How Should Journal Quality be Ranked? An Application to Agricultural, Energy, Environmental and Resource Economics

Chia-Lin Chang[1] and Michael McAleer[2,*]

[1]*Department of Applied Economics and Department of Finance, National Chung Hsing University, Taichung, Taiwan*

[2]*Department of Quantitative Finance, National Tsing Hua University, Hsinchu, Taiwan; Erasmus School of Economics, Erasmus University Rotterdam, Rotterdam, The Netherlands*

Abstract: The Thomson Reuters ISI Web of Science citations database (hereafter ISI) category of Economics has one of the largest numbers of journals, at 304 (as of 2011) and 333 (as of 2013), of any ISI discipline, and hence has wide coverage. The paper analyses the leading international journals in the Economics sub-disciplines of Agricultural, Energy, Environmental and Resource Economics using quantifiable Research Assessment Measures (RAMs), and highlights the similarities and differences in alternative RAMs. The RAMs are based on alternative transformations of citations and influence taken from the ISI database. Alternative RAMs may be calculated annually or updated daily to answer the perennial questions as to When, Where and How (frequently) published papers are cited. The RAMs include the most widely used RAM, namely the classic 2-year impact factor including journal self citations (2YIF), 2-year impact factor excluding journal self citations (2YIF*), 5-year impact factor including journal self citations (5YIF), Immediacy (or zero-year impact factor (0YIF)), Eigenfactor, Article Influence, C3PO (Citation Performance Per Paper Online), h-index, PI-BETA (Papers Ignored - By Even The Authors), 2-year Self-citation Threshold Approval Ratings (2Y-STAR), Historical Self-citation Threshold Approval Ratings (H-STAR), Impact Factor Inflation (IFI), and Cited Article Influence (CAI). As data are not available for 5YIF, Article Influence and CAI for one of the 20 journals considered, 13 RAMs are analysed for 19 highly-cited journals in Agricultural, Energy, Environmental and Resource Economics in the ISI category of Economics. The harmonic mean of the ranks of the 13 RAMs for the 19 highly-cited journals are also presented. It is shown that emphasizing the 2-year impact factor of a journal, which partly answers the question as to When published papers are cited, to the exclusion of other informative RAMs, which answer Where and How (frequently) published papers are cited, can lead to a distorted evaluation of journal impact and influence relative to the harmonic mean of the ranks. The "age" effect of journals, that is, the number of years for which the journals have been included in ISI, on the RAMs is also examined to check whether the RAMs are being compared fairly.

Keywords: Research assessment measures, Impact factor, IFI, C3PO, PI-BETA, STAR, Eigenfactor, Article Influence, h-index, harmonic mean of the ranks, age effect.

1. INTRODUCTION

The Thomson Reuters ISI Web of Science (2011) database (hereafter ISI) is widely-regarded as the leading high quality database for generating Research Assessment Measures (RAMs) to evaluate the research performance of individual researchers and the quality of academic journals. The RAMs are based on alternative transformations of citations and influence data from the ISI database. Although there are caveats regarding the methodology and data collection methods underlying any database (see, for example, Seglen (1997) and Chang *et al*. (2011a, b, c, d) for caveats regarding ISI, as well as other databases that report impact factors), the ISI citations database is the oldest source of rankings criteria and the benchmark against which other databases are compared.

In recent years, various RAMs have been used to compare journals in a wide range of ISI disciplines and sub-disciplines, such as Economics, Management, Finance and Marketing (Chang *et al*. (2011a), Chang and McAleer (2014)), leading ISI disciplines in the Sciences (Chang *et al*. (2011b)), Econometrics (Chang and McAleer (2013c, 2014), Chang *et al*. (2011c)), Finance (Chang and McAleer (2013b)), Neuroscience (Chang *et al*. (2011d)), Tourism and Hospitality (Chang and McAleer (2012)), and Statistics & Probability (Chang and McAleer (2013a)). As the alternative RAMs are based on citations and influence, the rankings methodology can be applied to any discipline or sub-discipline in the sciences or social sciences.

The ISI category of Economics is interesting and intriguing as it has one of the largest numbers of journals, at 304 (as of 2011), of any ISI discipline, and hence has very wide coverage, including numerous sub-disciplines, as follows: accounting; agricultural economics; applied econometrics; applied economics; banking and finance; behavioural finance; cliometrics; comparative economics; cultural change; computational economics; defence and peace economics; demography; derivatives research; development economics; ecological economics;

*Address correspondence to this author at the Department of Quantitative Finance, National Tsing Hua University, 101, Section 2, Kuang Fu Road, Hsinchu 300, Taiwan; Tel: 886-3-576-2534, Fax: 886-3-562-1823,
Email: michael.mcaleer@gmail.com

JEL Classifications: Q10, Q20, Q30, Q40, Q50.

econometric theory; economic and human biology; economic geography; economic growth; economic history; economic inequality; economic perspectives; economic policy; economic psychology; economic theory; economics and philosophy; economics and sociology; economics of education; economics of transition; emerging markets; empirical economics; energy economics; environmental economics; evolutionary economics; experimental economics; feminist economics; financial economics; financial stability; food policy; forecasting; forest economics; futures markets; game theory; health economics; history of economic thought; housing economics; income and wealth; industrial organization and economics; information economics; innovation; insurance; international economics; international money and finance; labour economics; land economics; law and economics; macroeconomics; mathematical economics; management and strategy; media economics; microeconomics; monetary economics; network economics; organisational economics; pension economics; political economy; population economics; post-Keynesian economics; productivity analysis; public economics; real estate economics; regional science; regulatory economics; resource economics; risk and uncertainty; social choice; spatial economics; taxation; time series analysis; transportation economics; urban economics; and welfare economics, among others.

In short, many sub-disciplines in the ISI category of Economics could be evaluated, either individually or jointly.

It is well known that comparing the impact of journals in different disciplines can lead to misleading conclusions. Given the extremely wide coverage of sub-disciplines in economics, among others, it is also not straightforward to compare the quality of journals across a variety of sub-disciplines or against leading generalist journals. Of the 304 journals in the ISI category of Economics, there are 20 journals in the broadly similar sub-disciplines of Agricultural, Energy, Environmental and Resource Economics (see Table **1**). Although this number may be relatively small numerically in comparison with the total number of journals in Economics, 20 journals nonetheless provide a critical mass for purposes of analysing the citations and impact of these leading journals. As the leading journals in Agricultural, Energy, Environmental and Resource Economics have not yet been analysed in terms of citations and impact on the academic profession, one of the primary aims of this paper is to undertake such an assessment.

It has frequently been emphasized in ISI Web of Science (2011), and elsewhere, that journal citations data should be used carefully, otherwise misleading and inappropriate inferences can be drawn. Seglen (1997) argues strongly against using impact factors of journals to evaluate scientific research. Accepting that citations measures are here to stay, Hirsch (2005) invented a widely-used citations measure, the h-index, for quantifying an academic's scientific research output historically. In addition to evaluating the research output of individuals, the h-index is now also routinely used to quantify the scientific output published in academic and professional journals.

Publishing research of high quality and significant impact is fundamental to progress in the sciences and social sciences. From a career perspective, the perceived research performance of individual researchers can be crucial for hiring, tenure and promotion decisions worldwide. In the absence of appropriate information regarding the perceived quality of an individual's research output, the perceived quality of academic journals has long been used as a proxy for determining the quality of academic research publications. Such a proxy may not be especially meaningful for established researchers, especially in the sciences, whereby an individual's scientific research output and impact can be measured by, for example, the h-index, which examines the number of citations for specific papers as well as the total number of citations historically. However, for early career researchers who may not yet have many citations, the quality of an individual's scientific research output is frequently based on the perceived quality of the journals in which research output has been published. This is especially true in economics and its sub-disciplines,

Seglen (1997) finds that the citations rates of published papers determine the impact factor of journals, though the reverse does not hold. It is well known that the perceived quality of a journal can be an inappropriate and misleading proxy for the perceived quality of a published paper. The quality and impact of an academic journal are typically based on outstanding published papers. However, as argued by a number of researchers in the bibliometrics literature, publication in a leading journal should not be taken to be an accurate reflection of the quality of a published paper, especially when the paper has not yet received many, or possibly any, citations.

Leading journals tend to publish important papers, the number of which can be measured using a journal's

Table 1: 13 Research Assessment Measures (RAMs) for 20 Agricultural, Energy, Environmental and Resource Economics Journals

Journal	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI	H-STAR	2Y-STAR	Years in ISI
J ENVIRON ECON MANAG	2.989	2.809	1.064	3.029	0.3	75	20.04	0.078	0.00752	1.608	1.483	92	88	38
REV ENV ECON POLICY	2.781	2.656	1.047	3.146	1.176	12	5.36	0.262	0.00194	2.07	1.528	88	92	5
ENERG ECON	2.449	1.861	1.316	2.903	0.238	40	7.39	0.228	0.00868	0.982	0.758	52	52	31
J AGRAR CHANGE	1.881	1.452	1.295	-	1.625	10	1.77	0.617	0.00121	-	-	48	56	6
FOOD POLICY	1.831	1.581	1.158	2.459	0.242	29	3.18	0.501	0.00376	0.828	0.413	78	74	36
RESOUR ENERGY ECON	1.778	1.778	1	1.865	0.429	29	8.59	0.239	0.00202	0.936	0.712	94	100	19
ENERG J	1.391	1.283	1.084	2	0.341	32	6.31	0.403	0.00459	1.035	0.618	86	86	25
LAND ECON	1.375	1.318	1.043	1.851	0.455	60	8.24	0.331	0.00323	0.850	0.569	90	92	56
AGR ECON-BLACKWELL	1.329	1.186	1.121	1.32	0.114	31	5.44	0.297	0.00386	0.548	0.385	84	80	15
ENVIRON RESOUR ECON	1.297	1.143	1.135	1.743	0.365	34	7.29	0.214	0.0065	0.824	0.648	84	78	17
AM J AGR ECON	1.233	1.008	1.223	1.607	0.118	63	3.95	0.676	0.00668	0.658	0.213	68	64	44
AUST J AGR RESOUR EC	1.117	0.983	1.136	1.374	0.088	20	3.39	0.497	0.00138	0.51	0.257	88	78	25
EUR REV AGRIC ECON	1.065	0.87	1.224	1.783	0.217	26	4.39	0.508	0.00144	0.641	0.315	86	64	19
ANNU REV RESOUR ECON	1	0.828	1.208	1	0.056	5	1.46	0.479	0.00017	0.304	0.158	60	66	3
J AGR ECON	0.969	0.875	1.107	1.549	0.235	29	2.71	0.589	0.00147	0.523	0.215	90	82	46
J FOREST ECON	0.867	0.8	1.084	1.453	0.238	7	1.97	0.45	0.00073	0.497	0.273	82	86	7
J AGR RESOUR ECON	0.75	0.661	1.135	0.79	0	24	2.47	0.649	0.00101	0.331	0.116	88	78	20
REV AGR ECON	0.582	0.582	1	0.873	0	15	3.07	0.389	0.00202	0.4	0.244	100	100	9
CAN J AGR ECON	0.477	0.431	1.107	0.95	0.357	13	2.33	0.409	0.00109	0.351	0.207	82	82	31
CHINA AGR ECON REV	0.167	0.167	1	0.167	0	2	0.23	0.844	0.00002	0.027	0.004	100	100	3
Mean	1.366	1.211	1.124	1.677	0.33	28	4.98	0.433	0.00297	0.733	0.480	82	80	23
Standard deviation	0.74	0.675	0.092	0.792	0.399	20	4.28	0.187	0.00257	0.476	0.419	14	14	-

Notes: Journal acronyms are from ISI. Daily RAMs are not reported when there are more than 10,000 articles, so the data for American Journal of Agricultural Economics are from 1984 onward. Data for all other journals are from their inception. The data were downloaded from ISI on 10 August 2011. Journals are ranked according to 2YIF.

h-index, among other measures. Such journals typically increase the visibility of the research findings of published papers, which may subsequently lead to higher citations. Otherwise, there would seem to be little point in publishing in leading journals, especially as one of the primary purposes in writing papers, especially in the sciences, is to encourage citations and influence.

As has been argued in Chang *et al*. (2011a, b, c, d), the acceptance of a paper for publication in a journal is typically based on the presumed expertise of a member of the Editorial Board of a journal and a small number of referees, with the specific number of referees varying considerably across disciplines. These professionals determine the rejection rate of a journal **before** a paper is published. Given the propensity of members of editorial boards and referees to exhibit errors of judgment, it is worthwhile recognizing that the implicit rejection rate after a paper has been published in a journal depends on the worldwide scientific community. Consequently, the proportion of published papers that is ignored by the profession, and possibly even by the authors themselves, is an important impact performance measure **after** publication.

The worldwide scientific community is less likely to make serious errors of judgment regarding the quality of academic research papers after they have been published, especially after several years have passed, than a small group of Editorial Board members and referees who are required to make difficult and tenuous judgments regarding the quality of a paper before publication.

Citations capture both the impact of a journal and the impact or performance of individual researchers. Citations and influence should be, and are, more important than publications for individual researchers, especially in the sciences. As the primary quantitative method of evaluating journal impact is through citations, it is not surprising that most RAMs are based, directly or indirectly, on citations. It is also important to examine the "age" effect of journals (that is, the number of years the journals have been included in ISI, rather than the number of years that journals have been in existence) on the RAMs to check whether the RAMs are being compared fairly.

This paper examines the importance of RAMs as viable rankings criteria in Agricultural, Energy, Environmental and Resource Economics, and attempts to answer some important questions raised in Chang *et al*. (2011a, b, c, d), namely When, Where and How (frequently) are published papers cited in leading journals in a discipline or range of sub-disciplines. In this paper, we ask the same questions of the leading ISI journals in the sub-disciplines of Agricultural, Energy, Environmental and Resource Economics, and evaluate the usefulness of 13 existing RAMs for 19 leading journals in Agricultural, Energy, Environmental and Resource Economics in the ISI category of Economics.

The plan of the remainder of the paper is as follows. Section 2 presents key RAMs using ISI data that may be calculated annually or updated daily, including the most widely used RAM, namely the classic 2-year impact factor including journal self citations (2YIF), 2-year impact factor excluding journal self citations (2YIF*), 5-year impact factor including journal self citations (5YIF), Immediacy (or zero-year impact factor (0YIF)), Eigenfactor, Article Influence, C3PO (Citation Performance Per Paper Online), h-index, PI-BETA (Papers Ignored - By Even The Authors), 2-year Self-citation Threshold Approval Ratings (2Y-STAR), Historical Self-citation Threshold Approval Ratings (H-STAR), Impact Factor Inflation (IFI), and Cited Article Influence (CAI). Section 3 discusses and analyses 13 RAMs for 19 leading journals in Agricultural, Energy, Environmental and Resource Economics in the ISI category of Economics, and also examines the "age" effect of journals on the RAMs. Section 4 summarizes the ranking outcomes and gives some practical suggestions as to how to rank journal quality.

2. RESEARCH ASSESSMENT MEASURES (RAM)

As discussed in ISI Web of Science (2011) and a number of papers, such as Chang *et al*. (2011a, b, c, d), the RAMs are intended as descriptive statistics to capture journal impact and influence, and are not based on any mathematical models. Hence, in what follows, no optimization or estimation is required in calculating the alternative RAMs. Moreover, as there are no models used in calculating the RAMs, there are no auxiliary assumptions to test.

As the alternative RAMs that are provided in ISI and in several recent publications may not be widely known, this section provides a brief description and definition of 13 RAMs that may be calculated annually or updated daily to answer the questions as to When, and Where and How (frequently), published papers are cited (for further details, see Chang *et al*. (2011a, b, c, d)). The answers to When published papers are cited are based on the set {2YIF, 2YIF*, 5YIF, Immediacy}, and the answers to Where and How (frequently) published papers are cited are based on the set {Eigenfactor, Article Influence, IFI, H-STAR, 2Y-STAR, C3PO, h-index, PI-BETA, CAI}.

2.1. Annual RAM

The discussion in this section of the various RAMs follows closely the presentation in Chang *et al*. (2011a, b, c). With three exceptions, namely Eigenfactor, Article Influence and Cited Article Influence (CAI), existing RAMs are reported separately for the sciences and social sciences. RAMs may be computed annually or updated daily. The annual RAMs given below are calculated for a Journal Citations Reports (JCR) calendar year, which is the year before the annual RAM are released. For example, the RAMs were released in late-June 2011 for the JCR calendar year 2010.

(1) 2-Year Impact Factor Including Journal Self Citations (2YIF)

The classic 2-year impact factor including journal self citations (2YIF) of a journal is typically referred to as "the impact factor", is calculated annually, and is defined as "Total citations in a year to papers published in a journal in the previous 2 years / Total papers published in a journal in the previous 2 years". The choice of 2 years by ISI is arbitrary. Rightly or wrongly, it is widely held in the academic community, and certainly by the editors and publishers of journals, that a higher 2YIF is better than lower.

(2) 2-Year Impact Factor Excluding Journal Self Citations (2YIF)*

ISI also reports a 2-year impact factor without journal self citations (that is, citations to a journal in which a citing paper is published), which is calculated annually. As this impact factor is not widely known or used, Chang *et al*. (2011c) refer to this RAM as 2YIF*. Although 2YIF* is almost never reported, for obvious reasons, as in the case of 2YIF, a higher value would be preferred to lower.

(3) 5-Year Impact Factor Including Journal Self Citations (5YIF)

The 5-year impact factor including journal self citations (5YIF) of a journal is calculated annually, and is defined as "Total citations in a year to papers published in a journal in the previous 5 years / Total papers published in a journal in the previous 5 years." The choice of 5 years by ISI is arbitrary. Although 5YIF is not widely reported, a higher value would be preferred to lower. [It is worth noting that 5-year impact factor excluding journal self citations is not presently available].

(4) Immediacy, or Zero-Year Impact Factor Including Journal Self Citations (0YIF)

Immediacy is a zero-year impact factor including journal self citations (0YIF) of a journal, is calculated annually, and is defined as "Total citations to papers published in a journal in the same year / Total papers published in a journal in the same year." The choice of the same year by ISI is arbitrary, but the nature of Immediacy makes it clear that a very short run outcome is under consideration. Although Immediacy is rarely reported, a higher value would be preferred to lower. [It is worth noting that Immediacy excluding journal self citations is not presently available.]

(5) Eigenfactor

The Eigenfactor score (see Bergstrom (2007), Bergstrom and West (2008), Bergstrom, West and Wiseman (2008)) is calculated annually (see www.eigenfactor.org), and is defined as: "The Eigenfactor Score calculation is based on the number of times articles from the journal published in the past five years have been cited in the JCR year, but it also considers which journals have contributed these citations so that highly cited journals will influence the network more than lesser cited journals. References from one article in a journal to another article from the same journal are removed, so that Eigenfactor Scores are not influenced by journal self-citation." Unfortunately, there is no indication as to the value of the threshold that separates "highly cited" from "lesser cited" journals, or how the former might "influence the network more" than the latter. Even though Eigenfactor does not check how much time researchers spend reading hard copies of journals, which would require extensive surveys across a wide range of disciplines, it does indicate how much time researchers might spend reading or scanning articles on a journal's website. Thus, Eigenfactor might usefully be interpreted as a "Journal Influence" measure (see Chang *et al*. (2013)). A higher Eigenfactor score would be preferred to lower.

(6) Article Influence

Article Influence (see Bergstrom (2007), Bergstrom and West (2008), Bergstrom, West and Wiseman (2008)) measures the relative importance of a journal's citation influence on a per-article basis. Despite the misleading suggestion of measuring "Article Influence", as every journal has only one Article Influence score, this RAM is actually a "per capita Journal Influence" score (see Chang *et al*. (2013)). Article Influence is a standardized Eigenfactor score, is calculated annually, and is defined as "Eigenfactor score divided by the fraction of all articles published by a journal." A higher Article Influence would be preferred to lower.

(7) IFI

It has been argued that coercive citations by editors and publishers can have a deleterious impact on journal self citations (see Wilhite and Fong (2012), Chang, McAleer and Oxley (2013)). The ratio of 2YIF to 2YIF* is intended to capture how journal self citations can inflate the impact factor of a journal, whether this is an unconscious self-promotion decision made independently by publishing authors or as an administrative decision undertaken by a journal's editors and/or publishers. Chang *et al*. (2011a) define Impact Factor Inflation (IFI) as "IFI = 2YIF / 2YIF*". The minimum value for IFI is 1, with any value above the minimum capturing the effect of journal self citations on the 2-year impact factor. For obvious purely academic reasons, a lower IFI would be preferred to higher.

(8) H-STAR

ISI has implicitly recognized the inflation in journal self citations by calculating an impact factor that excludes self citations, and provides data on journal self citations, both historically (for the life of the journal) and for the preceding two years, in calculating 2YIF. Chang *et al*. (2011b) define the Self-citation Threshold Approval Rating (STAR) as the percentage difference between citations in other journals and journal self citations. If HS = historical journal self citations, then Historical STAR (H-STAR) is defined as "H-STAR = [(100-HS) - HS] = (100-2HS)". If HS = 0 (minimum), 50 or 100 (maximum) percent, for example, H-STAR = 100, 0 and -100, respectively. A higher H-STAR would be preferred to lower.

(9) 2Y-STAR

H-STAR takes account of the self-citation threshold approval rating over the historical period for which data for a journal are available, whereas 2Y-STAR takes account of the self-citation threshold approval rating based on data for the preceding two years. If 2YS = journal self citations over the preceding 2-year period, then 2-Year STAR is defined by Chang *et al*. (2011b) as "2Y-STAR = [(100-2YS) – 2YS] = (100-2(2YS))". If 2YS = 0 (minimum), 50 or 100 (maximum) percent, for example, 2Y-STAR = 100, 0 and -100, respectively. A higher 2Y-STAR would be preferred to lower.

2.2. Daily Updated RAM

Some RAMs are updated daily, and are reported for a given day in a calendar year rather than for a JCR year.

(10) C3PO

ISI reports the mean number of citations for a journal, namely total citations up to a given day divided by the number of papers published in a journal up to the same day, as the "average" number of citations. In order to distinguish the mean from the median and mode, the C3PO of an ISI journal on any given day is defined by Chang *et al*. (2011a) as "C3PO (Citation Performance Per Paper Online) = Total citations to a journal / Total papers published in a journal." A higher C3PO would be preferred to lower.

(11) h-Index

The h-index (Hirsch (2005)) was originally proposed to assess the scientific research productivity and citations impact of individual researchers. However, the h-index can also be calculated for journals, and should be interpreted as assessing the impact or influence of highly cited journal publications. The h-index of a journal on any given day is based on historically cited and citing papers, including journal self citations, and is defined as "h-index = number of published papers, where each has at least h citations." The h-index differs from an impact factor in that the h-index measures the number of highly cited papers historically. A higher h-index would be preferred to lower. [Although several variations of the h-index have been recorded in recent years, their value relative to the original h-index has yet to be demonstrated in any convincing manner.]

(12) PI-BETA

This RAM measures the proportion of papers in a journal that has never been cited, As such, PI-BETA is, in effect, a rejection rate of a journal **after** publication. Chang *et al*. (2011c) argue that lack of citations of a published paper, especially if it is not a recent publication, reflects on the quality of a journal by exposing: (i) what might be considered as incorrect decisions by the members of the editorial board of a journal; and (ii) the lost opportunities of papers that might have been cited had they not been rejected by the journal. Chang *et al*. (2011c) propose that a paper with zero citations in ISI journals can be measured by PI-BETA (= Papers Ignored (PI) - By Even The Authors (BETA)), which is calculated for an ISI journal on any given day as "Number of papers with zero citations in a journal / Total papers published in a journal." As it would be reasonable to argue that journal editors and publishers would typically prefer a higher proportion of published papers to be cited rather than to be ignored, a lower PI-BETA would be preferred to higher.

(13) CAI

Article Influence is intended to measure the average influence of an article across the sciences and social sciences. As an article with zero citations typically does not have any (academic) influence, a more suitable measure of the influence of cited articles would seem to be Cited Article Influence (CAI). Chang *et al*. (2011b) define CAI as "CAI = (1 - PI-BETA)(Article Influence)". If PI-BETA = 0, then CAI is equivalent to Article Influence; if PI-BETA = 1, then CAI = 0. As Article Influence is calculated annually and PI-BETA is updated daily, CAI may be updated daily. A higher CAI would be preferred to lower.

3. ANALYSIS OF RAMs AND THE AGE EFFECT FOR ISI JOURNALS IN AGRICULTURAL, ENERGY, ENVIRONMENTAL AND RESOURCE ECONOMICS

The ISI category of Economics has 304 journals, 20 of which cover Agricultural, Energy, Environmental and Resource Economics (see Table **1**). Although there are some overlapping sub-disciplines in terms of journal titles, such as environmental and resource economics, there are 10 journals with "agrarian" or "agricultural", 3 with "energy", 3 with "environmental", and 3 with "resource", in their titles. It would be fair to suggest that each of these journals is reasonably specialized in its coverage, as compared with generalist economics journals. One of the journals is a recent inclusion in ISI, with Journal of Agrarian Change having been included for less than 5 years. As 5YIF, Article Influence and CAI data are not available for this journal, the 13 RAMs are analysed for the remaining 19 leading Agricultural, Energy, Environmental and Resource Economics journals in the ISI category of Economics in Tables **2-4**.

Only articles from the ISI Web of Science are included in the citations and influence data. The data for all journals in the ISI category of Economics, and hence also the sub-disciplines considered in this paper, were downloaded from ISI on 10 August 2011. As daily RAMs are not reported when there are more than 10,000 articles, the data for American Journal of Agricultural Economics are from 1984 onward. Data for all other journals are from their inception.

The Years in ISI is also included in the last column in Table **1** to try to capture the "Age" effect of a journal on the various RAMs. The data were downloaded on 10 August 2011 for the ISI calendar year 2010, so years start from their inclusion in ISI (as distinct from their inception as a journal) through to 2010. It is worth noting that the following three journals have 5-year impact factors (5YIF), and Article Influence and CAI scores, despite a journal purportedly having to be included in ISI for at least 5 years to have 5YIF, Article Influence and CAI values:

(1) Review of Environmental Economics and Policy has been included in ISI since 2007, Volume 1, so it was included in ISI for only 4 years before the ISI data were released in June 2011 for 2010;

(2) Annual review of resource Economics has been included in ISI since 2009, Volume 1, so it was in ISI for only 2 years before the ISI data were released in June 2011 for 2010;

(3) China agricultural Economic Review has been included in ISI since 2009, Volume 1, so it was in ISI for only 2 years before the ISI data were released in June 2011 for 2010.

On the other hand, Journal of Agrarian Change has been in ISI since 2006, Volume 6, so it was in ISI for 5 years before the ISI data were released in June 2011 for 2010, yet it has no 5YIF, Article Influence or CAI scores.

Clarification was sought from ISI on these apparent anomalies. It seems that the additional data elements required for calculation of 5YIF, Article Influence and CAI have not yet been accumulated for the Journal of Agrarian Change since 2006. As for the other three journals, each of which has been included in ISI since their inception (namely volume 1, issue 1), it seems that the following exception to the 5-year rule applies:

"However an exception to the above rule occurs for those journals whose coverage starts with volume:1, issue:1. If Thomson Reuters starts indexing a journal with Volume 1 Issue 1 in 2007, then an Impact Factor number will be available with the release of the 2008 Impact Factor numbers (in June 2009) along with the 5 years Impact Factor. The reason is that the number of articles and cites to articles in 2006 (and for the previous years) is known (zero). Therefore, as the 2008 5-years Impact Factor is based on data from 2007, 2006, 2005, 2004, 2003 the data is known (which is zero) and an Impact Factor can be generated."

In short, 2YIF and 5YIF will be identical for a journal that has been included in ISI for two years if this also happens to coincide with the inception of the journal. Whether this makes any sense is left to the reader to discern. From Table **1**, the mean of the Years in ISI is 23, with a range of (3, 56).

In Table **1** we evaluate the 20 most highly-cited journals, which are ranked according to 2YIF, in Agricultural, Energy, Environmental and Resource

Table 2: Correlations of 13 RAMs for 19 Agricultural, Energy, Environmental and Resource Economics Journals

	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI	H-STAR	2Y-STAR	Years in ISI
2YIF	1													
2YIF*	0.987	1												
IFI	0.143	-0.007	1											
5YIF	0.951	0.926	0.217	1										
Immediacy	0.607	0.662	-0.229	0.658	1									
h-index	0.53	0.513	0.171	0.518	0.055	1								
C3PO	0.749	0.775	-0.109	0.663	0.286	0.762	1							
PI-BETA	-0.715	-0.731	0.061	-0.677	-0.498	-0.384	-0.753	1						
Eigenfactor	0.63	0.557	0.397	0.633	0.094	0.772	0.659	-0.523	1					
Article Influence	0.913	0.942	-0.084	0.908	0.822	0.425	0.674	-0.679	0.481	1				
CAI	0.913	0.948	-0.156	0.86	0.758	0.424	0.779	-0.772	0.498	0.966	1			
H-STAR	-0.237	-0.105	-0.867	-0.268	0.078	-0.108	0.094	0.075	-0.404	-0.007	0.045	1		
2Y-STAR	-0.142	0.004	-0.998	-0.218	0.228	-0.186	0.099	-0.063	-0.391	0.081	0.155	0.862	1	
Years in ISI	0.226	0.199	0.194	0.327	0.017	0.770	0.369	-0.082	0.455	0.149	0.082	-0.111	-0.211	1

Table 3: 13 RAMs and Harmonic Mean of the Ranks for 19 Agricultural, Energy, Environmental and Resource Economics Journals

Journal	Harmonic Mean	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI	H-STAR	2Y-STAR
J ENVIRON ECON MANAG	1	1	1	6	2	7	1	1	1	2	2	2	4	6
REV ENV ECON POLICY	2	2	2	5	1	1	16	8	5	11	1	1	7	4
RESOUR ENERGY ECON	3	5	4	1	6	3	8	2	4	9	5	4	3	1
REV AGR ECON	4	17	17	1	17	17	14	13	8	10	15	13	1	1
ENERG ECON	5	3	3	19	3	9	4	4	3	1	4	3	19	19
CHINA AGR ECON REV	6	19	19	1	19	17	19	19	19	19	19	19	1	1
LAND ECON	7	7	6	4	7	2	3	3	7	8	6	7	5	4
ENVIRON RESOUR ECON	8	9	9	12	9	4	5	5	2	4	8	5	12	12
ENERG J	9	6	7	7	5	6	6	6	9	5	3	6	10	7
AM J AGR ECON	10	10	10	17	10	13	2	10	18	3	9	15	17	17
FOOD POLICY	11	4	5	15	4	8	8	12	14	7	7	8	16	15
AGR ECON-BLACKWELL	12	8	8	11	14	14	7	7	6	6	11	9	12	11
J AGR ECON	13	14	12	9	11	11	8	14	16	12	12	14	5	9
EUR REV AGRIC ECON	14	12	13	18	8	12	11	9	15	13	10	10	10	17
J FOREST ECON	15	15	15	7	12	9	17	17	11	17	14	11	14	7
AUST J AGR RESOUR EC	16	11	11	14	13	15	13	11	13	14	13	12	7	12
CAN J AGR ECON	17	18	18	9	16	5	15	16	10	15	16	16	14	9
J AGR RESOUR ECON	18	16	16	12	18	17	12	15	17	16	17	18	7	12
ANNU REV RESOUR ECON	19	13	14	16	15	16	18	18	12	18	18	17	18	16

Notes: The journals are ranked according to the harmonic mean of the ranks (Harmonic Mean). The simple correlation between 2YIF and harmonic mean of the ranks is 0.568.

Economics. Two of the 3 environmental economics journals are in the leading 2 positions, the 3 energy economics journals are among the leading 7 journals, the 3 resource economics journals are in the middle of the group, and 9 of the 10 agricultural economics journals are among the lowest 12 journals.

As can be seen from Table **1**, the means, standard deviations and ranges of 2YIF are, respectively, 1.366, 0.74 and (0.167, 2.989), of 2YIF* are 1.211, 0.675 and (0.167, 2.809), of 5YIF are 1.677, 0.792 and ((0.167, 3.146), and of Immediacy are 0.33, 0.399 and (0, 1.176). These impact factors are consistent with the related areas of general economics, finance, management, and marketing (see Chang *et al*. (2011a)), but are lower than many disciplines in the sciences (see Chang *et al*. (2011b)). In Table **1**, 5YIF is typically higher than 2YIF, which is to be expected in economics, with 5YIF being lower than 2YIF only for Agricultural Economics – Blackwell.

Despite the journals being reasonably specialized sub-disciplines in Economics, the journal self citations in Agricultural, Energy, Environmental and Resource Economics seem to be relatively low, with a mean IFI of 1.124, standard deviation of 0.092, and a range of (1, 1.316), with the two highest IFI scores being 1.316 and 1.295. On average, the 19 journals in Agricultural, Energy, Environmental and Resource Economics have 2YIF that is inflated by a factor of 1.124 through journal self citations. It is worth highlighting that 3 of the 20 journals had zero self citations.

These IFI values are remarkably low when compared with the corresponding IFI in the Economics discipline. Chang *et al*. (2013) show that the mean IFI for Economics is a comparatively high 1.442, and that the range of (1, 25.417) is incredibly high. Thus, on average, Economics journals have 2YIF that are inflated by a factor of 1.442 through journal self citations. Quite remarkably, the results in Chang *et al*. (2013) show that 5 journals have IFI values greater than 4, 9 journals have IFI greater than 3, 30 journals have IFI greater than 2, and 52 journals have IFI greater than 1.5. Therefore, IFI values as high as 1.316 in Agricultural, Energy, Environmental and Resource Economics would not seem to be a result of coercive citations. It can also be argued that, despite each of these journals being reasonably specialized in its coverage, as compared with generalist economics journals, the IFI values are not especially high compared with most journals in the Economics discipline (see Chang *et al*. (2013)).

Wilhite and Fong (2012, p. 542) find, on the basis of "6,672 responses from a survey sent to researchers in economics, sociology, psychology, and multiple business disciplines (marketing, management, finance, information systems, and accounting), as well as data from 832 journals in those same disciplines" that "coercion is uncomfortably common and appears to be practiced opportunistically". In short, many journal editors in these disciplines would seem to be encouraging to increase journal self citations or risk rejection. Wilhite and Fong (2012, p. 543) also find that "Coercive self-citation exists and is more common in the business disciplines than in economics, sociology, and psychology." On the contrary, observation of the IFI values reported for the Economics discipline in Chang *et al*. (2013), self citations in a large number of journals in the Economics category would seem to be consistent with coercion (see also Chang *et al*. (2013)).

The h-index has a mean of 28, standard deviation of 20, and a range of (2, 75), with the highest 3 journals having h-indexes of 75, 63 and 60, which suggests a relatively large number of highly-cited papers in these 3 journals. In terms of average citations, C3PO has a mean of 4.98, standard deviation of 4.28, and a range of (0.23, 20.04), with much of the contribution to the mean coming from one journal. Eigenfactor has a mean of 0.00297, standard deviation of 0.00257, and a range of (0.00002, 0.00868), with 4 journals clearly having the highest scores, and hence the greatest influence, in Agricultural, Energy, Environmental and Resource Economics. Article Influence has a mean of 0.733, standard deviation of 0.476, and a range of (0.027, 2.070), while Cited Article Influence (CAI) has a mean of 0.48, standard deviation of 0.419, and a range of (0.004, 1.528). The leading 2 journals ranked according to 2YIF in Table **1** have by far the highest Article Influence and CAI scores.

Further to the interpretation of Eigenfactor, Fersht (2009) showed that there was a very high positive correlation between Eigenfactor and the total number of journal citations, with a correlation coefficient of 0.968 for the top 200 cited ISI journals in 2007. Such a high correlation is not entirely surprising as it captures the size-effect of journals, with the total number of publications and total citations typically being positively and highly correlated. Eigenfactor is not highly correlated with the other 12 RAMs in Table **1**, so it provides useful bibliometric information compared with the other RAMs.

The values of H-STAR and 2Y-STAR for the 20 journals are remarkably high, with a mean of 82, standard deviation of 14, and a range of (48, 100) for H-STAR, and a similar mean of 80, the same standard deviation, and a similar range of (52, 100) for 2Y-STAR. The H-STAR and 2Y-STAR means of 82 and 80 reflect journal self citations of 9% and 10%, respectively, historically and for the preceding two years. For nearly all the journals, self citations have changed little over the preceding two years as compared with historical levels. These outcomes are generally consistent with the IFI outcomes.

The PI-BETA outcomes are revealing. The mean is 0.433 so that, on average, more than 2 of every 5 papers that are published in the leading 20 journals in Agricultural, Energy, Environmental and Resource Economics are not cited. The standard deviation is 0.187 and the range is (0.078, 0.844). Therefore, the journal with the highest percentage of cited papers, Journal of Environmental Economics and Management, has less than one uncited paper for every 10 published papers, while the journal with the lowest percentage of cited papers, China Agricultural Economic Review, has more than 8 uncited papers for every 10 published papers. Seven of the 20 journals in Agricultural, Energy, Environmental and Resource Economics have PI-BETA that exceeds 0.5, which suggests that at least one of every 2 published papers in these journals has zero citations.

The PI-BETA scores are similar to the values observed in the leading journals in general economics, finance, management and marketing (see Chang *et al*. (2011a)), and also in comparison with the sciences (see Chang *et al*. (2011b)). As it is widely held, especially in the sciences, that the primary purposes in writing papers are to be cited and to have influence, and not just to be published, the citations in the leading Agricultural, Energy, Environmental and Resource Economics journals are broadly consistent with the discipline of Economics.

The simple correlations of the 13 RAMs for the 19 leading journals in Agricultural, Energy, Environmental and Resource Economics are given in Table **2**. The 10 RAM pairs for which the correlations exceed 0.9 (in absolute value) are, in decreasing order: (IFI, 2Y-STAR), (2YIF, 2YIF*), (Article Influence, CAI), (2YIF, 5YIF), (2YIF*, CAI), (2YIF*, Article Influence), (2YIF*, 5YIF), (2YIF, Article Influence), (2YIF, CAI), and (5YIF, Article Influence). There are also 4 RAM pairs for which the simple correlations are in the range (0.8, 0.9), in absolute value. The correlation of -0.998 between IFI and 2Y-STAR is extremely high, which suggests that the inflation in journal self citations and the 2-year Self-citation Threshold Approval Rating are very similar, at least for journals in Agricultural, Energy, Environmental and Resource Economics. A similar comment applies to the very high simple correlation between Article Influence and CAI in Table **1**.

The simple correlations of the 13 RAMs with the Years in ISI are revealing. The three highest correlations with Years in ISI are h-index (at 0.77), Eigenfactor (or journal influence) (at 0.455), and C3PO (at 0.369). At least two of these correlations would not be regarded as high in any statistical sense. As the h-index tries to capture the number of high quality papers published in a journal, it is hardly surprising that it is correlated with Years in ISI. Similar outcomes might have been expected of Eigenfactor and C3PO, but these do not seem to be empirically relevant. It is interesting that PI-BETA (at -0.082) is not correlated with Years in ISI, so that the proportion of virtually irrelevant published articles is not a function of the number of years a journal has been included in ISI. A similar comment applies to the other RAMs, including the impact factors, which is a useful check as to whether the RAMs are being compared fairly.

It remains to be seen whether an emphasis on the classic 2-year impact factor of a journal, 2YIF, to the exclusion of other 12 informative RAMs, can lead to a distorted evaluation of journal quality, impact and influence. In order to give a summary measure of the 13 RAMs, 9 of which, namely 2YIF, 2YIF*, 5YIF, Immediacy, IFI, C3PO, PI-BETA, Article Influence and CAI, are based on ratios, the rankings of the 19 journals in Agricultural, Energy, Environmental and Resource Economics given in Table **3** are based on the harmonic mean of the ranks, which is given in the last column as Harmonic Mean. [Together with the arithmetic and geometric means, the harmonic mean is one of the three Pythagorean means, and is defined as the reciprocal of the arithmetic mean of the reciprocals.]

As discussed in Chang *et al*. (2013), as no single RAM captures adequately the quality, impact and influence of a journal, any general measure of journal quality and impact, such as a harmonic mean of the ranks as a robust rankings method of alternative RAMs, should depend on the following four distinct classes:

(i) **Class 1**: “impact factor, mean citations and non-citations” (2YIF, 2YIF*, 5YIF, Immediacy, C3PO, PI-BETA);

(ii) **Class 2**: "journal policy" (IFI, H-STAR, 2Y-STAR);

(iii) **Class 3**: "number of high quality papers" (h-index);

(iv) **Class 4**: "journal influence and article influence" (Eigenfactor, Article Influence, CAI).

Each of the RAMs in the four classes has equal weight in the calculation of the harmonic mean of the ranks. For journals that have been included in ISI for less than five years, Class 1 does not include 5YIF, and Class 4 does not include Article Influence and CAI, in calculating the harmonic mean of the ranks of the RAMs. When RAMs for only Eigenfactor are available, it follows that Class 4 would be a "journal influence" rather than "journal influence and article influence" class.

In comparison with the rankings in Table **1** that were based on 2YIF, only the first 2 journals, namely Journal of Environmental Economics and Management, and Review of Environmental Economics and Policy, the number 7 ranked journal, Land Economics, the number 10 ranked journal, American Journal of Agricultural Economics, and the number 15 ranked journal, Journal of Forest Economics, remain unchanged in Table **3**. Two journals to have moved up considerably are Review of Agricultural Economics (13 places, from 17 to 4), and China Agricultural Economic Review (13 places, from 19 to 6). In the other direction, Food Policy dropped by 7 from 4 to 11, Annual Review of Resource Economics fell by 6 from 13 to 19, Australian Journal of Agricultural and Resource Economics lost 5 positions from 11 to 16, and Agricultural Economics – Blackwell fell by 4 from 8 to 12.

Based on the harmonic mean of the ranks, the top 2 positions are filled by Journal of Environmental Economics and Management, and Review of Environmental Economics and Policy. A further 2 of the top 5 positions are taken by Resource and Energy Economics, and Energy Economics. Two of the top 6 journals are Review of Agricultural Economics and China Agricultural Economic Review. Thus, each of the sub-disciplines of Agricultural, Energy, Environmental and Resource Economics is represented by at least one journal in the top 6.

Using the harmonic mean of the ranks, the leading journal is Journal of Environmental Economics and Management, which is ranked number 1 according to 5 RAMs, while the number 2 journal, Review of Environmental Economics and Policy, is ranked number 1 according to 4 RAMs. In fact, each of the top 6 ranked journals is number 1 according to at least one RAM. In this sense, the use of the harmonic mean of the ranks may be seen as rewarding or penalizing widely-varying rankings across the 13 RAMs. Apart from the number 1 ranked journal, Journal of Environmental Economics and Management, for which the range of rankings is a narrow (1, 7), and the number 3 ranked journal, Resource and Energy Economics, which also has a narrow range of rankings of (1, 9), 3 of the remaining top 5 journals have a wide range of rankings. The number 2 journal, Review of Environmental Economics and Policy, has a range of rankings of (1, 16), the number 4 journal, Review of Agricultural Economics, has a range of (1, 17), and the number 5 journal, Energy Economics, has a range of (1, 19).

The harmonic mean of the ranks rewards journals with strong individual performances according to one or more RAMs, so that even one very strong performance can lead to a high, or greatly improved, ranking. This is certainly the case for Review of Agricultural Economics, which was ranked number 1 according to 3 RAMs and number 17 according to 4 RAMs, and China Agricultural Economic Review, which was ranked number 1 according to 3 RAMs and number 19 according to 9 RAMs.

The simple ranking correlations of the 13 RAMs for the 19 leading journals in Agricultural, Energy, Environmental and Resource Economics, based on the rankings in Table **3**, are given in Table **4**. The simple correlations of the 13 RAMs for the 19 leading journals in Agricultural, Energy, Environmental and Resource Economics are given in Table **2**. The correlations in Table **4** broadly mirror the simple correlations in Table **2** for the RAM scores. The 8 RAM pairs for which the correlations exceed 0.9 (in absolute value) are, in decreasing order: (IFI, 2Y-STAR), (2YIF, 2YIF*), (5YIF, Article Influence), (2YIF*, Article Influence), (2YIF, Article Influence), (Article Influence, CAI), (2YIF, 5YIF), and (2YIF*, 5YIF). There are also 11 RAM pairs for which the simple correlations are in the range (0.8, 0.9), in absolute value. The correlations of 0.996 and 0.991 for the pairs (IFI, 2Y-STAR) and (2YIF, 2YIF*), respectively, suggest that the rankings according to IFI and 2Y-STAR, as well as according to 2YIF and 2YIF*, would be virtually identical. Moreover, the rankings according to Article Influence are highly correlated with each of 5YIF, 2YIF* and 2YIF, at 0.956, 0.935 and 0.93, respectively.

Table 4: Correlations of 13 RAMs and Harmonic Mean of the Ranks for 19 Agricultural, Energy, Environmental and Resource Economics Journals

	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI	H-STAR	2Y-STAR	Harmonic Mean
2YIF	1													
2YIF*	0.991	1												
IFI	-0.113	-0.057	1											
5YIF	0.921	0.916	-0.101	1										
Immediacy	0.606	0.634	0.246	0.725	1									
h-index	0.632	0.659	-0.209	0.572	0.361	1								
C3PO	0.823	0.844	0.051	0.749	0.604	0.796	1							
PI-BETA	0.635	0.647	0.227	0.547	0.617	0.387	0.739	1						
Eigenfactor	0.744	0.747	-0.18	0.67	0.405	0.897	0.816	0.575	1					
Article Influence	0.93	0.935	0.027	0.956	0.738	0.668	0.865	0.633	0.775	1				
CAI	0.893	0.897	0.096	0.893	0.74	0.525	0.856	0.819	0.69	0.928	1			
H-STAR	-0.148	-0.086	0.789	-0.147	-0.026	-0.11	0.109	0.028	-0.198	-0.022	0.01	1		
2Y-STAR	-0.108	-0.053	0.996	-0.094	0.243	-0.236	0.053	0.221	-0.204	0.033	0.106	0.814	1	
Harmonic Mean	0.568	0.598	0.521	0.563	0.44	0.38	0.637	0.581	0.568	0.665	0.674	0.441	0.515	1

Table 5: 11 RAMs and Harmonic Mean of the Ranks for 19 Agricultural, Energy, Environmental and Resource Economics Journals

Journal	Harmonic Mean	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI
J ENVIRON ECON MANAG	1	1	1	6	2	7	1	1	1	2	2	2
REV ENV ECON POLICY	2	2	2	5	1	1	16	8	5	11	1	1
ENERG ECON	3	3	3	19	3	9	4	4	3	1	4	3
RESOUR ENERGY ECON	4	5	4	1	6	3	8	2	4	9	5	4
LAND ECON	5	7	6	4	7	2	3	3	7	8	6	7
ENVIRON RESOUR ECON	6	9	9	12	9	4	5	5	2	4	8	5
ENERG J	7	6	7	7	5	6	6	6	9	5	3	6
REV AGR ECON	8	17	17	1	17	17	14	13	8	10	15	13
AM J AGR ECON	9	10	10	17	10	13	2	10	18	3	9	15
FOOD POLICY	10	4	5	15	4	8	8	12	14	7	7	8
CHINA AGR ECON REV	11	19	19	1	19	17	19	19	19	19	19	19
AGR ECON-BLACKWELL	12	8	8	11	14	14	7	7	6	6	11	9
EUR REV AGRIC ECON	13	12	13	18	8	12	11	9	15	13	10	10
J AGR ECON	14	14	12	9	11	11	8	14	16	12	12	14
CAN J AGR ECON	15	18	18	9	16	5	15	16	10	15	16	16
J FOREST ECON	16	15	15	7	12	9	17	17	11	17	14	11
AUST J AGR RESOUR EC	17	11	11	14	13	15	13	11	13	14	13	12
J AGR RESOUR ECON	18	16	16	12	18	17	12	15	17	16	17	18
ANNU REV RESOUR ECON	19	13	14	16	15	16	18	18	12	18	18	17

Notes: The journals are ranked according to the harmonic mean of the ranks (Harmonic Mean). The simple correlation between 2YIF and harmonic mean of the ranks is 0.737.

The ranking correlation of 0.568 for the RAM pair (2YIF, Harmonic Mean) in Table **4** suggests that the classic two-year impact factor is not highly correlated with the harmonic mean of the ranks. Indeed, the simple correlations of the harmonic mean of the ranks with each of CAI, Article Influence, C3PO, 2YIF* and PI-BETA are higher than between the harmonic mean of the ranks and 2YIF, for which the simple correlation is the same as between the harmonic mean of the ranks and Eigenfactor. Thus, 2YIF would not seem to be the most informative single RAM to use if it were intended to capture the harmonic mean of the ranks. In fact, using 2YIF as a single RAM to capture the quality of a journal would lead to a distorted evaluation of a journal's impact and influence.

As the simple correlations for the pairs (IFI, 2Y-STAR) and (IFI, H-STAR), respectively, in Table **2** are -0.998 and -0.867, it might be argued that they provide broadly similar rankings. For this reason, Tables **3** and **4** are recalculated excluding the H-STAR and 2Y-STAR RAMs, and these are given, respectively, as Tables **5** and **6**. In comparison with the rankings in Table **3** that were based on the harmonic mean of the ranks of 13 RAMs, the results in Table **5** are based on the harmonic means of 11 RAMs. In this case, the first three named journals, namely Journal of Environmental Economics and Management, Review of Environmental Economics and Policy, and Energy Economics, and the number 14 ranked journal, Journal of Agricultural Economics, remain unchanged in Table **5**. As stated previously, the harmonic mean of the ranks rewards journals with strong individual performances according to one or more RAMs, so that even one very strong performance can lead to a greatly improved ranking. As in Table **3**, two journals to have moved up considerably are Review of Agricultural Economics (9 places, from 17 to 8), and China Agricultural Economic Review (7 places, from 19 to 11). These movements are not as extreme as those given in Table **3** as both the Review of Agricultural Economics and China Agricultural Economic Review are ranked number 1 for only 1 RAM in Table **5**, as compared with being ranked number 1 for 3 RAMs each in Table **3**.

The simple ranking correlations of the 13 RAMs for the 19 leading journals in Agricultural, Energy, Environmental and Resource Economics, based on the rankings in Table **5**, are given in Table **6**. The correlations in Table **6** broadly mirror the simple correlations in Table **2** for the RAM scores and in Table **4** for the 13 RAMs. The only difference between Tables **4** and **6** are in the pairwise correlations of the 11 RAMs with the harmonic mean of the ranks, as both 2Y-STAR and H-STAR have been omitted in calculating the harmonic mean of the ranks.

There are 7 RAM pairs for which the correlations exceed 0.9 (in absolute value), and 12 RAM pairs for which the simple correlations are in the range (0.8, 0.9), in absolute value. The ranking correlation of 0.737 for the RAM pair (2YIF, Harmonic Mean) in Table **6** suggests that the classic two-year impact factor is not very highly correlated with the harmonic mean of the

Table 6: Correlations of 11 RAMs and Harmonic Mean of the Ranks for 19 Agricultural, Energy, Environmental and Resource Economics Journals

	2YIF	2YIF*	IFI	5YIF	Immediacy	h-index	C3PO	PI-BETA	Eigenfactor	Article Influence	CAI	Harmonic Mean
2YIF	1											
2YIF*	0.991	1										
IFI	-0.113	-0.057	1									
5YIF	0.921	0.916	-0.101	1								
Immediacy	0.606	0.634	0.246	0.725	1							
h-index	0.632	0.659	-0.209	0.572	0.361	1						
C3PO	0.823	0.844	0.051	0.749	0.604	0.796	1					
PI-BETA	0.635	0.647	0.227	0.547	0.617	0.387	0.739	1				
Eigenfactor	0.744	0.747	-0.18	0.67	0.405	0.897	0.816	0.575	1			
Article Influence	0.93	0.935	0.027	0.956	0.738	0.668	0.865	0.633	0.775	1		
CAI	0.893	0.897	0.096	0.893	0.74	0.525	0.856	0.819	0.69	0.928	1	
Harmonic Mean	0.737	0.758	0.332	0.744	0.634	0.572	0.798	0.69	0.74	0.839	0.816	1

ranks. In fact, the simple correlations of the harmonic mean of the ranks with Article Influence (at 0.839), CAT (at 0.816), C3PO (at 0.798), 2YIF* (at 0.758), 5YIF (at 0.744) and Eigenfactor (at 0.74) are higher than between the harmonic mean of the ranks and 2YIF (0.737). Thus, as in the case of the simple correlations in Table **4**, 2YIF would not seem to be the most informative single RAM to use if it were intended to capture the broad-based harmonic mean of the ranks. On the basis of the results in Tables **4** and **6**, using 2YIF as a single RAM to capture the quality, impact and influence of a journal would lead to a distorted evaluation of a journal's impact and influence.

4. CONCLUDING REMARKS

This paper analysed the leading 19 journals in the sub-disciplines of Agricultural, Energy, Environmental and Resource Economics in the ISI category of Economics using 13 quantifiable Research Assessment Measures (RAMs). Alternative RAMs were discussed for the Thomson Reuters ISI Web of Science (2011) database (hereafter ISI). The 13 RAMs that may be calculated annually or updated daily are intended to answer the questions as to When, and Where and How (frequently), published papers are cited. The answers to When published papers are cited are based on the set {2YIF, 2YIF*, 5YIF, Immediacy}, and the answers to Where and How (frequently) published papers are cited are based on the set {Eigenfactor, Article Influence, Cited Article Influence, IFI, H-STAR, 2Y-STAR, C3PO, h-index, PI-BETA}.

The paper highlighted the similarities and differences in alternative RAMs, and showed that several RAMs were highly correlated with existing RAMs, so that they had little informative incremental value in capturing the impact and performance of the highly-cited journals. Other RAMs were not highly correlated pairwise, thereby providing additional information about journal impact and influence.

The harmonic mean of the ranks of the 13 RAM was also presented for these 19 leading journals in Agricultural, Energy, Environmental and Resource Economics. When the journals were ranked according to the harmonic mean of the ranks, the simple correlation between 2YIF and the harmonic mean of the ranks was found to be 0.568, which is less than the simple correlations of the harmonic mean of the ranks with each of CAI, Article Influence, C3PO, 2YIF* and PI-BETA.

It was also shown that emphasizing the 2-year impact factor of a journal, which partly answers the question as to When published papers are cited, to the exclusion of other informative RAMs, which answer Where and How (frequently) published papers are cited, can lead to a distorted evaluation of a journal's impact and influence. The harmonic mean of the ranks provides a more robust measure of citations and influence than relying solely on the 2-year impact factor.

The only RAM that had a noticeable correlation with Years in ISI was the h-index (at 0.77), with no other correlation regarded as having a meaningful correlation in any statistical sense. As the h-index is supposed to capture the number of high quality papers published in a journal, it was hardly surprising that it was found to be correlated with Years in ISI. No other RAM was found to be meaningfully correlated with the number of years a journal had been included in ISI, including the various impact factors, which is a useful check as to whether the RAMs are being compared fairly.

ACKNOWLEDGEMENT

For financial support, the first author wishes to thank the National Science Council, Taiwan, and the second author wishes to acknowledge the Australian Research Council and the National Science Council, Taiwan.

REFERENCES

Bergstrom C. (2007), Eigenfactor: Measuring the value and prestige of scholarly journals, *C&RL News*, 68, 314-316.

Bergstrom, C.T. and. J.D. West (2008), Assessing citations with the Eigenfactor™ metrics, *Neurology*, 71, 1850–1851. http://dx.doi.org/10.1212/01.wnl.0000338904.37585.66

Bergstrom, C.T., J.D. West and M.A. Wiseman (2008), The Eigenfactor™ metrics, *Journal of Neuroscience*, 28(45), 11433–11434 (November 5,).

Chang, C.-L., E. Maasoumi and M. McAleer (2013), Robust ranking of journal quality: An application to economics, to appear in *Econometric Reviews*.

Chang, C.-L. and M. McAleer (2012), Citations and impact of ISI tourism and hospitality journals, *Tourism Management Perspectives*, 1(1), 2-8. http://dx.doi.org/10.1016/j.tmp.2011.08.001

Chang, C.-L. and M. McAleer (2013a), Ranking journal quality by harmonic mean of ranks: An application to ISI Statistics & Probability, *Statistica Neerlandica*, 67(1), 27-53. http://dx.doi.org/10.1111/j.1467-9574.2012.00529.x

Chang, C.-L. and M. McAleer (2013b), What do experts know about forecasting journal quality? A comparison with ISI research impact in finance, *Annals of Financial Economics*, 8(1), 1-30. http://dx.doi.org/10.1142/S201049521350005X

Chang, C.-L. and M. McAleer (2013c), Ranking leading econometric journals using citations data from ISI and RePEc, *Econometrics*, 1(3), 217-235. http://dx.doi.org/10.3390/econometrics1030217

Chang, C.-L. and M. McAleer (2014), Ranking economics and econometrics ISI journals by quality weighted citations, to appear in *Review of Economics*.

Chang, C.-L., M. McAleer and L. Oxley (2011a), What makes a great journal great in economics? The singer not the song, *Journal of Economic Surveys*, 25(2), 326-361. http://dx.doi.org/10.1111/j.1467-6419.2010.00648.x

Chang, C.-L., M. McAleer and L. Oxley (2011b), What makes a great journal great in the sciences? Which came first, the chicken or the egg?, *Scientometrics*, 87(1), 17-40. http://dx.doi.org/10.1007/s11192-010-0335-0

Chang, C.-L., M. McAleer and L. Oxley (2011c), Great expectatrics: Great papers, great journals, great econometrics, *Econometric Reviews*, 30(6), 583-619. http://dx.doi.org/10.1080/07474938.2011.586614

Chang, C.-L., M. McAleer and L. Oxley (2011d), How are journal impact, prestige and article influence related? An application to neuroscience, *Journal of Applied Statistics*, 38(11), 2563-2573. http://dx.doi.org/10.1080/02664763.2011.559212

Chang, C.-L., M. McAleer and L. Oxley (2013), Coercive journal self citations, impact factor, journal influence and article influence, *Mathematics and Computers in Simulation*, 93, 190-197. http://dx.doi.org/10.1016/j.matcom.2013.04.006

Fersht, A. (2009), The most influential journals: Impact factor and Eigenfactor, *Proceedings of the National Academy of Sciences of the United States of America,* 106(17), 6883-6884. http://dx.doi.org/10.1073/pnas.0903307106

Hirsch, J.E. (2005), An index to quantify an individual's scientific research output, *Proceedings of the National Academy of Sciences of the United States of America,* 102(46), 16569-15572. http://dx.doi.org/10.1073/pnas.0507655102

ISI Web of Science (2011), *Journal Citation Reports, Essential Science Indicators,* Thomson Reuters ISI.

Seglen, P.O. (1997), Why the impact factor of journals should not be used for evaluating research, *BMJ: British Medical Journal*, 314(7079), 498-502. http://dx.doi.org/10.1136/bmj.314.7079.497

Wilhite, A.W. and E.A. Fong (2012), Coercive citation in academic publishing, *Science*, 335 (6068), 542-543. http://dx.doi.org/10.1126/science.1212540

Received on 19-02-2014 Accepted on 13-03-2014 Published on 20-03-2014

DOI: http://dx.doi.org/10.6000/1929-7092.2014.03.05