BIBLIOMETRIC STUDY OF GLOBAL RESEARCH OUTPUT AND GROWTH RATE STUDY ON THE SUBJECT OF MACROECONOMICS (1971-2016)

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Abstract : The bibliometrics and scientometrics are a set of methods being used for measuring the production and dissemination of scientific knowledge. This study reveals the research productivity in the field of Macroeconomics and the data have been downloaded from the SCOPUS database for the period from 1971-2016. Here we examined the year wise, author wise, and document wise distribution of records during the period of study covering 45 years. Through this analysis, the highest number of 551 (0.08649 %) publications was published in the year of 2013. The Author "Arestis, P." published highest number of articles in the study period with 22 (0.3453%) publications. The United States had been topped with 1886 (29.6029%) publications.

Keywords: Bibliometrics, Scientometrics, Macroeconomics, Relative Growth Rate, Doubling Time.

1.0 Introduction:

Bibliometrics is a type of research method used in Library and Information Science. It is a quantitative study of various aspects of literature on a topic and is used to identify the pattern of publication, authorship, year wise and document wise distribution of coverage with the objective of getting an insight into the dynamics of growth of knowledge in the areas under consideration. The various bibliometric indicators such as ratio of growth, relative growth rate and doubling time have been used.

2.0 Macroeconomics:

Macroeconomics explains how and why the economy grows and fluctuates over the period of time. The general upward path of the economy is the result of slow moving forces-increasing population, more factories and machines, and better technology. The long-run upward path has not been smooth. It occurs as a series of business cycles-recurrent cycles of expansions, recessions, and recoveries. Macroeconomics attempts to explain growth and fluctuations using the standard principles of economic analysis.

3.0 Objectives of the Study:

1. To analyze the Year wise distribution of publications in Macroeconomics.
2. To assess the Document wise research concentrations.
3. To identify Country – wise Collaboration.
4. To identify the ranking of authors based on their publications.
5. To find the relative growth rate and doubling time for publications.

4.0 Methodology:

The present study tries to analyze the research output of researchers in the field of "Macroeconomics". The primary data for the research was collected from SCOPUS database. Totally 6371 documents on "Macroeconomics" research were found from the above database during the period 1971- 2016. The growth rates of research productivity have been analyzed starting from 1971 to 2016.

5.0 Results and Analysis:

To analyze the year wise publication of research on Macroeconomics, the data has been presented in Table-1. From this, we could clearly see during the period 1971-2016, totally 6371 publications were published. The lowest publications 1 (0.00016%) was published in 1973. The highest publications 551 (0.08649%) was published in 2013.

Table No. 1: Year-Wise Distribution of Publications

S.No	Year	Number of Publications	% of 6371
1	1971	3	0.00047
2	1973	1	0.00016
3	1974	11	0.00173
4	1975	14	0.00220
5	1976	11	0.00173
6	1977	8	0.00126
7	1978	9	0.00141
8	1979	28	0.00439
9	1980	17	0.00267
10	1981	15	0.00235
11	1982	15	0.00235
12	1983	13	0.00204
13	1984	27	0.00424
14	1985	21	0.00330
15	1986	20	0.00314
16	1987	28	0.00439
17	1988	21	0.00330
18	1989	36	0.00565
19	1990	26	0.00408
20	1991	41	0.00644
21	1992	28	0.00439
22	1993	37	0.00581
23	1994	32	0.00502
24	1995	50	0.00785
25	1996	45	0.00706
26	1997	52	0.00816
27	1998	81	0.01271
28	1999	72	0.01130
29	2000	117	0.01836
30	2001	95	0.01491
31	2002	116	0.01821
32	2003	163	0.02558
33	2004	135	0.02119
34	2005	171	0.02684
35	2006	298	0.04677
36	2007	353	0.05541
37	2008	378	0.05933
38	2009	433	0.06796
39	2010	458	0.07189
40	2011	497	0.07801
41	2012	493	0.07738
42	2013	551	0.08649
43	2014	454	0.07126
44	2015	452	0.07095
45	2016	445	0.06985

6.0 Document Wise Distribution of Publications:

The study reveals that the major source of publications covered by SCOPUS database on Macroeconomics research in Journal articles   comprises with 5170 records, while the Review includes with 308 records, Conference Paper contains with 286 records, Book Chapter consists of 246 records, Book includes with 243 records, Editorial comprises with 51 records, Note comprises with 25 records, Short Survey comprises with 14 records, Article in Press comprises with 11 records, Erratum comprises with 8 records, Conference Review with 6 records, Business Article comprises with 2 records and Letter Comprises with one record.

Table .2 Document wise Distributions of Publications

S.No	Types of Documents	No of Documents
1	Article	5170
2	Review	308
3	Conference Paper	286
4	Book Chapter	246
5	Book	243
6	Editorial	51
7	Note	25
8	Short Survey	14
9	Article in Press	11
10	Erratum	8
11	Conference Review	6
12	Business Article	2
13	Letter	1
	Total	6371

7.0 Statistical Tools were used of this study:

7.1 Relative Growth Rate: The relative growth rate and doubling time model developed by Mahapatra was applied to examine the growth rate of research publications of Macroeconomics. The relative growth rate is increased in the number of publications or pages per unit of time. A specified period of interval can be calculated from the following equations.

$$\overline{R}(1\text{-}2) = \frac{W_1 - W_2}{T_2 - T_1}$$

Where, $R\,(\overline{1}\text{-}2)$ is mean relative growth rate over the specified period interval

$W_1 = Log\ W_1$: (Natural Log of initial number of publications / pages)

$W_2 = Log\ W_2$: (Natural Log of final number of publications / pages)

$T_2 - T_1$ = The unit difference between the initial time and final time

The relative growth rate for both publications and pages can be calculated separately. Therefore,

$\overline{R}\ (a)$ = Relative growth rate per unit of time (year)

$\overline{R}\ (p)$ = Relative growth rate per unit of pages, per unit of time (year)

Doubling Time:

Fro the calculation, it is found that there is a direct equivalence existing between the relative growth rates and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. If one uses a natural logarithm, this difference has a value of 0.693. The corresponding doubling time for publications and pages can be calculated by using the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{R}$$

$$\text{Therefore, Doubling time for publications Data } Dt(a) = \frac{0.693}{\overline{R}(a)}$$

$$\text{Doubling time for pages } Dt(p) = \frac{0.693}{R\,\overline{(p)}}$$

Table-3: Relative Growth Rate And Doubling Time for Publications

Year	R.O	Cumulative O/P	W1	W2	R(a) W2-W1	Mean R (a) (1-2)	Doubling time Dt(a)	Mean Dt(a) (1-2)
1971	3	3	-	1.098	-			
1973	1	4	1.098	1.386	0.288		0.241	
1974	11	15	1.386	2.708	1.322		0.052	
1975	14	29	2.708	3.367	0.659		0.105	
1976	11	40	3.367	3.688	0.321		0.216	
1977	8	48	3.688	3.871	0.183		0.379	
1978	9	57	3.871	4.043	0.172		0.403	
1979	28	85	4.043	4.442	0.399		0.174	
1980	17	102	4.442	4.624	0.182		0.381	
1981	15	117	4.624	4.762	0.138		0.502	
1982	15	132	4.762	4.882	0.120		0.577	
1983	13	145	4.882	4.976	0.094	0.170	0.737	
1984	27	172	4.976	5.147	0.171		0.405	
1985	21	193	5.147	5.262	0.115		0.603	
1986	20	213	5.262	5.361	0.099		0.700	0.557
1987	28	241	5.361	5.484	0.123		0.563	
1988	21	262	5.484	5.568	0.084		0.825	
1989	36	298	5.568	5.697	0.129		0.537	
1990	26	324	5.697	5.78	0.083		0.835	
1991	41	365	5.78	5.899	0.119		0.582	
1992	28	393	5.899	5.973	0.074		0.936	
1993	37	430	5.973	6.063	0.090		0.770	
1994	32	462	6.063	6.135	0.072		0.962	
1995	50	512	6.135	6.238	0.103		0.673	
1996	45	557	6.238	6.322	0.084		0.825	
1997	52	609	6.322	6.411	0.089		0.779	
1998	81	690	6.411	6.536	0.125		0.554	
1999	72	762	6.536	6.635	0.099		0.700	
2000	117	879	6.635	6.778	0.143		0.485	
2001	95	974	6.778	6.881	0.103		0.673	
2002	116	1090	6.881	6.993	0.112		0.619	
2003	163	1253	6.993	7.133	0.140		0.495	
2004	135	1388	7.133	7.235	0.102		0.679	
2005	171	1559	7.235	7.351	0.116		0.597	
2006	298	1857	7.351	7.526	0.175		0.396	
2007	353	2210	7.526	7.7	0.174		0.398	
2008	378	2588	7.7	7.858	0.158		0.439	
2009	433	3021	7.858	8.013	0.155		0.447	
2010	458	3479	8.013	8.154	0.141		0.491	
2011	497	3976	8.154	8.288	0.134		0.517	
2012	493	4469	8.288	8.404	0.116		0.597	
2013	551	5020	8.404	8.521	0.117		0.592	

2014	454	5474	8.521	8.607	0.086		0.806	
2015	452	5926	8.607	8.687	0.080		0.866	
2016	445	6371	8.687	8.759	0.072		0.962	

Table.3 shows the relative growth rate and doubling time for publications of Macroeconomics research. It is clear that relative growth rate of total research output decreases gradually. The growth rate is 0.288 in 1973 which decreased up to 0.072 in 2016. The mean relative growth rate for the periods 1971 – 2016 were of 0.170. The total output for the whole study period was 0.557.

7.2 Ranking of Authors Based on Publications:

Below the table.4 indicates the ranking of authors by number of publications. Author "Arestis.P." published highest number of articles for the study period with 22 (0.3453%) records, next nine consecutive authors namely Neck, R. 18 (0.2825%), Gallegati, M. 16 (0.2511%), Sawyer, M. 15 (0.2354%), Bresser-Pereira. L.C. 14 (0.2197%), Fortana, G. 14 (0.2197%), Colander. D. 12 (0.1884%), Flaschel, P. 12 (0.1884%), Setterfield, M. 12 (0.1884%), Dimand, R.W. 11 (0.1727%) respectively.

Table-4: Ranking of Authors Based on Publications

S.No	Author	R. O/P	% of 6371
1	Arestis, P.	22	0.3453
2	Neck, R.	18	0.2825
3	Gallegati, M.	16	0.2511
4	Sawyer, M.	15	0.2354
5	Bresser-Pereira, L.C.	14	0.2197
6	Fontana, G.	14	0.2197
7	Colander, D.	12	0.1884
8	Flaschel, P.	12	0.1884
9	Setterfield, M.	12	0.1884
10	Dimand, R.W.	11	0.1727

7.3 Top Ten Affiliation Institutions in the Research Output in Macroeconomics:

Table.5 shows the top ten Affiliation institutions in the research output in Macroeconomics research distribution of publications. The study found that the total research output of the Macroeconomics research for the study period (1971-2016). National Bureau of Economic Research topped with 109 (1.711%) publications; next University of Cambridge has 81 (1.271%) publications; next University of Oxford has 62 (0.973%) publications; next International Monetary Fund has got 57 (0.895%) publications and Australian National University with 55 (0.863%) publications respectively.

Table 5 Top Ten Affiliation Institutions in the Research Output in Macroeconomics Research

S.No	Affiliation Institutions	Research Output	% of 6371
1	National Bureau of Economic Research	109	1.711
2	University of Cambridge	81	1.271
3	University of Oxford	62	0.973
4	International Monetary Fund	57	0.895
5	Australian National University	55	0.863
6	The World Bank	53	0.832
7	Harvard University	44	0.691
8	University of Melbourne	44	0.691
9	London School of Economics and Political Science	43	0.675
10	University of Chicago	42	0.659

7.4 Research Outputs Among Top 20 Countries in the Research of Macroeconomics:

The research contributions in Macroeconomics research among top 20 countries were analyzed and are given in the table.6. The highest contributed countries were taken for analysis. The United States was contributed 1886 (29.6029 %) research publications of the among 6371 publications and occupied first position. United Kingdom contributed 864 (13.5615%) research publications and occupied second position among the 6371 publications.

Germany occupied third position, which had published 445 (6.9848%) research publications and India is in seventh position it had published 90 (1.4127%) among 6371 publications.

Table.6 Research Output Among Top 20 Countries in the Research Output in Macroeconomics

S.No	Country / Territory	Record Count	% of 6371	S.No	Country / Territory	Record Count	% of 6371
1	United States	1886	29.6029	11	Switzerland	141	2.2132
2	United Kingdom	864	13.5615	12	Brazil	128	2.0091
3	Germany	445	6.9848	13	Japan	119	1.8678
4	Italy	322	5.0542	14	Austria	108	1.6952
5	Australia	314	4.9286	15	Belgium	101	1.5853
6	France	293	4.5990	16	Greece	94	1.4754
7	Canada	230	3.6101	17	India	90	1.4127
8	Spain	213	3.3433	18	Turkey	87	1.3656
9	China	171	2.6840	19	Czech Republic	79	1.2400
10	Netherlands	162	2.5428	20	South Africa	76	1.1929

8.0 Findings and Conclusion:

Bibliometrics is a type of research method used in Library and Information Science. It is a quantitative study of various aspects of literature on a topic and is used to identify the pattern of publication, authorship, year wise and document wise distribution of coverage with the objective of getting an insight into the dynamics of growth of knowledge in the areas under consideration. The various bibliometric indicators such ratio of growth, relative growth rate and doubling time are used. Hopefully, the on-going theoretical work will point the way to more innovative techniques. Based on the analysis undertaken the present study, the following findings are drawn.

1. The lowest publications 1 (0.00016%) was published in the year 1973. The highest publications 551 (0.08649%) was published in 2013.
2. Journal articles comprises with 5170 records, while the Review comprises with 308 records, Conference Paper comprises with 286 records, Book Chapter comprises with 246 records, Book comprises with 243 records, Editorial comprises with 51 records, Note comprises with 25 records, Short Survey comprises with 14 records, Article in Press comprises with 11 records, Erratum comprises with 8 records, Conference Review with 6 records, Business Article comprises with 2 records and Letter Comprises with 1 record found.
3. The growth rate is 0.288 in 1973 which decreased up to 0.072 in 2016. The mean relative growth rate for the periods 1971 – 2016 was the relative growth rate of 0.170. The whole study period the mean doubling time for total output is 0.557 years.
4. Author "Arestis.P." published highest number of articles for the study period with 22 (0.3453%) records, next nine consecutive authors namely Neck, R. 18 (0.2825%), Gallegati, M. 16 (0.2511%), Sawyer, M. 15 (0.2354%), Bresser-Pereira. L.C. 14 (0.2197%), Fortana, G. 14 (0.2197%), Colander. D. 12 (0.1884%), Flaschel, P. 12 (0.1884%), Setterfield, M. 12 (0.1884%),Dimand, R.W. 11 (0.1727%) respectively.
5. The study found that the total research output of the Macroeconomics research for the study period (1971-2016). National Bureau of Economic Research topped with 109 (1.711%) publications; next University of Cambridge has 81 (1.271%) of publications; next University of Oxford has 62 (0.973%) of publications; next International Monetary Fund has 57 (0.895%) of publications and Australian National University with 55 (0.863%) publications respectively.
6. 6. The highest contributed countries were taken for analysis. The United States was contributed 1886 (29.6029 %) research publications of the among 6371 publications and occupied the first position. United Kingdom contributed 864 (13.5615%) research publications and occupied second position among the 6371 publications. Germany occupied the third position, this organization published 445 (6.9848%) research publications and India has seventh position this organization published 90 (1.4127%) among 6371 publications.

This study has highlighted quantitatively the contributions made by the researchers during 1971-2016 as reflected in SCOPUS database. During this 45 years contributions in terms of number of publications is significant. The present study also appears to be a milestone on the above said fact. The analysis of the present study further reveals the applications of statistical techniques and tools and the generation of number of formulae and equations that facilitate future researchers to test.

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