# An alternative size-independent journal performance indicator for science on the periphery

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**The use of conventional journal impact factors (JIFs) for isolated journal ecosystems which belong to what is called science on the periphery has limitations. We propose the power : weakness ratio as an alternative size-independent recursive metric for journal evaluation for such ecosystems. It is based on the idea of recursive citation weighting using graph theoretic tools from social network analysis. The two highly localized ecosystems (i.e. subgraphs isolated from the global graph) chosen are the chemistry journals from India and those from China which are found in the JCR. When the local ecosystems are isolated from the larger global scientific network, the cross-citation behaviour within the local ecosystem reveals different features. This indicator is a more meaningful measure of the standing of each journal in the cross-citation activity within the ecosystem than the well-known JIF which is a global measure.**

**Keywords:** Bibliometrics, isolated journal ecosystems, social-network analysis, power, weakness ratio.

INDIAN researchers tend to publish their best work in foreign journals. When they publish, they tend invariably not to cite their own countrymen. What is true for the individual is also true for Indian institutions, and for Indian journals. Thus, we find that Indian journals do not cite Indian journals. As a result, the most widely used indicator of journal performance, the Journal Impact Factor (JIF) not only underestimates the impact of Indian science published in India, but also tends to give a different picture of the ecology of the journals.

What is true for journal ecosystems from India is also true for localized ecosystem of journals from non-English speaking countries such as China and Russia, which belong to what is called science on the periphery. The use of global impact factor (IF) measures for the performance of such journals has obvious limitations. The phenomenon of science on the periphery has been well-documented in refs 1–3. Most of the journals of countries on the periphery of science are rarely covered in the major databases and where they are, do not get cited within the country to the extent they should. As a result, the IFs of such peripheral journals, low as they are, are due to citing to and citations from major international journals. Thus the IF fails to give an accurate picture of how the journals within the limited national ecosystem are cross-citing each other. We need therefore to find a size-independent journal performance indicator that can be used to evaluate journals in a specific domain and in a local or regional setting.

In India, chemistry is the area in which the largest output is seen while in China it is the second largest area of research (after engineering). Nishy *et al.*[4] have shown that Indian researchers in the subject area of chemistry published their best work in foreign journals. Nishy and Prathap[5] showed that chemistry accounted for the greatest share of published research in India as recorded in the *Web of Knowledge* from 2000 to 2005 across various disciplines and this share had increased from 2000 to 2005 (in the second-order indicator exergy terms, from 34.14% to 40.70%). Not only for chemistry[4], for all other disciplines as well, when citation information is used to compute second-order indicators, nearly 99% of the 'best' research from India has appeared in international journals. Thus, JIFs will capture this faithfully and the JIFs of Indian journals will be abysmally small. There is clearly a need for a new methodology where a domain-specific and region-specific set of journals can be studied as an isolated scientific system to see how they are inter-linked and perform relative to each other.

## Recursive network-based journal performance indicators

New and more sophisticated indicators for journal performance evaluation[6,7] have emerged from social-network analysis[8–10]. Ramanujacharyulu[11] had earlier shown that recursive indicators can be computed using well-established methodologies based on graph theoretic tools. Counting total citations as is done for computing the JIF is a simple non-recursive measure[12,13]. With a recursive iterative computation like the PageRank procedure[14], it is possible to take into account the 'prestige' of the journal from which the citation arises[6]. An excellent review of ranking techniques using PageRank-type recursive procedures is available in Franceschet[14].

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Journal performance metrics are either size-dependent or size-independent[8,15–17]. The JIF[12] is actually derived from two primary size-dependent indicators[12]: the total number of articles $P$ published in the journal during a two-year publication window and the total citations $C$ to these articles from all articles published in the complete journal set (more than 10,000 journals) during the one-year citation window immediately following the publication window. For example, the two-year JIF for any journal in a database (say, the contemporary Web of Science Core Collection of Thomson Reuters to which the authors have subscription access) for the year 2013 is based on a two-year publication window (in this case, 2011 and 2012). Then the impact $i$ is computed as citations per paper $C/P$, which is a size-independent measure. While $C$ is a size-dependent, total impact $i$ is a size-independent specific impact. Very quickly, $i$ was accepted a proxy for quality for journal evaluation. The number of articles $P$ was a natural candidate proxy for quantity or size.

Dimensionality of the indicators is another key issue. The new indicators which emerge from social network considerations may measure different dimensions of the citation networks, or may be highly correlated among themselves[7]. Leydesdorff[7] distinguishes two main dimensions – size and impact – and argues that together they shape a property called 'influence'[13,18]. The dimensions for non-recursive indicators like $P$, $C$ and $i$ are easily assigned: $P$ has the dimensions of size/quantity and $i$ has the dimensions of impact/quality. $C$, being a product of quality and size has both dimensions and can be identified with total impact or total 'influence' of a journal. However, with recursive indicators that emerge from a graph-theoretical and social network methodology, it is not so easy to assign dimensionality to the various indicators[7,19]. A rigorous principal component analysis study of 39 scientific impact measures[19] showed that the notion of scientific impact is a multi-dimensional construct that cannot be adequately measured by any single indicator, with the citation impact being just one measure at the periphery[19].

In this article we use a size-independent recursive indicator developed from Ramanujacharyulu[11] to evaluate two isolated journal ecosystems from India and China respectively, which belong to what is called science on the periphery, where the use of global IF measures has some limitations. These ecosystems are therefore localized sub-graphs extracted from the total or global network[20]. The cross-citing behaviour within the sub-graph will show features not seen when global cited–citing matrices are used to generate IFs.

## The power : weakness ratio as a size-independent journal performance indicator

The 'cited-citing' matrix that arises in a bibliometric formulation is typical of matrices that arise in graph theory. Row-wise, we can read the 'power to influence' and column-wise, we can read the 'weakness to be influenced'. Ramanujacharyulu[11] proposed a power : weakness measure ratio which sought to balance the 'power to influence' with the 'weakness to be influenced.' A journal that is cited frequently demonstrates a larger 'power to influence'. Conversely, a journal that cites frequently has a larger 'weakness to be influenced'. We shall follow the terminology used to compute the Eigenfactor Score and the Article Influence Score indicators to explain the principal features[10,21]. Another recursive citation related indicator which has become prominent recently is the SJR (Scimago Journal Rank)[22].

Let **Z** be the cited–citing matrix. If the entries are read row-wise, then for a journal in row $i$, an entry such as $\mathbf{Z}_{ij}$ are the citations from journal $j$ in the citation window (say 2013) to articles published in journal $i$ during the publications window (say 2011–2012); in social-network analysis these are the in-coming links. It is important to emphasize here that the matrix can also be read column-wise; now for the journal in column $j$, the entry $\mathbf{Z}_{ij}$ are the references from journal $j$ in the citation window (2013) to articles published in journal $i$ during the publications window (2011–2012). In social network analysis these are the out-going links. Thus, row-wise we see the journal $i$s 'power to influence' and 'column-wise' we see the journal $j$s 'weakness to be influenced'. The row-sum corresponding to row $i$ is therefore the non-recursive indicator $C$, i.e. the total citations to journal $i$ from all the journals in the ecosystem, including itself. This is taken as a measure of the 'popularity' of journal $i$. If we also have an article vector $a$, where $a_i$ is the number of articles published by journal $i$ over the publication window, then this is the value $P$ for journal $i$ and the ratio $C/P$ is the non-recursive impact of the journal. A note of caution to be introduced here is that the notation $i$ is used here as an indicial notation and elsewhere in this article, from the compulsions of historical legacy, also as the notation for journal impact.

In the graph theoretic sense, $\mathbf{Z} = [\mathbf{Z}_{ij}]$ is the matrix associated with the graph[11]. Many properties of such matrices are known and it can be raised indefinitely to the $k$th power, i.e. $\mathbf{Z}^k$. This is the matrix used to define the 'power of the journal to influence'[11]. The Eigenfactor approach is thus a recursive iteration that raises **Z** to an order where convergence is obtained for what is effectively the weighted value of the total citations. So far the matrix calculations have all proceeded row-wise. For each journal we can find a value $p_i(k)$, which can be called the iterated power of order $k$ of the journal $i$ 'to influence'.

It is possible to carry out the same operations column-wise using the transpose of the matrix $\mathbf{Z}^T$ and then proceeding row-wise on these transposed elements in the same recursive and iterative manner indicated above[11]. This now defines the 'weakness of the journal to be

**Table 1.** The journal ecosystems chosen for the present study and their abbreviated and full publication names

| Ecosystem | Abbreviated name | Publication name in full |
|---|---|---|
| Indian chemistry journals in JCR | *Asian J Chem* | *Asian Journal of Chemistry* |
| | *Indian J Chem A* | *Indian Journal of Chemistry Section A Inorganic Bio Inorganic Physical Theoretical Analytical Chemistry* |
| | *Indian J Chem B* | *Indian Journal of Chemistry Section B Organic Chemistry including Medicinal Chemistry* |
| | *Indian J Heterocy Ch* | *Indian Journal of Heterocyclic Chemistry* |
| | *J Chem Sci* | *Journal of Chemical Sciences* |
| Chinese chemistry journals in JCR | *Acta Chim Sinica* | *Acta Chimica Sinica* |
| | *Acta Phys-Chim Sin* | *Acta Physico Chimica Sinica* |
| | *Chem J Chinese U* | *Chemical Journal of Chinese Universities Chinese* |
| | *Chem Res Chinese U* | *Chemical Research in Chinese Universities* |
| | *Chinese Chem Lett* | *Chinese Chemical Letters* |
| | *Chinese J Anal Chem* | *Chinese Journal of Analytical Chemistry* |
| | *Chinese J Catal* | *Chinese Journal of Catalysis* |
| | *Chinese J Chem* | *Chinese Journal of Chemistry* |
| | *Chinese J Inorg Chem* | *Chinese Journal of Inorganic Chemistry* |
| | *Chinese J Org Chem* | *Chinese Journal of Organic Chemistry* |
| | *Chinese J Struc Chem* | *Chinese Journal of Structural Chemistry* |
| | *J Rare Earth* | *Journal of Rare Earths* |
| | *Prog Chem* | *Progress in Chemistry* |
| | *Sci China Chem* | *Science China Chemistry* |

**Table 2.** Power matrix **Z** for Indian chemistry journals in JCR for citation window 2013 and publications window all years

| Indian chemistry journals in JCR (power matrix) | *Asian J Chem* | *Indian J Chem A* | *Indian J Chem B* | *Indian J Heterocy Ch* | *J Chem Sci* |
|---|---|---|---|---|---|
| *Asian J Chem* | **1006** | 2 | 3 | 3 | 1 |
| *Indian J Chem A* | 55 | **57** | 5 | 7 | 10 |
| *Indian J Chem B* | 76 | 1 | **117** | 86 | 29 |
| *Indian J Heterocy Ch* | 10 | 0 | 15 | **77** | 2 |
| *J Chem Sci* | 15 | 6 | 2 | 0 | **41** |

influenced by'. Again, for each journal we can find a value $w_i(k)$, which can be called the iterated weakness of order $k$ of the journal $i$ 'to be influenced by'.

At this stage we have two vectors of power $k$ – the power vector $p(k)$ and the weakness vector $w(k)$. The elements of the former are the recursive counts of citations. In this article, we take $w_i(k)$ as the recursive surrogate of the size of each journal. Then Ramanujacharyulu's[11] power : weakness ratio of order $k$, $r_i(k) = p_i(k)/w_i(k)$ becomes a size-independent recursive measure of impact or quality of the journal. As $k \to \infty$, we get the converged power : weakness ratio. Typically, for $k$ between 10 and 20 we get reasonably good convergence of the eigenvector.

Put simply, the Ramanujacharyulu's[11] power : weakness interpretation is: 'A journal becomes powerful when it is cited by other powerful journals and is weakened when it cites other weaker journals'.

We shall now use this indicator to examine how journals in science on the periphery can be assessed.

## The power : weakness ratio of journals in science on the periphery

The power : weakness ratio as a recursive size-independent measure of journal-specific impact can be used to study isolated journal ecosystems which belong to what is called science on the periphery[1–3], where the use of IF measures has obvious limitations. In India, chemistry is the area in which the largest output is seen while in China it is the second largest area of research. From the *Journal Citations Report* (*JCR*) for 2012, we can identify about 10 journals in chemistry from India and about 16 from China. For each ecosystem, we take the citation window to be the year 2013 and the publication window to be all years preceding that. This is necessary, as otherwise the quantum of citations is too low for meaningful study. In each case, the matrix **Z** could be set up easily and in each case two approaches could be followed, the first with self-citations included and a second cycle of analysis carried out without self-citations (by setting all

**Table 3.** Power matrix **Z** for Chinese chemistry journals in JCR for citation window 2013 and publications window all years

| Chinese chemistry journals in JCR (power matrix) | *Acta Chim Sinica* | *Acta Phys-Chim Sin* | *Chem J Chinese U* | *Chem Res Chinese U* | *Chinese Chem Lett* | *Chinese J Anal Chem* | *Chinese J Catal* | *Chinese J Chem* | *Chinese J Inorg Chem* | *Chinese J Org Chem* | *Chinese J Struc Chem* | *J Rare Earth* | *Prog Chem* | *Sci China Chem* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acta Chim Sinica* | **333** | 54 | 101 | 19 | 6 | 13 | 17 | 83 | 77 | 144 | 19 | 2 | 26 | 16 |
| *Acta Phys-Chim Sin* | 46 | **678** | 57 | 7 | 4 | 7 | 37 | 7 | 91 | 2 | 6 | 1 | 1 | 2 |
| *Chem J Chinese U* | 24 | 41 | **932** | 263 | 12 | 62 | 20 | 15 | 78 | 34 | 10 | 2 | 26 | 10 |
| *Chem Res Chinese U* | 0 | 5 | 290 | **252** | 3 | 1 | 1 | 4 | 6 | 9 | 2 | 0 | 5 | 0 |
| *Chinese Chem Lett* | 4 | 4 | 9 | 7 | **286** | 8 | 16 | 38 | 4 | 50 | 7 | 1 | 10 | 3 |
| *Chinese J Anal Chem* | 17 | 3 | 64 | 17 | 6 | **473** | 2 | 1 | 13 | 1 | 0 | 1 | 19 | 2 |
| *Chinese J Catal* | 13 | 59 | 28 | 4 | 8 | 0 | **432** | 7 | 33 | 9 | 5 | 13 | 24 | 11 |
| *Chinese J Chem* | 30 | 17 | 20 | 20 | 23 | 4 | 20 | **237** | 14 | 99 | 13 | 1 | 11 | 8 |
| *Chinese J Inorg Chem* | 7 | 28 | 39 | 7 | 5 | 4 | 14 | 4 | **723** | 4 | 44 | 4 | 12 | 3 |
| *Chinese J Org Chem* | 72 | 4 | 22 | 7 | 23 | 1 | 11 | 92 | 18 | **523** | 7 | 0 | 23 | 14 |
| *Chinese J Struc Chem* | 3 | 2 | 5 | 1 | 3 | 0 | 0 | 2 | 53 | 5 | **285** | 0 | 0 | 1 |
| *J Rare Earth* | 2 | 11 | 6 | 3 | 0 | 0 | 5 | 1 | 17 | 0 | 1 | **424** | 9 | 2 |
| *Prog Chem* | 24 | 14 | 29 | 2 | 6 | 11 | 22 | 5 | 32 | 1 | 3 | 2 | **144** | 12 |
| *Sci China Chem* | 10 | 12 | 11 | 2 | 8 | 6 | 10 | 13 | 5 | 1 | 3 | 0 | 12 | **187** |

**Table 4.** Indicators used and their description and classification

| Indicator | Description | Classification |
|---|---|---|
| $p(1)$ | No. of citations – raw | Size-dependent, non-recursive, proxy for performance involving quantity and quality |
| $w(1)$ | No. of references – raw | Size-dependent, non-recursive, proxy for quantity |
| $p(k)$ | No. of citations – weighted | Size-dependent, recursive, proxy for performance involving quantity and quality |
| $w(k)$ | No. of references – weighted | Size-dependent, recursive, proxy for quantity |
| Impact factor– (IF) 2012 | Journal impact factor | Size-independent, proxy for quality |
| $r(1)$ | Power-weakness ratio | Size-independent, non-recursive proxy for quality |
| $r(k)$ | Power-weakness ratio | Size-independent, recursive proxy for quality |

**Table 5.** The size-dependent and size-independent recursive and non-recursive indicators for Indian chemistry journals in JCR with self-citations included

| Indian chemistry journals in JCR | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
|---|---|---|---|---|---|---|---|
| *Asian J Chem* | 1015 | 1162 | 1384.83 | 1608.93 | 0.253 | 0.87 | 0.86 |
| *Indian J Chem A* | 134 | 66 | 81.22 | 3.44 | 0.787 | 2.03 | 23.59 |
| *Indian J Chem B* | 309 | 142 | 120.78 | 5.72 | 0.689 | 2.18 | 21.12 |
| *Indian J Heterocy Ch* | 104 | 173 | 16.90 | 5.96 | 0.169 | 0.60 | 2.84 |
| *J Chem Sci* | 64 | 83 | 22.27 | 1.95 | 1.298 | 0.77 | 11.40 |
| Pearson's correlation | | | | | | | |
| $p(1)$ | 1.00 | 0.97 | 0.98 | 0.97 | –0.50 | –0.13 | –0.48 |
| $w(1)$ | 0.97 | 1.00 | 0.99 | 1.00 | –0.54 | –0.34 | –0.64 |
| $p(k)$ | 0.98 | 0.99 | 1.00 | 1.00 | –0.47 | –0.24 | –0.55 |
| $w(k)$ | 0.97 | 1.00 | 1.00 | 1.00 | –0.48 | –0.31 | –0.60 |
| IF-2012 | –0.50 | –0.54 | –0.47 | –0.48 | 1.00 | 0.22 | 0.55 |
| $r(1)$ | –0.13 | –0.34 | –0.24 | –0.31 | 0.22 | 1.00 | 0.90 |
| $r(k)$ | –0.48 | –0.64 | –0.55 | –0.60 | 0.55 | 0.90 | 1.00 |

the diagonal elements $\mathbf{Z}_{ii}$ to zero). Since there were many near-dangling nodes (where the journals are cited within the ecosystem, but hardly cite any journal in the same system), in each ecosystem some journals had to be discarded because even within the ecosystem these journals were seen to be clearly 'on the periphery'. This was done as the calculation using Microsoft Excel proceeded. The cross-citation matrix is used directly and no damping and

**Table 6.** The size-dependent and size-independent recursive and non-recursive indicators for Chinese chemistry journals in JCR with self-citations included

| Chinese Chemistry Journals in JCR | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
|---|---|---|---|---|---|---|---|
| *Acta Chim Sinica* | 910 | 585 | 802.45 | 254.85 | 0.622 | 1.56 | 3.15 |
| *Acta Phys–Chim Sin* | 946 | 932 | 854.31 | 647.13 | 0.869 | 1.02 | 1.32 |
| *Chem J Chinese U* | 1529 | 1613 | 3768.11 | 4013.27 | 0.856 | 0.95 | 0.94 |
| *Chem Res Chinese U* | 578 | 611 | 1354.50 | 1331.94 | 0.735 | 0.95 | 1.02 |
| *Chinese Chem Lett* | 447 | 393 | 117.03 | 106.03 | 1.21 | 1.14 | 1.10 |
| *Chinese J Anal Chem* | 619 | 590 | 492.84 | 448.29 | 0.769 | 1.05 | 1.10 |
| *Chinese J Catal* | 646 | 607 | 320.41 | 227.76 | 1.304 | 1.06 | 1.41 |
| *Chinese J Chem* | 517 | 509 | 240.80 | 171.68 | 0.917 | 1.02 | 1.40 |
| *Chinese J Inorg Chem* | 898 | 1164 | 584.19 | 1305.16 | 0.72 | 0.77 | 0.45 |
| *Chinese J Org Chem* | 817 | 882 | 364.93 | 403.21 | 0.741 | 0.93 | 0.91 |
| *Chinese J Struc Chem* | 360 | 405 | 74.08 | 150.67 | 0.405 | 0.89 | 0.49 |
| *J Rare Earth* | 481 | 451 | 79.81 | 29.16 | 1.363 | 1.07 | 2.74 |
| *Prog Chem* | 307 | 322 | 192.55 | 174.76 | 0.67 | 0.95 | 1.10 |
| *Sci China Chem* | 280 | 271 | 88.99 | 71.09 | 1.327 | 1.03 | 1.25 |
| Pearson's correlation | | | | | | | |
| $p(1)$ | 1.00 | 0.94 | 0.84 | 0.82 | –0.20 | 0.03 | 0.01 |
| $w(1)$ | 0.94 | 1.00 | 0.81 | 0.87 | –0.21 | –0.29 | –0.26 |
| $p(k)$ | 0.84 | 0.81 | 1.00 | 0.97 | –0.17 | –0.07 | –0.11 |
| $w(k)$ | 0.82 | 0.87 | 0.97 | 1.00 | –0.18 | –0.28 | –0.28 |
| IF-2012 | –0.20 | –0.21 | –0.17 | –0.18 | 1.00 | 0.12 | 0.30 |
| $r(1)$ | 0.03 | –0.29 | –0.07 | –0.28 | 0.12 | 1.00 | 0.83 |
| $r(k)$ | 0.01 | –0.26 | –0.11 | –0.28 | 0.30 | 0.83 | 1.00 |

**Table 7.** The size-dependent and size-independent recursive and non-recursive indicators for Indian chemistry journals in JCR without self-citations

| Indian chemistry journals in JCR | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
|---|---|---|---|---|---|---|---|
| *Asian J Chem* | 9 | 156 | 18.69 | 130.07 | 0.253 | 0.06 | 0.14 |
| *Indian J Chem A* | 77 | 9 | 56.99 | 12.37 | 0.787 | 8.56 | 4.61 |
| *Indian J Chem B* | 192 | 25 | 168.41 | 45.76 | 0.689 | 7.68 | 3.68 |
| *Indian J Heterocy Ch* | 27 | 96 | 62.23 | 99.60 | 0.169 | 0.28 | 0.62 |
| *J Chem Sci* | 23 | 42 | 21.68 | 40.20 | 1.298 | 0.55 | 0.54 |
| Pearson's correlation | | | | | | | |
| $p(1)$ | 1.00 | –0.61 | 0.96 | –0.49 | 0.15 | 0.80 | 0.74 |
| $w(1)$ | –0.61 | 1.00 | –0.48 | 0.98 | –0.69 | –0.77 | –0.79 |
| $p(k)$ | 0.96 | –0.48 | 1.00 | –0.31 | –0.05 | 0.66 | 0.61 |
| $w(k)$ | –0.49 | 0.98 | –0.31 | 1.00 | –0.76 | –0.74 | –0.76 |
| IF-2012 | 0.15 | –0.69 | –0.05 | –0.76 | 1.00 | 0.24 | 0.23 |
| $r(1)$ | 0.80 | –0.77 | 0.66 | –0.74 | 0.24 | 1.00 | 0.99 |
| $r(k)$ | 0.74 | –0.79 | 0.61 | –0.76 | 0.23 | 0.99 | 1.00 |

no normalization is needed. We were finally left with 5 journals in the Indian chemistry ecosystem and 14 journals in the Chinese chemistry ecosystem. Table 1 shows the abbreviated and full publication names of the journals in the two journal ecosystems chosen for the study. In each case when $k = 1$, we get the raw or non-recursive value of impact and when the iteration is continued to higher orders of $k$ as $k \to \infty$, we find rapid convergence of the recursive power : weakness ratio.

Tables 2 and 3 display the power matrix **Z** for Indian and Chinese chemistry journals in the *JCR* for citation window 2013 and publication window comprising all preceding years where self-citations are included. The weakness matrix is obtained as the transpose and the cases without self-citation are obtained by discarding the entries in the diagonal and replacing them with zeroes. These matrices are simple and there is no need for the PageRank kind of modifications in order to carry out the recursive iterations. All these operations can be carried out using standard Excel spreadsheets.

In Table 4 we bring together the key indicators, their description and classification in terms of size-dependency and nature of recursiveness. Tables 5 and 6 give the size-dependent and size-independent recursive and non-recursive indicators for Indian and Chinese chemistry journals in the *JCR* with self-citations included. Tables 7

**Table 8.** The size-dependent and size-independent recursive and non-recursive indicators for Chinese chemistry journals in JCR without self-citations

| Chinese chemistry journals in JCR | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
|---|---|---|---|---|---|---|---|
| *Acta Chim Sinica* | 577 | 252 | 505.32 | 193.27 | 0.622 | 2.29 | 2.61 |
| *Acta Phys–Chim Sin* | 268 | 254 | 259.19 | 215.23 | 0.869 | 1.06 | 1.20 |
| *Chem J Chinese U* | 597 | 681 | 639.94 | 796.55 | 0.856 | 0.88 | 0.80 |
| *Chem Res Chinese U* | 326 | 359 | 565.83 | 668.67 | 0.735 | 0.91 | 0.85 |
| *Chinese Chem Lett* | 161 | 107 | 124.81 | 87.19 | 1.21 | 1.50 | 1.43 |
| *Chinese J Anal Chem* | 146 | 117 | 195.26 | 174.26 | 0.769 | 1.25 | 1.12 |
| *Chinese J Catal* | 214 | 175 | 168.40 | 133.74 | 1.304 | 1.22 | 1.26 |
| *Chinese J Chem* | 280 | 272 | 242.27 | 188.20 | 0.917 | 1.03 | 1.29 |
| *Chinese J Inorg Chem* | 175 | 441 | 146.40 | 371.13 | 0.72 | 0.40 | 0.39 |
| *Chinese J Org Chem* | 294 | 359 | 266.27 | 259.49 | 0.741 | 0.82 | 1.03 |
| *Chinese J Struc Chem* | 75 | 120 | 46.70 | 108.44 | 0.405 | 0.63 | 0.43 |
| *J Rare Earth* | 57 | 27 | 42.68 | 18.16 | 1.363 | 2.11 | 2.35 |
| *Prog Chem* | 163 | 178 | 145.54 | 147.58 | 0.67 | 0.92 | 0.99 |
| *Sci China Chem* | 93 | 84 | 77.40 | 64.09 | 1.327 | 1.11 | 1.21 |
| Pearson's correlation | | | | | | | |
| $p(1)$ | 1.00 | 0.74 | 0.92 | 0.67 | –0.30 | 0.16 | 0.20 |
| $w(1)$ | 0.74 | 1.00 | 0.75 | 0.89 | –0.36 | –0.44 | –0.39 |
| $p(k)$ | 0.92 | 0.75 | 1.00 | 0.84 | –0.32 | 0.05 | 0.06 |
| $w(k)$ | 0.67 | 0.89 | 0.84 | 1.00 | –0.33 | –0.39 | –0.40 |
| IF-2012 | –0.30 | –0.36 | –0.32 | –0.33 | 1.00 | 0.40 | 0.39 |
| $r(1)$ | 0.16 | –0.44 | 0.05 | –0.39 | 0.40 | 1.00 | 0.98 |
| $r(k)$ | 0.20 | –0.39 | 0.06 | –0.40 | 0.39 | 0.98 | 1.00 |

**Table 9.** Rankings according to the various size-dependent and size-independent and recursive or non-recursive indicators for Indian chemistry journals in JCR, with and without self-citations

| Indian chemistry Journals in JCR | Size-dependent | | | | Size-independent | | |
|---|---|---|---|---|---|---|---|
| | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
| With self-citations | *Asian J Chem* | *Asian J Chem* | *Asian J Chem* | *Asian J Chem* | *J Chem Sci* | *Indian J Chem B* | *Indian J Chem A* |
| | *Indian J Chem B* | *Indian J Heterocy Ch* | *Indian J Chem B* | *Indian J Heterocy Ch* | *Indian J Chem A* | *Indian J Chem A* | *Indian J Chem B* |
| | *Indian J Chem A* | *Indian J Chem B* | *Indian J Chem A* | *Indian J Chem B* | *Indian J Chem B* | *Asian J Chem* | *J Chem Sci* |
| | *Indian J Heterocy Ch* | *J Chem Sci* | *J Chem Sci* | *Indian J Chem A* | *Asian J Chem* | *J Chem Sci Heterocy Ch* | *Indian J* |
| | *J Chem Sci* | *Indian J Chem A* | *Indian J Heterocy Ch* | *J Chem Sci* | *Indian J Heterocy Ch* | *Indian J Heterocy Ch* | *Asian J Chem* |
| Without self-citations | *Indian J Chem B* | *Asian J Chem* | *Indian J Chem B* | *Asian J Chem* | *J Chem Sci* | *Indian J Chem A* | *Indian J Chem A* |
| | *Indian J Chem A* | *Indian J Heterocy Ch* | *Indian J Heterocy Ch* | *Indian J Heterocy Ch* | *Indian J Chem A* | *Indian J Chem B* | *Indian J Chem B* |
| | *Indian J Heterocy Ch* | *J Chem Sci* | *Indian J Chem A* | *Indian J Chem B* | *Indian J Chem B* | *J Chem Sci* | *Indian J Heterocy Ch* |
| | *J Chem Sci* | *Indian J Chem B* | *J Chem Sci* | *J Chem Sci* | *Asian J Chem* | *Indian J Heterocy Ch* | *J Chem Sci* |
| | *Asian J Chem* | *Indian J Chem A* | *Asian J Chem* | *Indian J Chem A* | *Indian J Heterocy Ch* | *Asian J Chem* | *Asian J Chem* |

and 8 give the size-dependent and size-independent recursive and non-recursive indicators for Indian and Chinese chemistry journals in the *JCR* without self-citations. We see from Tables 5 to 8 that the size-dependent indicators are all well correlated with each other. The size-independent indicators are similarly

**Table 10.** Rankings according to the various size-dependent and size-independent and recursive or non-recursive indicators for Chinese chemistry journals in JCR, with self-citations

| Chinese chemistry journals in JCR | Size-dependent | | | | Size-independent | | |
|---|---|---|---|---|---|---|---|
| | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
| With self- | *Chem J* | *Chem J* | *Chem J* | *Chem J* | *J Rare* | *Acta Chim* | *Acta Chim* |
| citations | *Chinese U* | *Chinese U* | *Chinese U* | *Chinese U* | *Earth* | *Sinica* | *Sinica* |
| | *Acta Phys-* | *Chinese J* | *Chem Res* | *Chem Res* | *Sci China* | *Chinese* | *J Rare* |
| | *Chim Sin* | *Inorg Chem* | *Chinese U* | *Chinese U* | *Chem* | *Chem Lett* | *Earth* |
| | *Acta Chim* | *Acta Phys-* | *Acta Phys-* | *Chinese J* | *Chinese J* | *J Rare* | *Chinese J* |
| | *Sinica* | *Chim Sin* | *Chim Sin* | *Inorg Chem* | *Catal* | *Earth* | *Catal* |
| | *Chinese J* | *Chinese J* | *Acta Chim* | *Acta Phys-* | *Chinese Chem* | *Chinese J* | *Chinese J* |
| | *Inorg Chem* | *Org Chem* | *Sinica* | *Chim Sin* | *Lett* | *Catal* | *Chem* |
| | *Chinese J* | *Chem Res* | *Chinese J* | *Chinese J* | *Chinese* | *Chinese J* | *Acta Phys-* |
| | *Org Chem* | *Chinese U* | *Inorg Chem* | *Anal Chem* | *J Chem* | *Anal Chem* | *Chim Sin* |
| | *Chinese J* | *Chinese J* | *Chinese J* | *Chinese J* | *Acta Phys-* | *Sci China* | *Sci China* |
| | *Catal* | *Catal* | *Anal Chem* | *Org Chem* | *Chim Sin* | *Chem* | *Chem* |
| | *Chinese J* | *Chinese J* | *Chinese J* | *Acta Chim* | *Chem J* | *Chinese J* | *Chinese* |
| | *Anal Chem* | *Anal Chem* | *Org Chem* | *Sinica* | *Chinese U* | *Chem* | *Chem Lett* |
| | *Chem Res* | *Acta Chim* | *Chinese J* | *Chinese J* | *Chinese J* | *Acta Phys-* | *Prog* |
| | *Chinese U* | *Sinica* | *Catal* | *Catal* | *Anal Chem* | *Chim Sin* | *Chem* |
| | *Chinese J* | *Chinese J* | *Chinese J* | *Prog* | *Chinese J* | *Prog* | *Chinese J* |
| | *Chem* | *Chem* | *Chem* | *Chem* | *Org Chem* | *Chem* | *Anal Chem* |
| | *J Rare* | *J Rare* | *Prog* | *Chinese J* | *Chem Res* | *Chem J* | *Chem Res* |
| | *Earth* | *Earth* | *Chem* | *Chem* | *Chinese U* | *Chinese U* | *Chinese U* |
| | *Chinese* | *Chinese J* | *Chinese* | *Chinese J* | *Chinese J* | *Chem Res* | *Chem J* |
| | *Chem Lett* | *Struc Chem* | *Chem Lett* | *Struc Chem* | *Inorg Chem* | *Chinese U* | *Chinese U* |
| | *Chinese J* | *Chinese* | *Sci China* | *Chinese* | *Prog* | *Chinese J* | *Chinese J* |
| | *Struc Chem* | *Chem Lett* | *Chem* | *Chem Lett* | *Chem* | *Org Chem* | *Org Chem* |
| | *Prog* | *Prog* | *J Rare* | *Sci China* | *Acta* | *Chinese J* | *Chinese J* |
| | *Chem* | *Chem* | *Earth* | *Chem* | *Chim Sinica* | *Struc Chem* | *Struc Chem* |
| | *Sci China* | *Sci China* | *Chinese J* | *J Rare* | *Chinese J* | *Chinese J* | *Chinese J* |
| | *Chem* | *Chem* | *Struc Chem* | *Earth* | *Struc Chem* | *Inorg Chem* | *Inorg Chem* |

correlated with each other. As is to be expected, the size-dependent and size-independent indicators are not strongly correlated with each other.

Table 9 translates the information into rankings according to the various size-dependent, and size-independent and recursive or non-recursive indicators for Indian chemistry journals in the *JCR*, with and without self-citations. In size terms, the *Asian Journal of Chemistry* dominates in all categories within the Indian ecosystem of chemistry journals. We see that without self-citations, the *Asian Journal of Chemistry* slides down to the bottom of the table. The IF, which is based on the global system of journals, does not accurately reflect the cross-citations within the local ecosystem. It is not the *J. Chem. Sci.* which has the highest IF, but the two *Indian Journals of Chemistry – Sections A and B* which are now at the top as far as influence within the country is concerned.

Tables 10 and 11 display the rankings according to the various size-dependent and size-independent and recursive or non-recursive indicators for Chinese chemistry journals in the *JCR*, with and without self-citations respectively. In size terms, the *Chem. J. Chinese U* dominates in all categories within the Chinese ecosystem of chemistry journals. We see that *Acta. Chim. Sinica*, which was second from the bottom in IF rises to the top position when only cross-citing within the Chinese ecosystem is the basis for journal influence. This is true irrespective of whether self-citations are included or not. The IF, which is based on the global system of journals, does not accurately reflect the cross-citations within the local ecosystem.

## Concluding remarks

We have studied two highly localized ecosystems, namely the chemistry journals from India and those from China which are found in the *JCR* using citation data to obtain size-independent recursive measure of specific impact. This has the potential to indicate alternative views of the relevance and excellence of work reported in a journal from a developing country[1–3].

The power : weakness ratio which is derived using ideas from graph theory and social network analysis is an alternative size-independent recursive index of journal performance. It can be easily applied to local ecosystems (sub-graphs) isolated from the larger global scientific network (graphs) and study cross-citation behaviour

**Table 11.** Rankings according to the various size-dependent and size-independent and recursive or non-recursive indicators for Chinese chemistry journals in JCR without self-citations

| Chinese chemistry journals in JCR | Size-dependent | | | | Size-independent | | |
|---|---|---|---|---|---|---|---|
| | $p(1)$ | $w(1)$ | $p(k)$ | $w(k)$ | IF-2012 | $r(1)$ | $r(k)$ |
| Without | *Chem J* | *Chem J* | *Chem J* | *Chem J* | *J Rare* | *Acta Chim* | *Acta Chim* |
| self-citations | *Chinese U* | *Chinese U* | *Chinese U* | *Chinese U* | *Earth* | *Sinica* | *Sinica* |
| | *Acta Chim* | *Chinese J* | *Chem Res* | *Chem Res* | *Sci China* | *J Rare* | *J Rare* |
| | *Sinica* | *Inorg Chem* | *Chinese U* | *Chinese U* | *Chem* | *Earth* | *Earth* |
| | *Chem Res* | *Chem Res* | *Acta Chim* | *Chinese J* | *Chinese J* | *Chinese* | *Chinese* |
| | *Chinese U* | *Chinese U* | *Sinica* | *Inorg Chem* | *Catal* | *Chem Lett* | *Chem Lett* |
| | *Chinese J* | *Chinese J* | *Chinese J* | *Chinese J* | *Chinese* | *Chinese J* | *Chinese J* |
| | *Org Chem* | *Org Chem* | *Org Chem* | *Org Chem* | *Chem Lett* | *Anal Chem* | *Chem* |
| | *Chinese J* | *Chinese J* | *Acta Phys-* | *Acta Phys-* | *Chinese J* | *Chinese J* | *Chinese J* |
| | *Chem* | *Chem* | *Chim Sin* | *Chim Sin* | *Chem* | *Catal* | *Catal* |
| | *Acta Phys-* | *Acta Phys-* | *Chinese J* | *Acta Chim* | *Acta Phys-* | *Sci China* | *Sci China* |
| | *Chim Sin* | *Chim Sin* | *Chem* | *Sinica* | *Chim Sin* | *Chem* | *Chem* |
| | *Chinese J* | *Acta Chim* | *Chinese J* | *Chinese J* | *Chem J* | *Acta Phys-* | *Acta Phys-* |
| | *Catal* | *Sinica* | *Anal Chem* | *Chem* | *Chinese U* | *Chim Sin* | *Chim Sin* |
| | *Chinese J* | *Prog* | *Chinese J* | *Chinese J* | *Chinese J* | *Chinese J* | *Chinese J* |
| | *Inorg Chem* | *Chem* | *Catal* | *Anal Chem* | *Anal Chem* | *Chem* | *Anal Chem* |
| | *Prog* | *Chinese J* | *Chinese J* | *Prog* | *Chinese J* | *Prog* | *Chinese J* |
| | *Chem* | *Catal* | *Inorg Chem* | *Chem* | *Org Chem* | *Chem* | *Org Chem* |
| | *Chinese* | *Chinese J* | *Prog* | *Chinese J* | *Chem Res* | *Chem Res* | *Prog* |
| | *Chem Lett* | *Struc Chem* | *Chem* | *Catal* | *Chinese U* | *Chinese U* | *Chem* |
| | *Chinese J* | *Chinese J* | *Chinese* | *Chinese J* | *Chinese J* | *Chem J* | *Chem Res* |
| | *Anal Chem* | *Anal Chem* | *Chem Lett* | *Struc Chem* | *Inorg Chem* | *Chinese U* | *Chinese U* |
| | *Sci China* | *Chinese* | *Sci China* | *Chinese* | *Prog* | *Chinese J* | *Chem J* |
| | *Chem* | *Chem Lett* | *Chem* | *Chem Lett* | *Chem* | *Org Chem* | *Chinese U* |
| | *Chinese J* | *Sci China* | *Chinese J* | *Sci China* | *Acta Chim* | *Chinese J* | *Chinese J* |
| | *Struc Chem* | *Chem* | *Struc Chem* | *Chem* | *Sinica* | *Struc Chem* | *Struc Chem* |
| | *J Rare* | *J Rare* | *J Rare* | *J Rare* | *Chinese J* | *Chinese J* | *Chinese J* |
| | *Earth* | *Earth* | *Earth* | *Earth* | *Struc Chem* | *Inorg Chem* | *Inorg Chem* |

within the local ecosystem. The power indicator, $p_i(k)$, where a sufficiently large value of $k$ will ensure convergence, becomes the size-dependent recursive value of the citations, or recursive total impact or influence, of journal $i$, taking the prestige of all journals in the ecosystem. This is the numerator of the formula for size-independent recursive specific impact or influence. Unlike the conventional approach for calculating IF, or even the Article Influence Score, the number of articles is not taken as the size-dependent term in the denominator for the calculation of the size-independent specific impact. The recursive weakness indicator $w_i(k)$ is the size-dependent term for the denominator. Then the power : weakness ratio $r_i(k) = p_i(k)/w_i(k)$ becomes a size-independent recursive indicator for specific impact.

One of the authors (G.P.) is frequently asked if it is possible to 'improve' the standard and quality of Indian journals. By 'improve' it is normally implied that the JIF must be enhanced. This is difficult in the face of evidence that Indian researchers continue to publish their best work in foreign journals. Invariably, Indian authors tend not to cite their own countrymen. This is also true for Indian institutions and Indian journals. Thus, we find that Indian journals do not cite Indian journals. As a result, the most widely used indicator of journal performance, *JIF*, not only underestimates the impact of Indian science published in India, but also tends to give a different picture of the ecology of the journals. It is therefore imperative that to improve our journals and our scientific standing, we must 'publish in India, cite in India'.


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