.	1335	97	57	46	57	149	138	124	98	48	113	114	140	154
Carnegie Mellon Univ.	1296	64	91	72	110	167	144	30	89	127	75	117	124	86
UofIllinois Urbana	1220	69	51	97	86	126	115	141	184	115	43	66	69	58

Table 6: Top 20 institutions of USA according to adjusted pages

4 Trends in Institutions

In this section we analyze institutions instead of countries. In order to have more homogeneous comparison we have divided the data into three groups. The first is U.S. that, as shown in Table 4, accounts for about 50% of the total output. The other half of the output is approximately equally splitted between Europe and the Rest of the world and, for this reason, we will analyze the institutions in these three groups. As before we have used the time series of the percentage of contributions in order to eliminate the general increasing trend of the number of adjusted pages, and the analysis has been made in absolute terms using model 1.

The Tables in this section show in the second column the total of adjusted pages for each institution, and in the following columns this quantity appears desegregated per years.

Table 6 shows the evolution in the period 1985–1997 of the twenty top more productive U.S. institutions sorted by the value of their productivity in adjusted pages. Adding two years of data has produced some interesting differences with respect to the results presented by Genest (1997). For instance, Pennsylvania State University moves from position 12 to 9, and Carnegie Mellon University from position 8 to 19.

Figure 3 shows the estimated value of the slope μ with model 1 for the U.S. institutions. First, it is interesting to note that most of these institutions

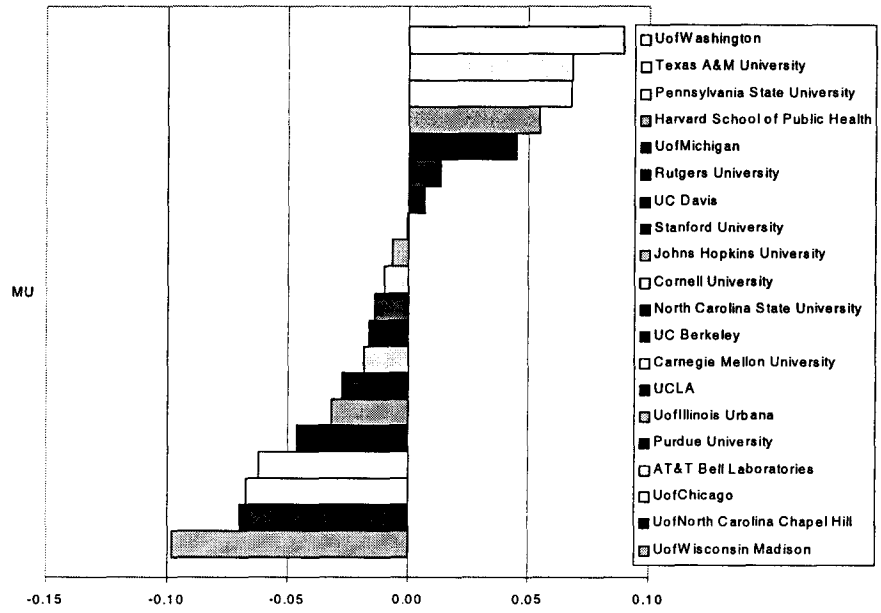

Figure 3: Top 20 most productive institutions of U.S. Estimated value of the average growth

have a negative trend value. Among the institutions with a positive trend, University of Washington is the first, followed by Texas A&M University and Pennsylvania State University. Three of the top ten institutions present the most negative trends: University of Wisconsin Madison, University of North Carolina Chapel Hill and University of Chicago.

Table 7 shows the evolution during this period in the twenty more productivity institutions in Europe. The first of them is the Imperial College (United Kingdom) and the second the University of Aarhus (Denmark). The country with more institutions in this table is, as could be expected, The United Kingdom with 11 out of the 20 institutions. Denmark have two institutions among the five first of Europe, and moreover, these two institutions publish the 65% of the total output in Denmark. Germany is the fourth country in the world, but only two German institutions appear in this table. This seems to imply that German productivity is very distributed among all its institutions. Another interesting fact is the sixth position of the London School of Economics even if it has no contributions during four years.

Figure 4 show the estimated trend of the twenty European institutions that appear in table 7. The institution with the most positive trend is the London School of Economics. In second position is the University Paul Sabatier from France. The other two French institutions have a positive

Institutions	PAG	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Imperial College (UK)	883	56	107	40	109	75	28	20	35	65	62	89	104	92
UofAarhus (Den)	858	41	125	47	40	111	67	88	32	83	132	53	7	35
UofHeidelberg (Ger)	674	12	74	15	16	59	3	109	5	48	52	98	75	108
UofCopenhagen (Den)	590	50	18	59	21	75	119	100	41	13	22	25	9	39
UofOslo (Nor)	553	62	—	60	63	23	29	16	73	18	61	70	43	38
L.School E. (UK)	506	24	20	—	—	—	—	46	8	53	88	72	55	141
UofPaul Sabatier (Fra)	497	21	2	11	6	28	46	81	—	39	47	37	72	107
UofCambridge (UK)	474	49	27	7	5	3	18	42	30	44	59	40	59	93
INRA (Fra)	461	—	14	50	16	—	39	89	16	45	14	109	38	31
UofSouthampton (UK)	443	27	46	2	42	22	7	23	8	40	48	54	51	74
UofSurrey (UK)	438	21	26	61	28	23	55	16	46	9	21	72	32	29
U.College London (UK)	431	37	8	5	47	—	38	46	19	63	90	31	40	8
UofBath (UK)	411	36	9	27	4	62	81	83	11	43	—	30	13	12
UofKent (UK)	401	43	7	6	2	32	25	22	25	15	74	61	55	33
UofParis VI (Fra)	375	13	12	—	26	32	30	12	40	21	53	87	—	50
UofGlasgow (UK)	360	49	8	9	32	22	12	39	45	27	8	65	18	27
UofLeiden (Net)	350	10	7	28	36	27	26	19	11	37	12	58	31	49
UofOxford (UK)	343	40	9	24	28	26	39	20	52	16	33	7	17	32
UofWarwick (UK)	327	47	30	15	38	19	13	15	20	22	7	26	19	56
UofCologne (Ger)	317	17	15	—	34	54	10	14	—	56	38	25	19	36

Table 7: Top 20 institutions of Europe according to adjusted pages

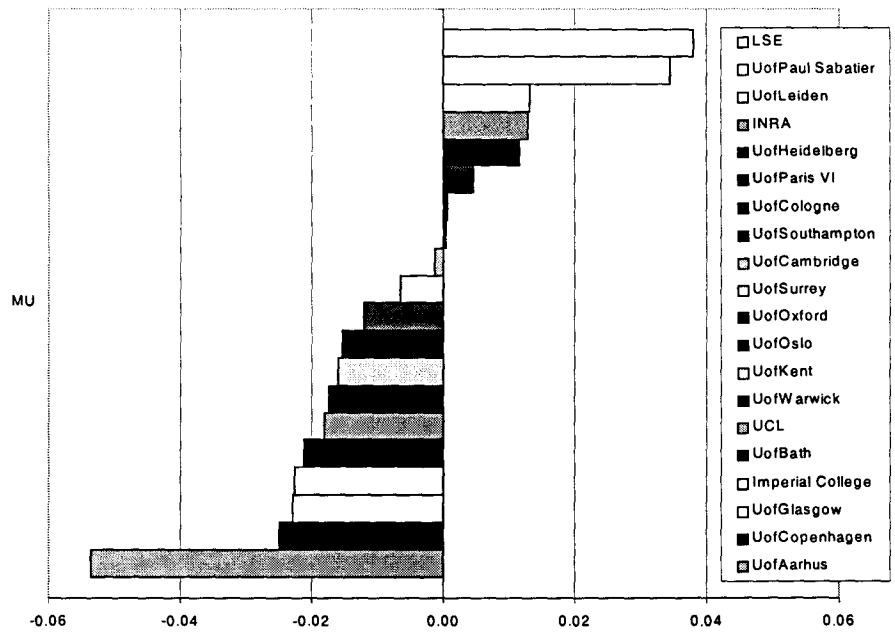

Figure 4: Top 20 most productive institutions of Europe. Estimated value of the average growth

Institution	PAG	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Aust. Nat. Univ. (Aus)	2306	69	87	183	221	172	199	120	232	242	225	155	218	185
UofWaterloo (Can)	1792	63	104	110	140	149	112	191	198	198	124	147	143	112
UofToronto (Can)	1233	25	132	85	127	121	56	28	30	184	100	127	155	62
UBC (Can)	1134	76	27	50	114	94	65	47	99	86	114	102	158	104
Indian Stat. Inst. (Ind)	998	39	59	73	89	28	65	39	67	90	83	123	117	127
Inst. of Stat. Math. (Jap)	968	131	81	119	79	84	50	127	65	26	42	30	104	29
Hebrew Univ. (Isr)	887	104	103	91	104	40	67	101	43	64	43	37	51	39
CSIRO (Aus)	765	69	106	97	76	70	5	43	39	38	101	4	67	51
UofMontreal (Can)	737	43	22	34	51	40	51	43	188	55	46	60	59	46
Academia Sinica (Tai)	732	15	—	45	34	43	42	35	74	116	72	68	81	108
Carleton Univ. (Can)	730	43	51	57	33	38	27	40	101	66	15	70	144	45
UofAlberta (Can)	703	44	39	11	68	48	53	79	18	79	78	14	130	43
McGill Univ. (Can)	640	16	47	11	32	43	16	88	86	55	58	59	73	58
UofWestern Ontario (Can)	637	20	81	19	42	79	59	36	30	25	54	38	123	33
UofTokyo (Jap)	625	15	14	58	39	38	12	92	72	106	51	26	26	75
Hiroshima Univ. (Jap)	566	28	79	65	79	16	38	20	49	42	27	7	44	72
UofOsaka (Jap)	514	46	34	6	40	22	61	33	62	41	60	32	61	16
Stat. Canada (Can)	491	2	15	9	194	24	4	15	51	10	43	20	58	47
Simon Fraser Univ. (Can)	485	33	44	25	15	38	33	17	41	15	37	16	54	118
UofOttawa (Can)	480	7	9	16	10	39	48	43	131	80	—	30	50	19

Table 8: Top 20 institutions of the Rest of the World according to adjusted pages

trend too. The two institutions with the most decreasing trend are University of Aarhus and university of Copenhagen, both from Denmark. Next, there are a group of institutions from U.K that have a negative value of μ.

Finally, in table 8 we present the data in the group *Rest of the world.* Eleven of the twenty institutions in this group are from Canada. Australian National University is the institution with the biggest productivity, followed by the University of Waterloo. Others countries with top institutions in this groups are Japan, with four institutions, and India, Israel and Taiwan, with one institution.

The trends of these institutions are showed in figure 5. Academia Sinica is the institution with the most clear increasing trend. This could be related to the fact that in 1991 *Statistical Sinica* appears. The Australian National University is the only institution among the five most productive in the world with a positive trend. On the other side, with a negative trend, there are two institutions from Japan and one from Australia.

5 Conclusions

This papers extends the statistic descriptive analysis of Genest (1997) incorporating a dynamic analysis over the period 1985–1997. This study shows

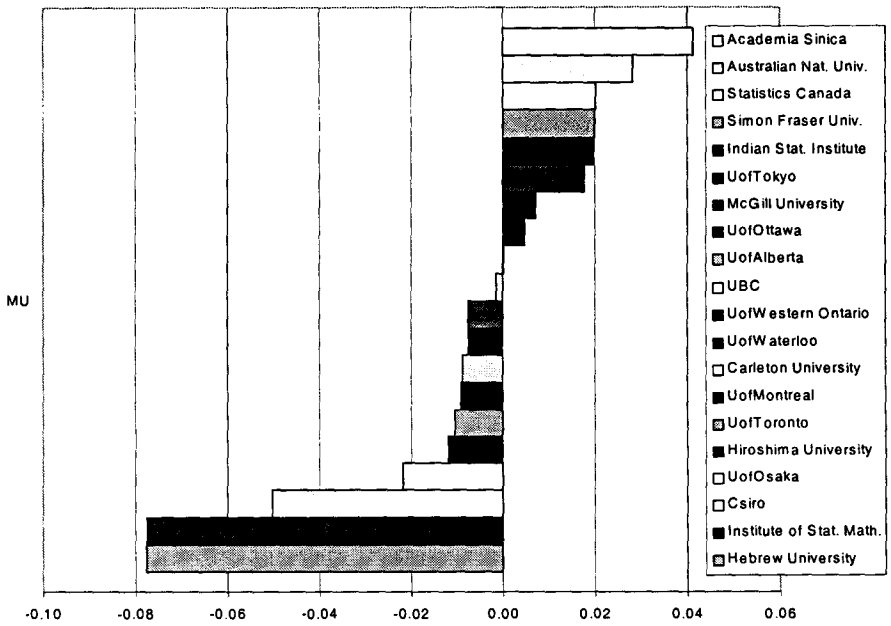

Figure 5: Top 20 most productive institutions of group of Others countries. Estimated value of the average growth

that some countries, as Taiwan, France, Germany and Spain, have increased dramatically their contribution to the world statistic productivity. On the other hand three out the four most productive countries, United States, United Kingdom and Japan, have a decreasing trend of its productivity in favour of the rest of countries. The trend of almost all the twenty best institutions in each group (U.S., Europe and Rest of the world) present a general decreasing, what will imply the consolidation of new institutions in next years in top positions.

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