Does the Journal Impact Factor help make a Good Indicator of Academic Performance?

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Abstract

After the notification of the University Grants Commission (Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education) Regulations, 2009, publication of research papers/articles in reputed journals has become an important factor in assessment of the academic performance of teachers in colleges and universities in India. One of the measures of reputation and academic standard (rank or importance) of a journal is the so-called 'Impact Factor.' This study makes a detailed statistical analysis of Journal Impact Factors across the disciplines covering thousands of journals. It finds that if journal impact factor is used to assess the academic performance of individuals (for the purpose of selection, promotion, etc) some will be over-rewarded while others will be under-rewarded.

Key words: Journal impact factor, University Grants Commission (UGC), regulation, India, academic performance indicator (API)

I. Introduction: After the notification of the *University Grants Commission (Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education) Regulations, 2009* (called the UGC Regulations hereinafter) on September 23rd 2009, publication of research papers/articles in reputed journals has become an important factor in assessment of the academic performance of teachers in colleges and universities in India. One of the measures of reputation and academic standard (rank or importance) of a journal is the so-called 'Impact Factor', which, with some qualifications, is the average number of citations for papers published in a particular journal. It is obtained as the ratio of the total number of citations received by the papers published in the journal to the number of papers published in the journal. The impact factor was devised by Eugene Garfield. Garfield is the founder of the Institute for Scientific Information (ISI), which is now part of Thomson Reuters. Impact factors are calculated annually for those journals that are indexed in Thomson Reuter's *Journal Citation Reports*. However, *Journal Citation Reports* covers science subjects more exhaustively and includes only a few social science journals. Therefore, in social sciences, other organizations are doing this job; for example, RePEc does the job of computing the impact factor of journals in economics.

The computation of impact factor uses a simple formula. As described in the Wikipedia, in a given year, the impact factor of a journal is the average number of citations to those papers that were published during the two preceding years. For example, the 2007 impact factor of a journal would be calculated as follows:

A = the number of times articles published in 2005 and 2006 were cited by indexed journals during 2007

B = the total number of "citable items" published in 2005 and 2006. ("Citable items" are usually articles, reviews, proceedings, or notes; not editorials or Letters-to-the-Editor.)
2007 impact factor = A/B

Note that 2007 impact factors are actually published in 2008; it cannot be calculated until all of the 2007 publications had been received by the indexing agency.

The UGC Regulations assign different level of importance to the impact factors in the natural science/engineering and the humanities/arts/social science streams of higher education. For this purpose, they classify Engineering, Agriculture, Veterinary Science, Sciences and Medical Sciences in one category and Languages, Arts, Humanities, Social Sciences, Library, Physical education, and Management in the other category. Table-1 shows how the UGC Regulations assign importance to impact factors in these two categories.

On this account several questions can be and have been raised from different corners. Some view it as a discrimination against the "sciences" and favour to the non-sciences (without any disparaging connotation, of course). Others think that even within the 'sciences' there is so much of difference in the journal impact factors that no single yardstick can be used to assign importance to them. In support of their argument they point out that there are few journals in mathematics that have an impact factor above 5.0 while such journals abound in life sciences. There are still others who think that instead of using the crude journal impact factor for assessment of importance, one should use the 'normalized' impact factor and possibly, the average impact factor (computed over, say, five best journals in the discipline) may be considered as 100.0 and other journal impact factors (in the discipline) should be normalized with respect to that such that all journals in the discipline score between zero and 100.0. And lastly, there are many who believe that the journal impact factor, as it has been defined, is a surely misleading indicator of academic importance especially when the inter-disciplinary comparisons are made.

Table-I: Relative Weightage assigned to Impact Factors (IF) in the Different Categories of Disciplines

Engineering/Agriculture/Veterinary Science/ Sciences / Medical Sciences [The Sciences Category]	**Languages, Arts/ Library/ Humanities/ Social Sciences/ Physical education/ Management [The Non-Sciences Category]**	**Max. points for University and college teacher position**
Refereed and indexed Journals with impact factor 0.0 but less than 1.0	Refereed Journals which are *not indexed* and thus have no impact factor	15 per publication
Refereed Journals with impact factor 1.0 and below 2.0	Refereed Journals which are indexed publications with Impact factor less than one	20 per publication
Refereed Journals with impact factor 2.1 and below 5.0	Refereed Journals with impact factor 1.0 and below 2.0	30 per publication
Refereed Journals with impact factor 5.1 and below 10.0	Refereed Journals with impact factor 2.0 and below 5.0	40 per publication
Vernacular & Indian language journals in all disciplines without any impact factors included in the list of journals prepared by UGC and hosted in its website	Vernacular & Indian language journals in all disciplines without any impact factors included in the list of journals prepared by UGC and hosted in its website	10 per Publication
Non impact factor National level research papers in non-refereed/ journals but having ISBN/ISSN numbers and the list of journals prepared by UGC and hosted in its website.	National level research papers in non-refereed/non Journals but having ISBN/ISSN numbers and the list of journals prepared by UGC and hosted in its website.	10 per publication
Full papers in conference proceedings, etc. (Abstracts not to be included)	Full papers in Conference proceedings, etc. (Abstracts not to be included)	10 per publication
Note: Class intervals of **IF** as given in the UGC Regulations; obviously, faulty – what if the **IF** lies in the interval [2, 2.1) ?		

II. What Do the Statistics Say: We have collected some data on the Journal impact factors for two points in time; for the year 1994 (source: http://www.mkk.szie.hu/~fulop/Res/If/If.htm) and for the year 2006 (source: http://www.icast.org.in/Impact/subject2006.html). We have been constrained by unavailability of data especially in the 'non-sciences' and therefore we have used the data for the year 2002 (Source: http://www.staff.city.ac.uk/~sj361/here_you_can_see_an_excel_spread.htm). For Economics, the *Internet Documents in Economics Access Service* (IDEAS) journal impact factors are available and are updated regularly (http://ideas.repec.org/top/top.journals.simple.html). We assume some sort of stability in the journal impact factor (without which assumption it loses all its value) and thus, in spite of the obvious limitations, we venture upon comparing them.

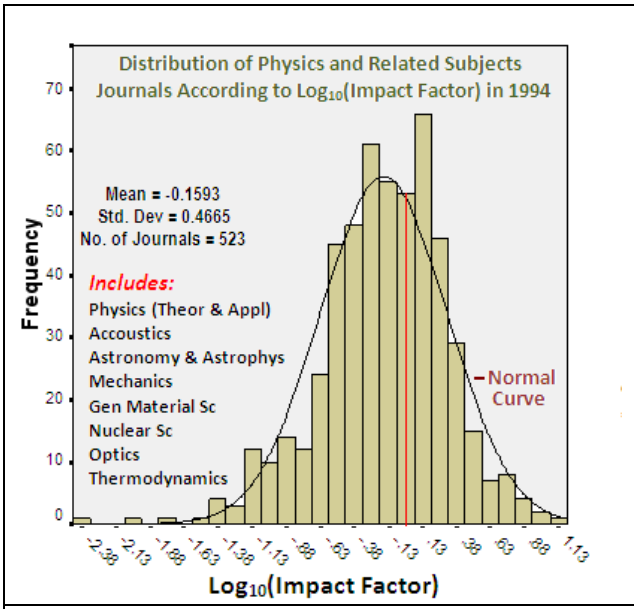
Methodologically, in this study we have included only those journals that have positive (larger than zero) impact factor. The journals that are indexed but have not yet gained any impact factor are thus excluded from the analysis. Then we have used mean and standard deviation of the ($\log_{10}$ transformation of) journal impact factors in different discipline groups and their frequency distribution to arrive at the conclusions. We have also computed the median and the skewness of the distributions. The most up-to-date (for the year 2006 for Sciences and engineering, and the year 2002 for psychology and social sciences) information on the impact factors reveal that the frequency distributions in the subject groups of engineering, social sciences and psychology, the mean and the median both are negative. In particular, engineering and social sciences have quite low mean impact factor. Distribution of impact factor in these subject groups exhibit negative skewness too. On the other hand, in case of biology, chemistry and physics, the mean and the median both are positive. However, the skewness is positive for physics alone (Table-2). In particular, skewness in chemistry and physics is mild. Distributions are presented in the graphs presented in Fig.1 and Fig.2. It may be noted that the major characteristics of impact factor distributions have remained more or less constant over the years (1994 and 2002).

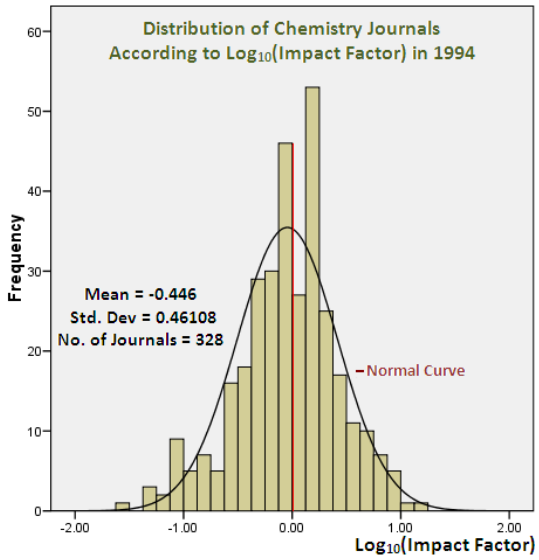
Table-2: Statistical Description of Journal Impact Factor Distribution in Different Subject Groups-2006

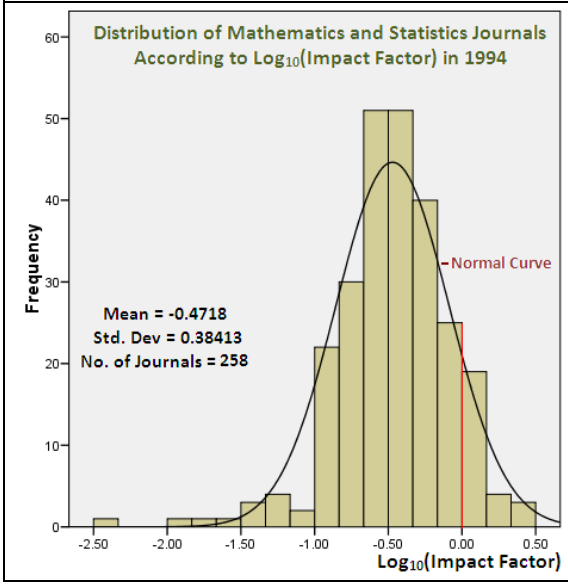
Subject Group	No. of Journals	Mean	Median	Minimum	Maximum	Std.Dev.	SEE(Mean)	Skewness	SEE(Skew)
Biology	1043	0.2984	0.3300	-1.4400	1.8000	0.4336	0.0134	-0.3111	0.0757
Chemistry	433	0.1037	0.1000	-1.2900	1.4200	0.4266	0.0205	-0.0321	0.1173
Engineering	706	-0.2477	-0.1900	-3.0000	1.0200	0.4565	0.0172	-1.0639	0.0920
Physics	294	0.0942	0.0900	-1.3600	1.5251	0.3966	0.0231	0.2372	0.1421
Psychology	421	-0.0813	-0.0700	-1.5100	0.9400	0.3835	0.0187	-0.3145	0.1190
Social Sc.	1301	-0.2312	-0.2100	-1.9600	1.0700	0.4166	0.0115	-0.4901	0.0678

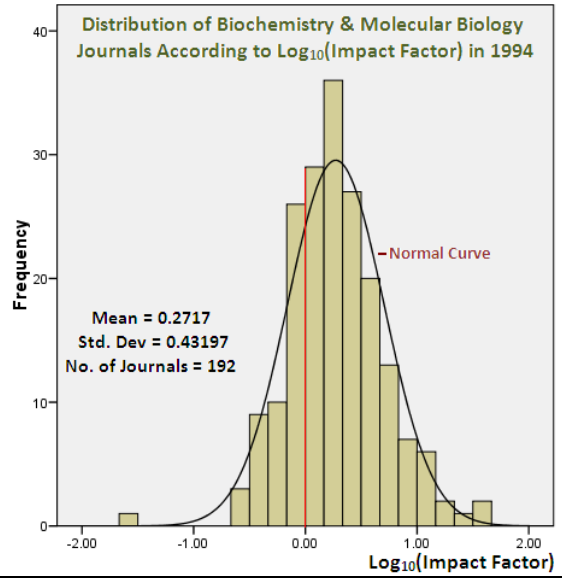
III. Does the Impact Factor Provide an Accurate Measure of a Journal's Importance? In counting citations, only papers published in the past two years are considered. In fact, many papers are appreciated after several years of their publication and then referred and many other papers continue influencing others' research for much longer period. Also, items such as news articles and editorials that are the regular features of some journals are not counted in the denominator of the impact factor, but citations to those news articles may be included in the numerator, inflating the impact factor of journals that publish such articles.

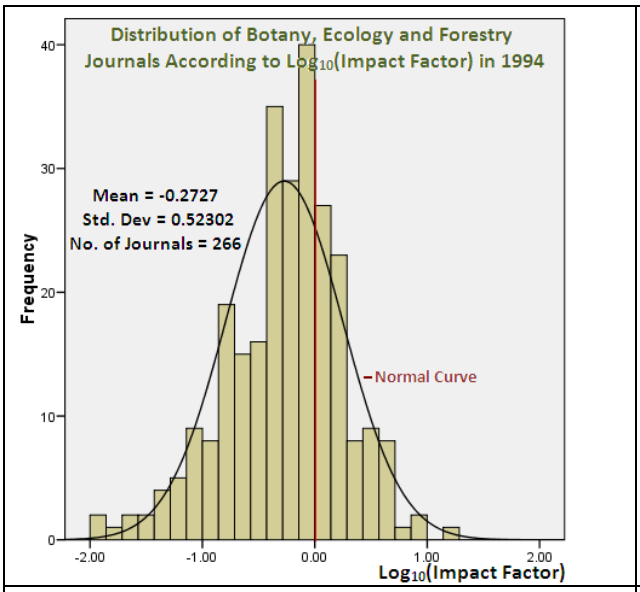
Review articles are often much more highly cited than the average original research paper, so the impact factor of review journals can be quite high. In some fields, there have been reports of journals that have manipulated [1] their impact factors by such tactics as adding news articles, accepting papers preferentially that are likely to raise the journal's impact factor, or even asking authors to add citations to other articles in the journal.

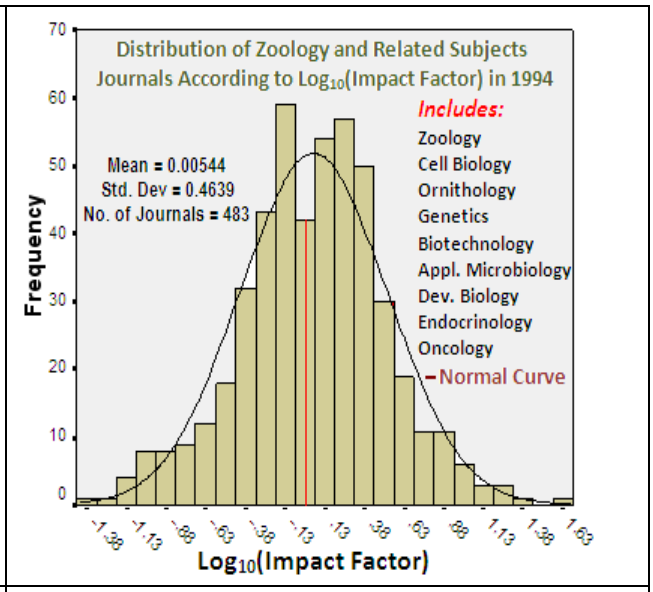

Distribution of Physics and Related Subjects
Journals According to Log10(Impact Factor) in 1994
Mean = -0.1593
Std. Dev = 0.4665
No. of Journals = 523
Includes:
Physics (Theor & Appl)
Accoustics
Astronomy & Astrophys
Mechanics
Gen Material Sc
Nuclear Sc
Optics
Thermodynamics
Normal Curve
Frequency
Log10(Impact Factor)

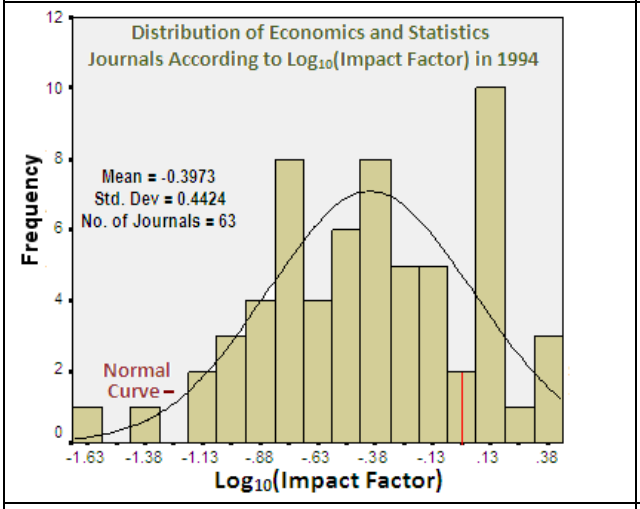

Distribution of Chemistry Journals
According to Log10(Impact Factor) in 1994
Mean = -0.446
Std. Dev = 0.46108
No. of Journals = 328
Normal Curve
Frequency
Log10(Impact Factor)

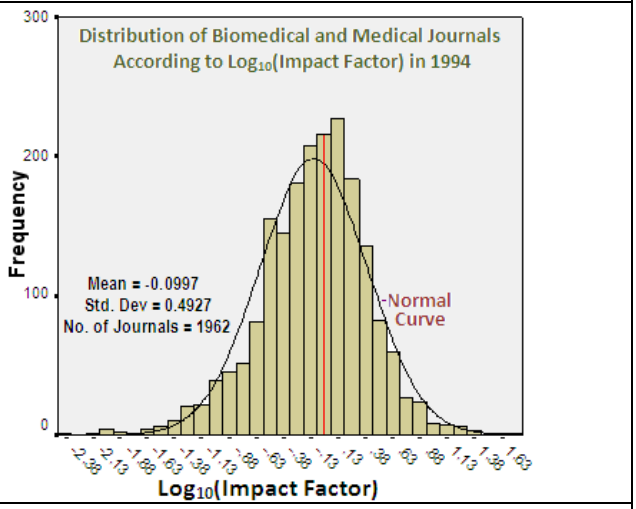

Distribution of Mathematics and Statistics Journals
According to Log10(Impact Factor) in 1994
Mean = -0.4718
Std. Dev = 0.38413
No. of Journals = 258
Normal Curve
Frequency
Log10(Impact Factor)

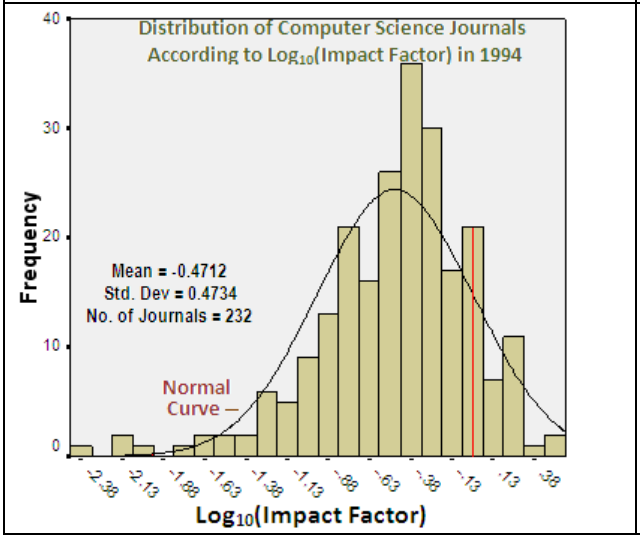

Distribution of Biochemistry & Molecular Biology
Journals According to Log10(Impact Factor) in 1994
Mean = 0.2717
Std. Dev = 0.43197
No. of Journals = 192
Normal Curve
Frequency
Log10(Impact Factor)

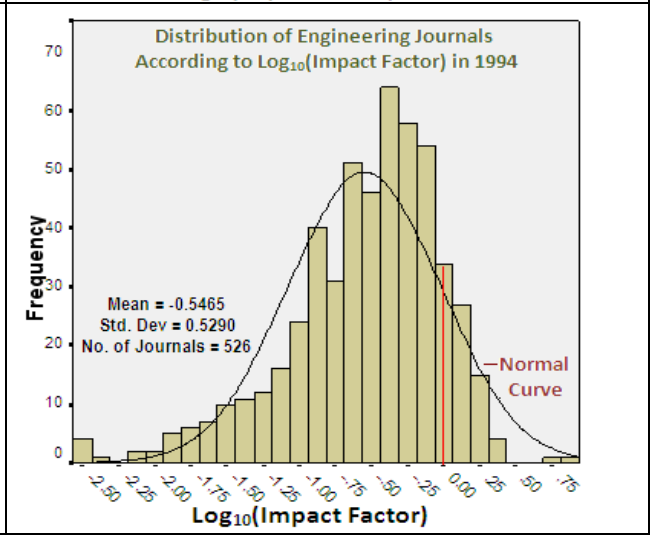

Distribution of Botany, Ecology and Forestry Journals According to Log10(Impact Factor) in 1994
Mean = -0.2727
Std. Dev = 0.52302
No. of Journals = 266
Normal Curve
Frequency
Log10(Impact Factor)


Distribution of Zoology and Related Subjects Journals According to Log10(Impact Factor) in 1994
Includes:
Zoology
Cell Biology
Ornithology
Genetics
Biotechnology
Appl. Microbiology
Dev. Biology
Endocrinology
Oncology
Mean = 0.00544
Std. Dev = 0.4639
No. of Journals = 483
Normal Curve
Frequency
Log10(Impact Factor)


Distribution of Economics and Statistics Journals According to Log10(Impact Factor) in 1994
Mean = -0.3973
Std. Dev = 0.4424
No. of Journals = 63
Normal Curve
Frequency
Log10(Impact Factor)


Distribution of Biomedical and Medical Journals According to Log10(Impact Factor) in 1994
Mean = -0.0997
Std. Dev = 0.4927
No. of Journals = 1962
Normal Curve
Frequency
Log10(Impact Factor)


Distribution of Computer Science Journals According to Log10(Impact Factor) in 1994
Mean = -0.4712
Std. Dev = 0.4734
No. of Journals = 232
Normal Curve
Frequency
Log10(Impact Factor)


Distribution of Engineering Journals According to Log10(Impact Factor) in 1994
Mean = -0.5465
Std. Dev = 0.5290
No. of Journals = 526
Normal Curve
Frequency
Log10(Impact Factor)

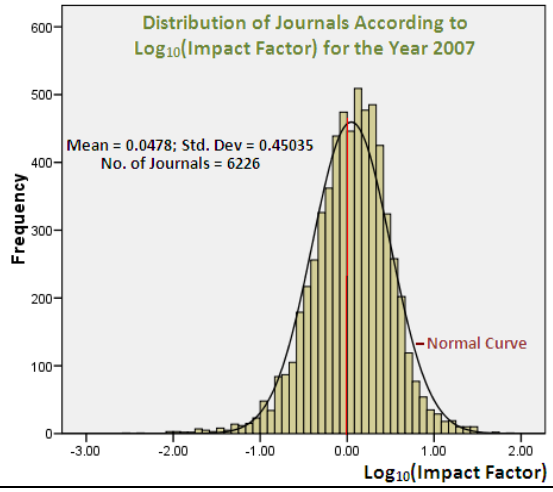
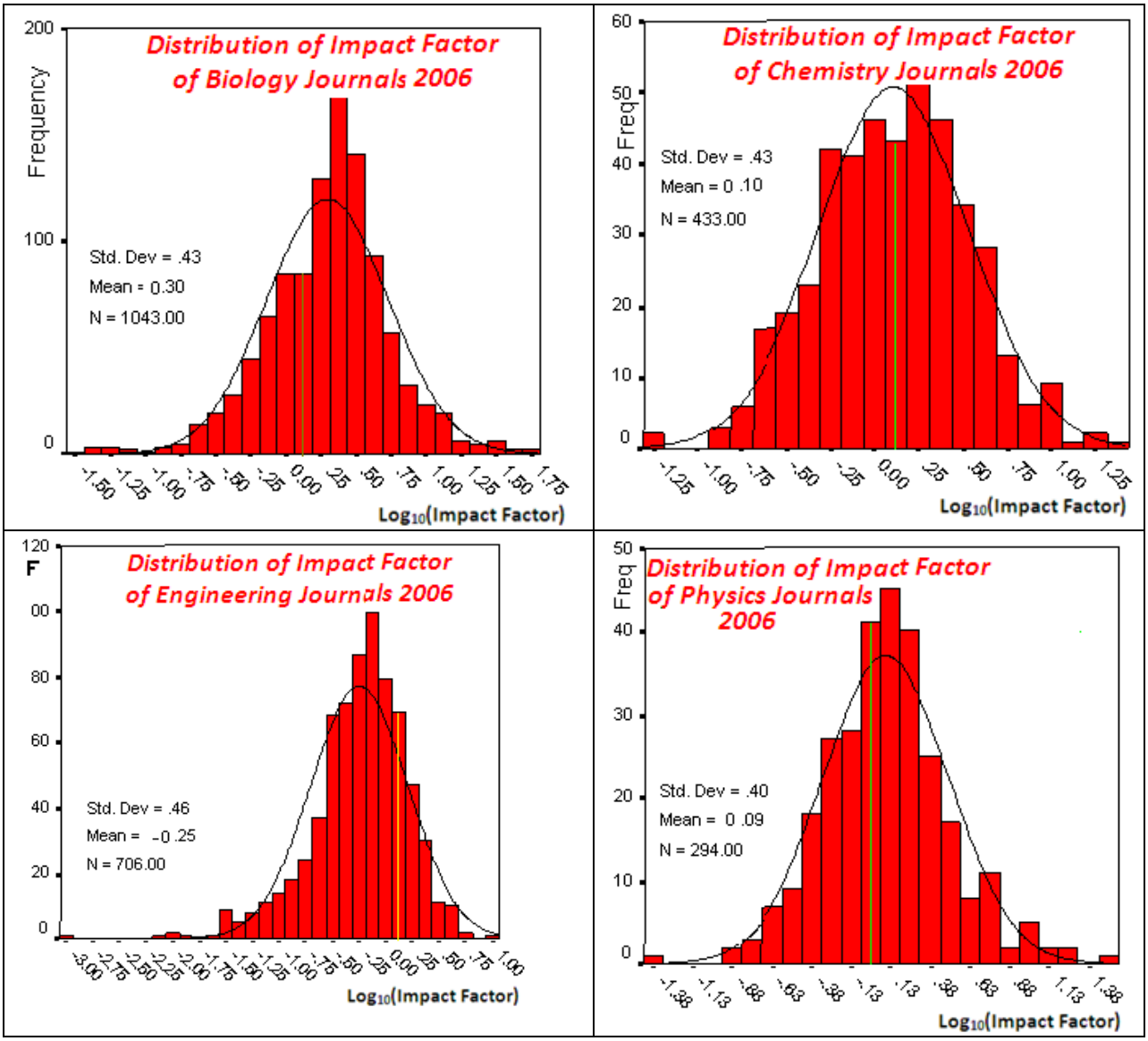


Fig.1. Statistical Distribution of Journal Factors in Various Subject Groups in 1994



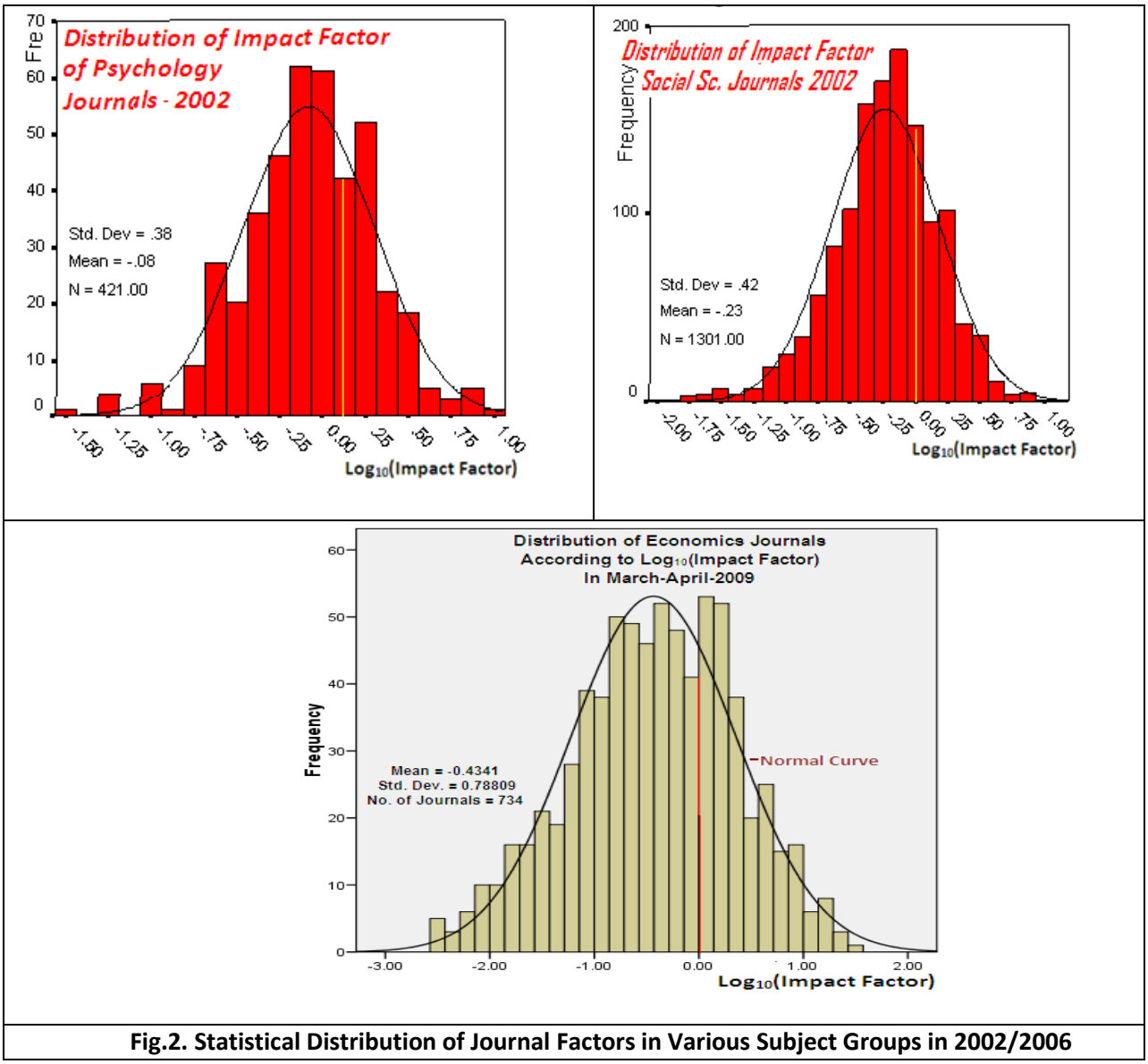


Fig.2. Statistical Distribution of Journal Factors in Various Subject Groups in 2002/2006

IV. Should the Journal Impact Factor be used for Evaluation of an Individual Publication or Researcher? As pointed out in the Wikipedia, "the impact factor is often misused to evaluate the importance of an individual publication or evaluate an individual researcher [2]. This does not work well since a small number of publications are cited much more than the majority - for example, about 90% of Nature's 2004 impact factor was based on only a quarter of its publications, and thus the importance of any one publication will be different and on the average less than the overall number [3]. The impact factor, however, averages over all articles and thus underestimates the citations of the most cited articles while exaggerating the number of citations of the majority of articles. Consequently, the Higher Education Funding Council for England was urged by the House of Commons Science and Technology Select Committee to remind Research Assessment Exercise panels that they are obliged to assess the quality of the content of individual articles, not the reputation of the journal in which they are published. To quote:

> "As is the case with any process, peer review is not an infallible system and to a large extent depends on the integrity and competence of the people involved and the degree of editorial oversight and quality assurance of the peer review process itself. Nonetheless we are satisfied that publishers are taking reasonable measures to main high standards of peer review. … The perception that the RAE (Research Assessment Exercise) rewards publication in journals with high impact factors is affecting decisions made by authors about where to publish. We urge HEFCE to remind RAE panels that they are obliged to assess the quality of the content of individual articles, not the reputation of the journal in which they are published." [4].

Even the scholars in medical sciences (that have a very high IF) question the validity of the journal impact factor as a measure of relevance of individual articles or scholars [5]. Some scholars hold that the rise of the Journal Impact Factor is a result of the perceived value of quantification measures in the contemporary society and the restructuring of capitalism. A key implication of this acceptance is an increase in global academic dependency [6]. It may be noted that in India we have hardly any journal that has an impact factor greater than one. For example, even the IDEAS (which is especially indexing economics and some statistics journals) index only six Indian journals in economics and the highest IF is less than one; interestingly, the *Indian Economic Review*, of the reputed Department of Economics, Delhi School of Economics has an impact factor only about 0.24. For physical and life sciences journals too, the conditions are not much better.

Use of journal impact factor for academic evaluation of individuals is widely deplored [7]. If journal impact factor is used to assess the academic performance of individuals (for the purpose of selection, promotion, etc) and it is not borne in mind that due to vast differences in the nature of distribution of impact factors across the disciplines they are not justifiably comparable, a below average scholar in the one discipline will rank higher and will be honored (and benefitted) more than another scholar in some other discipline. It may be noted that even in the university departments there are specializations with low impact factor journals and other specializations with very high impact factor journals. But the teachers/researchers of different specializations in the departments compete with each other for promotion. Will the researchers with an unfortunate specialization (wherein the journal impact factor is subdued) receive justice on such criteria?

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