

TABLE III RANKING OF JOURNALS PUBLISHING ECONOMICS LITERATURE BY CHINA

CHINA						
S. No.	Journal	Total Publication	Percentage	Total Citations	Percentage	ACPP
1	Energy Policy	67	1.51	2276	3.47	33.97
2	China Economic Review	66	1.49	914	1.39	13.85
3	Journal of Comparative Economics	65	1.47	1467	2.24	22.57
4	Journal of Cleaner Production	56	1.26	918	1.40	16.39
5	Sustainability	55	1.24	188	0.29	3.42
6	PLOS One	54	1.22	587	0.90	10.87
7	China & World Economy	40	0.90	261	0.40	6.53
8	Economic Modelling	38	0.86	139	0.21	3.66
9	Renewable & Sustainable Energy Reviews	38	0.86	1206	1.84	31.74
10	Habitat International	36	0.81	441	0.67	12.25
11	Journal of Banking & Finance	34	0.77	838	1.28	24.65
12	Applied Energy	33	0.75	755	1.15	22.88
13	China Agricultural Economic Review	30	0.68	131	0.20	4.37
14	International Review of Economics & Finance	27	0.61	136	0.21	5.04
15	Physica A-Statistical Mechanics & Its Applicatns	27	0.61	243	0.37	9.00
16	Energy	26	0.59	479	0.73	18.42
17	Land Use Policy	26	0.59	366	0.56	14.08
18	Journal Of Geographical Sciences	25	0.56	166	0.25	6.64
19	Journal of International Economics	24	0.54	342	0.52	14.25
20	Journal of Econometrics	23	0.52	232	0.35	10.09
21	Journal of Contemporary China	22	0.50	72	0.11	3.27
22	Chinese Geographical Science	21	0.47	103	0.16	4.90
23	Applied Economics	19	0.43	85	0.13	4.47
24	European Journal of Operational Research	19	0.43	349	0.53	18.37
25	Emerging Markets Finance And Trade	18	0.41	50	0.08	2.78
26	Review of International Economics	18	0.41	57	0.09	3.17
27	Social Science & Medicine	18	0.41	622	0.95	34.56
28	International Journal of Production Economics	17	0.38	183	0.28	10.76
29	Review of Development Economics	17	0.38	35	0.05	2.06
30	38 Journals (Publication within the range of 16-11)	477	10.77	8536	13.02	17.90
31	1553 Journals (Publication within the range of 10-1)	2991	67.56	43382	66.17	14.50
		4427		65559		
ACPP: Average Citations Per Paper						

Among these journals Energy Policy tops the journal ranking list publishing 67 (1.51%) articles, followed by Chinese Economic Review publishing 66 (1.49%) articles and Journal of Comparative Economics occupied the third position with 65 (1.47%) articles. The Journal of Cleaner Production with 56 (1.26%) articles and Sustainability with 55 (1.24%) articles with fourth and fifth rank respectively. The analysis shows that the research work on economics in China is scattered in various journals and not concentrated on the few core or nucleus journals.

We observe a similar trend among the scholar in publishing research output in economics in India and China. The top ten ranked journals in the ranked list contributed to 12% of the total literature and the top-ranked ten journals contributed not even 1% of the total number of journals. The majority of the publications 2991 (68%) (published in the range of 1-10 articles each) are scattered across large number 1553 (96%) of journals.

This clearly indicates that probably there is less number of journals devoted to the economics subjects and hence the

research scholars tend to publish their research work in multi-disciplinary journals.

C. Bradford's Law of Scattering

Identifying the journals in a subject field is an important aspect of scientometric studies especially Bradford's law of scattering, has its application in the acquisition policy of journals in libraries and information centres.

Bradford law of scattering describes how the literature on a particular subject is scattered or distributed in various journals, and he formulated that, "if a scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus. When the number of periodicals in the nucleus in the and succeeding zones will be as $1: n : n^2$ " where n is a multiplier (Bradford, 1934, p.86).

Bradford gave a graphical model for his law. The mathematical models were suggested later by Vickery (1948), Leimkuhler (1967), Brookes (1969a, 1969b), Wilkinson (1972), Egghe (1985, 1986, 1990a, 1990b), Basu (1992), Ravichandra Rao (1998). These scholars gave the mathematical models for the scattering of articles in journals are mentioned here (Sudhier, 2010).

D. Brooke's Model (1969)

$$F(x) = a + b \log x \quad (1)$$

where $F(x)$ is the cumulative number of references contained in the first x most productive journals, and a and b are constants. This is the most widely used formulation of Bradford's Law.

Vickery (1948) extended the verbal formulation to show that it can be applied to any number of zones of equal yield.

E. Leimkulher's (1967) Model

$$R(r) = a \log(1 + br) \quad (2)$$

where $R(r)$ is the cumulative number of articles contributed by journals ranked 1 through r , and a and b are parameters. Where $r = 1, 2, 3 \dots$

F. Egghe's model (1985, 1986) Modifications for Calculating Bradford's Multiplier based on Leimkuhler's Model

$$k = (e^\gamma \times Y_m)^{1/p} \quad (3)$$

Where γ is Euler's number ($e^\gamma = 1.781$), $p =$ Number of zones i.e. 3.

$Y_m =$ Number of items in the most productivity sources.

$r_0 =$ Number of journals in the nucleus zone of Bradford is calculated as:

$$r_0 = \frac{T(k-1)}{(k^p-1)} \quad (4)$$

where $T =$ Total number of journals

G. Application of Bradford's Law

1. India

Table III presents details of the articles published by the Indian scholars in the field of Economics. Furthermore, the frequency of journal articles arranged in decreasing order of the articles to test Bradford's law.

For testing of the verbal formulation of Bradford's law, the 887 journal titles were divided into three zones. The distribution of journals and a corresponding number of articles in the three zones along with the value of Bradford multiplier are shown in Table IV.

In the present dataset, the first 42 journals publishing 644 articles, followed by 229 journals containing 641 articles and next 616 journals containing 639 articles. It can be noticed that the three zones are almost exactly the 1/3rd of the total articles as suggested by Bradford.

TABLE IV SCATTERING OF JOURNALS AND ARTICLES OVER BRADFORD ZONE

Zone	Journals	Articles	Bradford Multiplier
1st	42	644	---
2nd	229	641	5.4
3rd	616	639	2.6
Total	887	1924	Avg. 4

The identified zones arranged in the geometric series in the form of $1: n: n^2$ as given by Bradford. We found that the relationship of each zone in the present study is 42:168:672.

Here, 42 journals found in the nucleus zone and the mean value of Bradford's multiplier is $n=4$. Therefore, $42 : (42 \times 4) : (42 \times 4^2) :: 1 : n : n^2$
42: 168: 672

Since the percentage of error is negative here, the data fits well Bradford's law.

H. Application of Egghe's Model

Though the dataset fits into Bradford's model, to compare the Egghe's model i.e. modification of Leimkuhler is employed for the verification of Bradford's law of scattering. For the application of Bradford's law, three zones were selected, $p=3$, $y_m = 74$. Then by using mathematical formula (3), the obtained value of the Bradford's multiplier k is 5.51. The number of articles in each zone is $y_0 = 641.33$.

The r_0 = number of journals in the nucleus of Bradford is calculated using the equation (4) and hence $r_0 = 24.05$

The No. of Journals in the nucleus zone is 24, similarly, the number of journals in the second the third zones are 132.51 and 730 respectively. Therefore, the distribution is written as:

$$24.05 : (24.05 \times 5.51) : (24.05 \times 5.51^2) :: 1 : k : k^2$$

i.e. 24.05 : 132.51 : 730.16

TABLE V SCATTERING OF JOURNALS AND ARTICLES OVER BRADFORD ZONE

Zone	No. of Journals	No. of Articles	Bradford Multiplier
1st	24.05	522	---
2nd	132.51	533	5.5
3rd	730.16	869	5.5
Total	887	1924	

From the above table, it's clear that the journals contributing articles to each zone increase by multiplier 5.5. Top 24 journals appeared in the nucleus zone contributed 522 articles, followed by 132.51 approx. 133 journals in the second zone containing 533 articles and 730 journals with 869 articles in the third zone. Since the percentage of error is very negligible, Bradford's law fits very well in this data set.

1. China

The ranked list of journals and the corresponding frequency of articles published by Chinese scholars in the field of Economics is shown in Table IV.

For the verification of verbal formulation of Bradford's law, the 1620 journal titles published 4427 articles were divided into three zones. The table VI provides the zone-wise journals and their corresponding articles along with the Bradford multiplier.

TABLE VI SCATTERING OF JOURNALS AND ARTICLES OVER BRADFORD ZONE

Zone	No. of Journals	No. of Articles	Bradford Multiplier
1st	71	1476	---
2nd	329	1476	4.6
3rd	1220	1475	3.7
Total	1670	4427	Avg. 4.17

In the present dataset, the top 71 journals publishing 1476 articles in the nucleus zone, followed by 329 journals containing 1476 articles second zone and 1220 journals containing 1475 articles in the third zone. The mean value of Bradford's multiplier is $n=4.17$. It can be noticed that the three zones are almost exactly the $1/3^{rd}$ of the total articles as suggested by Bradford.

The identified zones arranged in the geometric series in the form of $1 : n : n^2$ as given by Bradford. We found that the relationship of each zone in the present study is $71 : 294.65 : 1222.79$. Since the percentage of error is (-1.94) negligible here, the data fits well Bradford's law.

I. Application of Egghe's model

Here also, though the dataset fits into Bradford's model, to compare the scattering of journals in the different zones, the Egghe's model i.e. modification of Leimkuhler is employed. Total articles were equal-divided into three zones ($p=3$) is $y_0 = 641.33$. $y_m = 67$. Then by using mathematical formula (3) and (4), the obtained value of the Bradford's multiplier and number of journals in the nucleus zone were $k = 4.9231$ and $r_0 = 24.05$ respectively.

The No. of Journals in the nucleus zone is 53.71, followed by, the number of journals in the second the third zones are 264.41 and 1301.76 respectively. Therefore, the distribution is written as:

$$53.71 : (53.71 \times 4.92) : (53.71 \times 4.92^2) :: 1 : k : k^2$$

i.e. 53.71 : 264.241 : 1302.76

TABLE VII SCATTERING OF JOURNALS AND ARTICLES OVER BRADFORD ZONE

Zone	No. of Journals	No. of Articles	Bradford Multiplier
1st	53.71	1292	---
2nd	264.41	1424	4.9231
3rd	1301.76	1711	4.9231
Total	1620	4427	

From the above table, it's clear that the journals contributing articles to each zone increase by multiplier 4.9231. Top 54 journals appeared in the nucleus zone contributed 1292 articles, followed by 264 journals in the second zone containing 1424 articles and 1302 journals with 1711 articles in the third zone. Since the percentage of error is very negligible, Bradford's law fits very well in this data set.

V. CONCLUSION

The journal distribution pattern of the Economics literature published during 1991-2016 from India and China countries fit the Bradford distribution pattern. Similarly when the Egghe's model applied for the same data set for the verification of Bradford's law and found that both the data sets fit Bradford's distribution pattern with the unequal number of articles in the three zones. The data also revealed that majority of the economics research publications of both the countries scattered across various journals of multi-disciplinary nature mostly in social sciences and agricultural sciences. In other words, both India and Chinese economics publications not concentrated much in core or nucleus journals in economics.

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