Measuring the excellence contribution at the journal level: An alternative to Garfield's impact factor

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Abstract
The aim of this study is to analyze to which extent the JIF reflects the amount of excellent publications contained in a journal in the corresponding subject category. Therefore, we are introducing two percentile-based indicators in order to measure the excellence contribution at journal level. Calculations of these indicators have been carried out for five different JCR subject categories to investigate the correlation with Garfield's Journal Impact Factor. Differences in the ranking according to all three indicators especially in Quartile 1 of each category are shown and discussed. We have also studied the effect of multidisciplinary journals to the excellence contribution at category level and observed considerable differences between the five categories. In the hard sciences, their omission would lead to neglect a large part of excellent publications. Furthermore, our results hint to the fact that the introduced excellence indicators are very robust considering the types of documents considered for their calculation.
This pilot study shows that the introduction of journal excellence indicators will provide a complete and more accurate picture of the citation impact of a journal than the JIF, because they are informing directly about the total and normalized excellence contribution of each journal to the corresponding subject category.

Introduction
Since its introduction by Garfield in the 1960s (first mention in 1963, Garfield and Sher,1963; Garfield 1972, 1976), the Journal Impact Factor (JIF) is still one of the most common bibliometric indicators when it comes to measuring journal impact (Archambault & Larivière, 2009). Its popularity is unbroken, and not only because its introduction meant a revolution for the scientific community (Lariviere & Sugimoto, 2019). The simple fact that, despite the development of a multitude of new indicators, none of the alternatives has prevailed testifies to the high acceptance of the IF when it is used reasonably (Garfield, 2005; Gorraiz et al., 2020). The past has clearly shown that the JIF is not an all-in-one solution for various issues, which has led to controversial discussions and justified criticism (Todorov & Glänzel, 1988; Moed & van Leeuwen, 1995; Glänzel & Moed, 2002; Moed, 2002; Alberts, 2013; Gorraiz et al., 2012a). In response, several manifestos and statements were published especially due to the increasingly frequent misuse in research-assessment practices (San Francisco Declaration on Research Assessment, ASCB, 2012).
The first edition of the Journal Citation Reports (JCR) – including for the first time the Journal Impact Factor - was launched in 1975 and was based on the fundamental understanding that citations can be used as valuable criterion for the assessment of scientific journals (Garfield, 1976). The more frequently a journal is cited, the higher the recognition of its importance and prestige as information channel in the respective research field.
Researchers started to use the JIF in order to identify adequate publication venues and to optimize their publication strategies. As of its introduction editors and publishers rely on the

JIF in order to estimate the reputation, prestige and market value of their journal portfolio. Furthermore, the JIF opened up a new support tool for librarians to back up decisions about subscriptions, to guarantee the presence of indispensable journals in their collections and to optimize their acquisition strategy. Finally, policy makers have thus gained a quantitative indicator for evaluation purposes, which additionally drove the expansion from its use for scientific information to application in evaluative contexts (cf. Glänzel, 2006).
The JIF has been further developed and improved over the years (extension of the citation window to five years, consideration of the journal self-citations, etc.) and nowadays a number of alternative journal citation-indicators are available such as the h-index for journals (Braun et al., 2006), eigenfactor metrics (Bergstrom et al., 2008; West et al., 2010), SJR (González-Pereira et al., 2010; Guerrero-Bote & Moya- Anegón, 2012), the SNIP indicator (Moed, 2010 a&b) or the CiteScore (cf. van Noorden, 2016). Nevertheless, the new edition of the JCR is eagerly expected each year, which shows the continuing importance of this analytical tool for the scholarly community and for research assessment.
Research assessment exercises are often performed for recent time periods. In these cases, impact analyses relying on citations are not very useful, because in many disciplines the citation window is practically too short for retrieving significant citation numbers.
Although it is not the appropriate indicator to measure the impact of a publication (Waltman & Traag, 2017), the JIF does provide a quick information on the impact and prestige of the journals in which the researcher, group or institution has been able to publish. Being published in journals with high JIF is much more difficult (higher rejection quotes), and successful publication in these journals needs recognition. JIF also helps to identify the top journals in each field according to their impact or prestige. This is why the Journal Impact Factor plays such a key role.
The competition to be included in the Web of science Core Collection and to be indexed as a Q1 journal or to publish in one continues unabated (Osterloh, & Frey, 2014) and is inextricably linked to the question of how the citation impact and prestige of a journal is measured.
However, since the introduction of the IF, many analytical tools have been developed and are available, enabling a very quick and automatic calculation of the percentiles of the most cited publications for each publication year and each subject category (Lozano et al., 2012)..
Nowadays the normalized citation counts like Category Normalized Citation Impact CNCI and the number and percentage of Top 10% and Top 1% most cited publications are essential indicators in citation analyses (Adams et al., 2007; Gorraiz et al., 2012b; Gorraiz & Gumpenberger, 2015).). Top 10% is usually considered as a measure of "excellence".
Therefore, it can be quite interesting to use these normalized indicators as an alternative to the JIF. Does the JIF reflect the amount of excellent publications contained in a journal or in a subject category? Are there other approaches to paint a more precise picture of journal excellence? This is the subject of our study.

Research questions

In order to achieve our objectives to measure the excellence contribution at the journal level, we will answer the following research questions.

1. Can the Journal Impact Factor (JIF) designed to provide a robust and size-independent journal performance measure be supplemented by an indicator of excellence based on the high-end of a journal's publications? Could a proper percentile-based approach result in an improved assessment of the citation impact of a journal?
2. How does the Impact Factor correlate with the proposed percentile-based indicators?
3. Which high-impact journals from the last ten years do not appear in Quartile 1 (Q1/WoS)? What could be the reasons for this?
4. How do multidisciplinary journals affect the indicators?

5. How sensitive are these indicators to the choice of document types, particularly of the so-called 'citable items' (i.e., research articles and reviews) instead of all documents types?

Methodology

All documents assigned to the WoS Subject Categories "Virology" (VIR), "Physics, Condensed Matter" (PHCM), "Economics" (ECO), "Information & Library Science" (ILS) and "History" (HIS) published of the years between 2009 and 2018 were selected and subsequently analyzed in InCites at the journal level.

In this study, we are considering only journals with an Impact Factor, and we are performing the analyses for two different groups: 1) only journals assigned to each WoS subject category according to Journal Citation Reports ("JCR Cat."), and 2) including all multidisciplinary journals that, according to InCites, have likewise contributed to this category ("JCR Cat. + Multidisciplinary").

For each journal, we list:

- Number of publications published in this journal in JCR Cat.: p(J)
- Number of excellent publications published in this journal in JCR Cat.: x(J)

For each category we list:

- Total number of publications in JCR Cat: p(T)
- Total number of excellent publications in JCR Cat.: x(T)

In this study the term "excellent publications" or "excellence" is used as synonym for publications belonging to the Top 10% most cited documents in the same JCR Category, publication year and document type.

Beside the Journal Impact Factor retrieved from the JCR Edition 2020, we have calculated the following indicators for each journal:

1. Journal Percentage of Excellent Publications (JPEP) = (x(J)/p(J)) = Number of excellent publications published in this journal in the PY=2009-2018 in this WoS Category / Total number of publications published in this journal in the PY=2009-2018 in this WoS Category
2. Journal Contribution to the Excellence of the Category (JCEC) = (x(J)/x(T)) = Number of excellent publications published in this journal in the PY=2009-2018 in this WoS Category / Total number of excellent publications published in the PY=2009-2018 in this WoS Category.

Both indicators are size dependent: The first one (JPEP) can reach very high values for journals with just few publications in the category, and the second one (JCEC) benefits journals with a large number of publications. Therefore, we have also calculated two further indicators:

3. Journal Brute Excellence (JBE) = JPEP * JCEC = $x^2(J)/(p(J)*x(T))$.
4. Journal Normalized Excellence (JNE) = (x(J)/x(T))/(p(J)/p(T)) = Journal Contribution to the Excellence (JCEC) / Journal Contribution to the Category

The first one reflects the total brute excellence force or brute contribution of the journal to the category. The second one provides the normalized excellence contribution of the journal to the category. Both together provide a more complete picture of the journal excellence.

We are using the JNE especially for the analysis limited to the journals assigned to the JCR Category under study ("JCR Cat."), because the number of publications of these journals is significant, resulting in relevant JNE values. Note that JNE is inspired by the "Attractivity Index" by Schubert and Braun (1996), which is, in turn, defined based on the model of the Activity Index introduced into Scientometrics by Frame (1977). Both indicators have been used since the late 1980s to reflect a country's, region's or other unit's relative contribution to research productivity and citation impact in given subject fields (cf. Schubert et al., 1989). JNE here expresses a journal's contribution to the excellence in a given subject. As such JNE,

analogously to the above-mentioned indicators by the Hungarian research group, is a balance measure with neutral value 1, i.e. a journal contributes relatively more (less) to the subject's excellence according as JNE > (<) 1. It is not contributing at all, if JNE = 0. The only conceptual deviation of JNE from activity/attractivity is that the balance in not considered across subjects but across units (i.e., journals). A consequence of the "balance" property of this concept is that not all journals can contribute relatively more (less) than expected – some journals assigned to the subject category reflect relatively more excellence than the subject standards, others contribute to subject excellence to a lesser extent.

When analyzing the effect of the multidisciplinary journals, we use the JBE. Multidisciplinary journals contributing rather few publications to the category yield high JNE values, but according to the JBE no significant contributions are achieved.

Pearson Correlations were then performed for the JIF, JPEP, JCEC, JBE and JNE for each of the five categories considering only journals assigned to the subject category ("JCR Cat.") and including also multidisciplinary journals ("JCR Cat. + Multidisciplinary").

In addition, the Gini coefficient has been calculated for all five categories.

Furthermore, we have compared the Q1 journals assigned to each category according JCR (2020) with the Top Journals according to the two new indicators JNE ("JCR Cat."), and JBE ("JCR Cat. + Multidisciplinary").

In order to address research question #4, we have analyzed and discussed the contribution of other journals not directly assigned to the corresponding category, like e.g. the multidisciplinary journals, to the excellence of the category. For this purpose, we have introduced two more indicators:

5. Category Percentage of Multidisciplinarity (CPM) = Number of publications added by multidisciplinary journals not directly assigned to this category according to the JCR (e.g. Nature, Science, PLOS, etc.) / Total number of publications in the category.
6. Category Excellence Degree Multidisciplinarity (CEDM) = Number of excellent publications added by journals not directly assigned to this category according to the JCR (e.g. Nature, Science, PLOS, etc.) / Total number of excellent publications in the category.

Last but not least, we have also performed our analysis not only for the document types articles and reviews, but also for all document types in order to address research question 5.

Results

General Overview

Table 1 gives an overview of the number of journals, publications and excellent publications for each category considered in this study.

Table 1. Overview of the five categories (PY= 2009-2018)

		JCR Category			JCR Cat. + Multidisciplinary			Multidisciplinarity	
Categories	**Document Types**	**Nr Journals**	**Nr Pubs**	**Nr Excellent Pubs**	**Nr Journals**	**Nr Pubs**	**Nr Excellent Pubs**	**Percentage CPM**	**Degree CEDM**
Economy	All types	351	242.035	29987	433	246764	30481	1.92%	1.62%
	Art. / Rev.	343	181852	26332	424	187937	26694	3.24%	1.36%
History	All types	99	82575	8983	126	88258	9902	6.44%	9.28%
	Art. / Rev.	99	25443	7371	119	27992	8157	9.11%	9.64%
Information & Library S	All types	79	92657	7077	144	95329	7213	2.80%	1.89%
	Art. / Rev.	73	33745	5850	131	37828	5950	10.79%	1.68%
Physics High Condensed M	All types	63	285812	29762	100	289678	29934	1.33%	0.58%
	Art. / Rev.	62	278819	29145	98	283149	29307	1.53%	0.55%
Virology	All types	35	83006	7269	145	89138	8248	6.88%	11.87%
	Art. / Rev.	34	65277	6258	140	71280	7174	8.42%	12.77%

Furthermore, it provides information about the differences between document types – all document types (All types) versus Article and Reviews (Art. /Rev.) –, the "Category Percentage of Multidisciplinarity" (CPM) and the "Category Excellence Degree Multidisciplinarity (CEDM)" (see section Methodology). The results show that articles and reviews are mostly responsible for the number of excellent publications in all categories. This is even true for the three categories related to the Social Sciences where big differences between the total number of all document types compared to articles and reviews can be observed.
The lowest percentage of articles and reviews within the excellent publications is observed for "Information & Library Science" (ILS) and "History" (HI) with 82%, followed by "Virology" and "Economics" with around 88% and the highest in "Physics, Condensed Matter" (PCM) with almost 98%. In this study, we are focusing on the document types Articles (Art,) and Reviews (Rev.). In Section 5, the effect of the document types will be further analyzed and discussed.
Table 1 also shows that the category percentage and degree of multidisciplinarity are different according to the subject categories. For the category "Virology" (VIR) it is even more significant when considering the contribution to excellence (CEDM). More than 12% of the excellent publications are published in multidisciplinary journals in the category of "Virology" and around 10% in the category "History". In "Physics, Condensed Matter" (PCM) the effect of the multidisciplinary journals is almost inexistent, and in Economics (ECO) very low. In "Information & Library Science" (ILS) the effect is much higher in the total number of publications (CPM) than in the number of excellent publications (CEDM) as well as for articles and reviews in comparison to all document types.

Showcase Results for the category "Information & Library Science" (ILS)
Table 2 provides an example of the results obtained for the category "Information & Library Science" (ILS) and includes all the indicators mentioned in the methodology.

Table 2. Excerpt of the data retrieved for the category ILS, only Q1 journals according to the JIF 2019 (Article & Reviews, PY=2009-2018)

						Final Indicators	
	Journal Impact Factor	Nr Pubs	Nr Excellent Pubs	% Journal Contribution JPEP	% Category Contribution JCEC	Brute Excellence JBE	Normalized Excellence JNE
INT. JOURNAL OF INFORMATION MANAGEMENT	8,21	796	357	44.85%	6.10%	2.737	2.851
MIS QUARTERLY	5,37	511	333	65.17%	5.69%	3.709	4.143
JOURNAL OF COMPUTER-MEDIATED COMMUNICATION	5,366	338	154	45.56%	2.63%	1.199	2.897
JOURNAL OF STRATEGIC INFORMATION SYSTEMS	5,231	192	79	41.15%	1.35%	0.556	2.616
INFORMATION & MANAGEMENT	5,155	640	294	45.94%	5.03%	2.309	2.921
GOVERNMENT INFORMATION QUARTERLY	5,098	598	231	38.63%	3.95%	1.525	2.456
INFORMATION PROCESSING & MANAGEMENT	4,787	685	151	22.04%	2.58%	0.569	1.401
JOURNAL OF KNOWLEDGE MANAGEMENT	4,745	663	264	39.82%	4.51%	1.797	2.532
JOURNAL OF INFORMETRICS	4,611	734	204	27.79%	3.49%	0.969	1.767
INFORMATION SYSTEMS JOURNAL	4,188	247	83	33.60%	1.42%	0.477	2.136
TELEMATICS AND INFORMATICS	4,139	702	195	27.78%	3.33%	0.926	1.766
JOURNAL O AMERICAN MEDICAL INFORMATICS ASSOCIATION	4,112	1713	525	30.65%	8.97%	2.750	1.948
MIS QUARTERLY EXECUTIVE	4,088	163	32	19.63%	0.55%	0.107	1.248
INT. J. COMPUTER-SUPPORTED COLLABORATIVE LEARNING	4,028	194	55	28.35%	0.94%	0.267	1.802
JOURNAL OF MANAGEMENT INFORMATION SYSTEMS	3,949	406	157	38.67%	2.68%	1.038	2.458
INT. JOURNAL OF GEOGRAPHICAL INFORMATION SCIENCE	3,733	1079	222	20.57%	3.79%	0.781	1.308
JOURNAL OF INFORMATION TECHNOLOGY	3,625	217	56	25.81%	0.96%	0.247	1.641
INFORMATION SYSTEMS RESEARCH	3,585	497	204	41.05%	3.49%	1.431	2.610
INFORMATION AND ORGANIZATION	3,3	132	29	21.97%	0.50%	0.109	1.397
JOURNAL OF THE ASSOCIATION FOR INFORMATION SYSTEMS	2,957	317	89	28.08%	1.52%	0.427	1.785
SCIENTOMETRICS	2,867	2921	495	16.95%	8.46%	1.434	1.077

It shows the Q1 journals according to the Journal Impact Factor[1].
Figure 1 shows the correlation between the IF and the two new indicators for all journals of the JCR Category "Information & Library Science" (ILS). The correlation is rather moderate (JBE; r = 0.763, see Table 3), most notably for the normalized JNE (*r* = 0.906, see Table 3), but some of the journals change their position, if a normalized and size-independent indicator (JNE) is used (e.g., JASIST and Scientometrics).

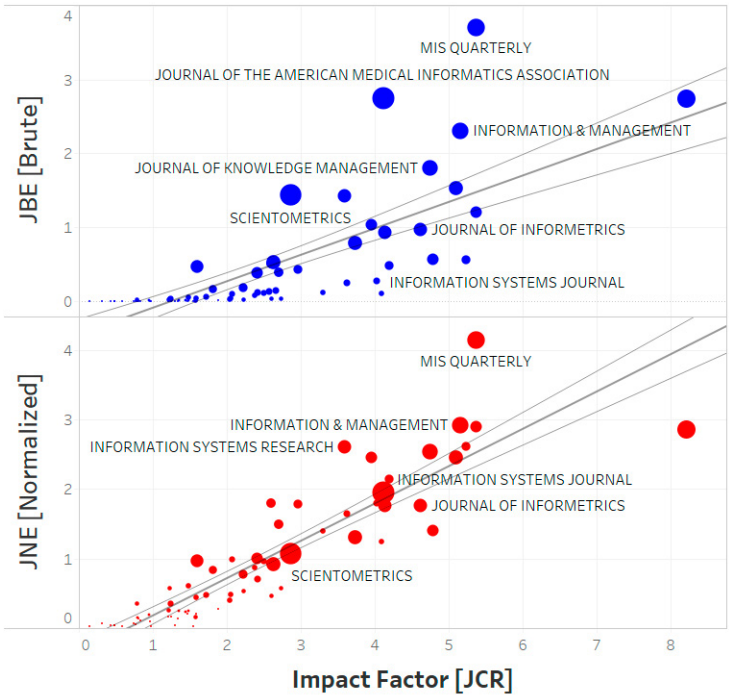

Figure 1. Correlations of the Impact factor with the JBE and JNE in the category Information Library & Science

Table 3 shows the Pearson correlations between all five indicators: JPEP, JCEC, Journal Impact Factor (JIF), JBE and JNE for the category "Information & Library Science" (ILS) for a) only articles and reviews (lower left triangle) b) for all the document types (upper right triangle).

Table 3. Pearson correlations between all measures and indicators for all JCR journals of the category ILS (lower left triangle: Articles & Reviews; upper right triangle: all document types; PY=2009-2018)

A+R vs. all	Pubs	Exc. Pubs	JIF	JPEP	JCEC	JBE	JNE
Pubs	-----	0.077	-0.136	-0.107	0.077	-0.107	-0.029
Exc. Pubs	0.775	-----	0.683	0.696	1.000	0.696	0.890
JIF	0.253	0.700	-----	0.897	0.683	0.897	0.755
JPEP	0.222	0.716	0.906	-----	0.696	1.000	0.830
JCEC	0.775	1.000	0.700	0.716	-----	0.696	0.890
JBE	0.462	0.890	0.763	0.836	0.890	-----	0.830
JNE	0.222	0.716	0.906	1.000	0.716	0.836	-----

[1] The complete dataset will be uploaded in Zenodo.

We will discuss the effects of the differentiation between all document types and articles & reviews later in section 5.

Table 4. Ranking changes for journals of the category ILS according to the JIF in comparison with JBE and/or JNE (green/red= increasing/decreasing positions) (Article & Reviews, PY=2009-2018)

	Ranks			Differences Between rankings	
	JIF	Brute Excellence JBE	Normalized Excellence JBE	JIF and JBE	JIF and JNE
JOURNAL OF HEALTH COMMUNICATION	41	**19**	26	+22	+15
PORTAL-LIBRARIES AND THE ACADEMY	65	**45**	44	+20	+21
JOURNAL OF ACADEMIC LIBRARIANSHIP	55	**38**	45	+17	+10
INFORMATION TECHNOLOGY & MANAGEMENT	56	**40**	36	+16	+20
SCIENTOMETRICS	21	**7**	23	+14	-2
ELECTRONIC LIBRARY	64	**51**	58	+13	+6
ONLINE INFORMATION REVIEW	39	**26**	32	+13	+7
LIBRARY & INFORMATION SCIENCE RESEARCH	47	**35**	35	+12	+12
LIBRARY HI TECH	57	**46**	47	+11	+10
EUROPEAN JOURNAL OF INFORMATION SYSTEMS	27	**17**	13	+10	+14
INFORMATION SYSTEMS RESEARCH	18	**8**	6	+10	+12
JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	12	**2**	11	+10	+1
ETHICS AND INFORMATION TECHNOLOGY	35	**33**	25	+2	+10
JOURNAL OF INFORMETRICS	9	**11**	15	-2	-6
PROFESIONAL DE LA INFORMACION	44	**49**	57	-5	-13
KNOWLEDGE ORGANIZATION	59	**68**	70	-9	-11
LIBRARY COLLECTIONS ACQUISITIONS & TECHNICAL SERVICES	52	**62**	60	-10	-8
ASLIB JOURNAL OF INFORMATION MANAGEMENT	34	**44**	38	-10	-4
INFORMATION AND ORGANIZATION	19	**30**	20	-11	-1
JOURNAL OF STRATEGIC INFORMATION SYSTEMS	4	**15**	5	-11	-1
REVISTA ESPANOLA DE DOCUMENTACION CIENTIFICA	53	**66**	68	-13	-15
DATA BASE FOR ADVANCES IN INFORMATION SYSTEMS	42	**55**	51	-13	-9
JOURNAL OF ORGANIZATIONAL AND END USER COMPUTING	38	**52**	46	-14	-8
JOURNAL OF GLOBAL INFORMATION TECHNOLOGY MANAGEMENT	45	**60**	56	-15	-11
LEARNED PUBLISHING	26	**42**	41	-16	-15
INFORMATION TECHNOLOGY FOR DEVELOPMENT	22	**39**	37	-17	-15
MIS QUARTERLY EXECUTIVE	13	**32**	22	-19	-9
MALAYSIAN JOURNAL OF LIBRARY & INFORMATION SCIENCE	46	**71**	71	-25	-25

In Table 4, journals in the category ILS are listed. It shows the changes in ranking position, which is traditionally based on the Journal Impact Factor, when applying the Excellence Indicators JBE and JNE. Values in green indicate a higher ranking position compared to the JIF, values in red indicate a lower position.
Portal: *Libraries and the Academy* and *Journal of Health Communication* are the journals that improve their rank position the most due to the excellence indicators. *Malaysian Journal of Library & Information Science* and *Information Technology for Development* are the ones decreasing the most in the brute and normalized excellence rankings.

Comparisons between the five categories analyzed
Table 5 shows the results of the correlation between the Impact Factor and the two Excellence Indicators for all the categories considered in our study: "Information & Library Science" (ILS),

"Economics" (ECO), "History" (HIS), "Physics, Condensed Matter" (PHCM) and "Virology" (VIR).

Table 5. Correlations between JIF, JBE and JNE for the five subject categories analyzed (Article & Reviews, PY=2009-2018)

ILS	JIF	JBE	JNE
JIF	1.000		
JBE	0.763	1.000	
JNE	0.906	0.836	1.000
ECO	JIF	JBE	JNE
JIF	1.000		
JBE	0.544	1.000	
JNE	0.909	0.620	1.000
HIS	JIF	JBE	JNE
JIF	1.000		
JBE	0.624	1.000	
JNE	0.784	0.836	1.000
PHCM	JIF	JBE	JNE
JIF	1.000		
JBE	0.691	1.000	
JNE	0.941	0.799	1.000
VIR	JIF	JBE	JNE
JIF	1.000		
JBE	0.758	1.000	
JNE	0.956	0.867	1.000

The results show that the correlation between the Journal Impact Factor (JIF) and the JNE is higher than between JIF and the JBE. This is expected because JIF and JNE are both size independent.
The correlation between the JIF and the JNE is very high for the JCR Categories "Virology" (VIR) and "Physics, Condensed Matter" (PHCM) (around 0.95), good for "Economics" (ECO) and "Information & Library Science" (ILS) (around 0.9) and lower for "History" (HIS) (0.784).

Effect of the multidisciplinarity
Table 6 illustrates strong differences in the effects of the "multidisciplinary journals" in the five selected categories. Categories related to the life sciences and natural sciences show strong influences of such journals compared with the Social Science that are less affected. Of course, we have to keep in mind that humanities and most fields in the social sciences have a lesser weight in the big multidisciplinary journals. In particular, virology (VIR) is the category with the highest presence in multidisciplinary journals. Five multidisciplinary journals are responsible for the largest brute excellence contribution and can be considered as "Q1 journals" in this category according to this indicator. In Economics, four multidisciplinary journals appear among the journals with high contribution to the brute excellence, but not on the top. Also four journals are listed for "Physics, Condensed Matter" (PHCM) with comparably lower ranking positions.
The only multidisciplinary journal ascending to the first quartile in "Information & Library Science" (ILS) is PLOS ONE. As it is well-known, PLOS ONE has a special section for Research assessment and Bibliometrics. However, according to its size, its excellence contribution is not as high as expected (see also Table 1).

Table 6. Effect of the multidisciplinary journals in the JBE Ranking for the journals of the five subject categories (Article & Reviews, PY=2009-2018)

			Contributions		Brute		
Category	Journal	PUBs	JPEP	JCEC	JBE	Rank JBE	Percentile
VIR	PNAS	650	49.38%	4.47%	2.210	4	8
VIR	SCIENCE	118	98.30%	1.61%	1.590	5	10
VIR	NATURE	100	97%	1.35%	1.312	6	12
VIR	NATURE COMMUNICATIONS	176	58.52%	1.43%	0.840	7	14
VIR	NEW ENGLAND JOURNAL OF MEDICINE	15	73.33%	0.15%	0.112	12	24
PHCM	SCIENCE	30	93.33%	0.09%	0.089	11	15
PHCM	NATURE COMMUNICATIONS	178	34.27%	0.20%	0.071	13	18
PHCM	NATURE	26	84.61%	0.07%	0.064	14	20
PHCM	PNAS	84	30.92%	0.08%	0.027	16	23
ILS	PLOS ONE	199	39.19%	1.31%	0.514	17	20
HIS	JOURNAL OF ECONOMIC HISTORY	323	74.30%	2.94%	2.186	2	2
ECO	PNAS	248	56.04%	0.52%	0.292	24	7
ECO	SCIENCE	62	85.48%	0.19%	0.170	37	10
ECO	PLOS ONE	726	11.98%	0.32%	0.039	88	24
ECO	NATURE	10	100%	0.03%	0.037	92	25

Effect of the document types

Finally, we analyzed the effect of considering all types of documents instead of only articles and reviews. As it is common knowledge that there is an asymmetry in the calculation of the Journal Impact Factor. In the numerator, the citations to all types of documents are summed up, while in the denominator only research articles and reviews are considered[2]. In Section 1 we have already analyzed the document types in each category and their contribution to the Excellence (see Table 1). The results corroborate that in the subject categories related to the social sciences (ILS and HIS), other document types than articles and reviews might play a significant role accounting for around 18% of the category excellence.

Furthermore, the two new excellence indicators have been also calculated for all document types and for articles and reviews only (see Table 3). The results underline the role of research articles and reviews in scientific journals. Any reasonable correlation of the number of documents with excellence measure is absent, even slightly negative. Thus it is plausible that the observed Pearson correlation between JIF and JNE is distinctly higher for articles and reviews than for all document types (0.906 versus 0.755), while it is just the opposite for the brute excellence contribution (JBE), where the total number of publication in the category plays a role (0.763 versus 0.897).

Figure 2 shows the correlation of the Journal Impact Factor, and the two excellence indicators (JBE and JNE) for the Q1 journals of the category ILS when considering only articles and reviews (column 2 and 3) and all document types (column 4 and 5), respectively. The results show that, even if the actual indicator values are changing, the distribution of the JBE or JNE as such is not much affected by the considering all document types instead of only 'citable items'. This hints to the fact that our excellence indicators are quite robust or less sensitive to the types of documents considered. In particular, the correlations are very strong, e.g. 0.986 for the Journal Normalized Excellence (JNE), and 0.99 for the Journal Brute

[2] Originally, Garfield used the document types, articles and reviews, also called "citable items" in the JCR Edition. Nowadays, all the proceedings papers published in journals are also considered articles in the Core Collection with the effect of double assignment.

Excellence (JBE), and they corroborate the robustness of both indicators concerning the document types used in their calculation. One possible reason is that the normalizations performed for defining excellent publications are also done by document type (= Top 10% most cited publications of the same document type and publication year in the same category year).

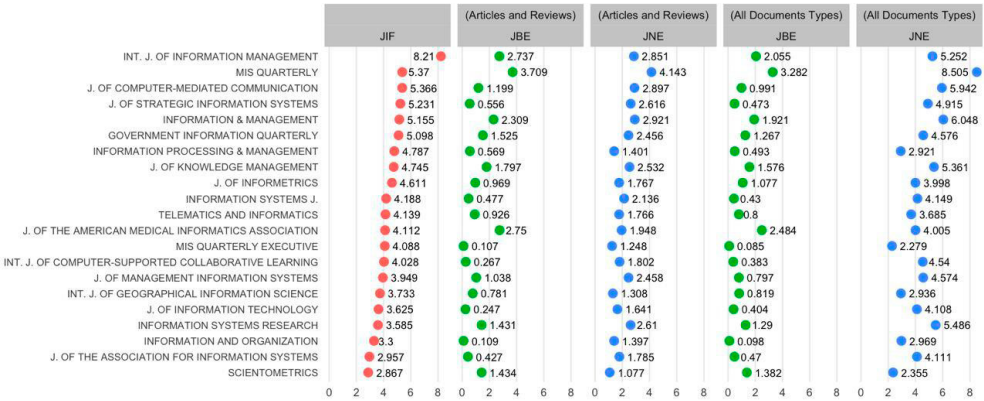

Figure 2. Distribution of JIF, JBE and JNE for all Q1 journals of the category ILS for only Articles and Reviews (2nd and 3rd columns 2 and 3) and all document types (columns 4 and 5).

Conclusions

Due to the precariousness and long half-lives of the citations, the identification of the top journals in each discipline is one of the most requested and used tools in academic evaluation exercises focusing on the assessment of the research performance of the most recent years.

The Journal Impact Factor has established itself as one of the most consolidated instruments for assessing the impact and prestige of the journals where the scientists, research groups, organizations and countries have published in.

To provide a broader view of each journal's contribution to the excellence in each category or field, we have introduced two new indicators, which ideally complement the JIF. The first one, the Journal Normalized Excellence (JNE) measures the normalized excellence contribution of a journal to its subject category. A journal contributes relatively more (less) to the subject's excellence according as JNE > (<) 1.

On the other side, it is also interesting to know the total contribution of a journal to the category excellence, independently of its size. The Journal Brute Excellence (JBE) reflects the total brute excellence force or brute contribution of the journal to the category. It also plays a crucial role in order to estimate the effect of multidisciplinary journals in the category and especially their contribution to the excellence in the category.

This study also reveals that the effect of the multidisciplinary journals is very different according to the category and it is generally stronger in the hard sciences.

In this pilot study, which was restricted to five subject categories, our excellence indicators have shown a robustness concerning the consideration of all types of documents instead of only articles and reviews. Therefore, they provide an amelioration of the inherent asymmetry reflected in the definition and calculation of Garfield's Impact Factor.

Another advantage of our excellence indicators relies on the practical aspect for the measurement of the visibility of publications. When using the Impact Factor for this purpose, there is always a controversial decision: what JCR Edition should be used? There are three possibilities: a) using JIF values of the last JCR-edition for all publications independently of their publication year; b) Using the JCR-edition corresponding to the publication year of each

publication; and c) using the mean value of the last *x* years according to the time period under study. Anyone of them is completely satisfactory (Glänzel et al., 2016). Our excellence indicators circumvent this problem because they are based on accumulated measures including the last ten complete publication years and are not restricted to two years or a selected JCR edition.

One of the possible applications of our study is to prevent the use of JCR Categories for the delineation of scientific areas, as has been done in many previous bibliometric studies. Our study warns of serious consequences of this approach, as contributions from multidisciplinary journals are not considered in some categories. For example, reducing the study to only journals of the category in Virology or PHM would mean missing a large part of the scientific breakthroughs and excellent publications, which are regularly published in multidisciplinary journals. In economics, however, this contribution is not notable, and in LIS or HIS, only sporadic contributions can be observed.

Although it is well known that journal impact measures do not work well in the Arts and Humanities and can lead to false interpretations (Repiso et al., 2019), we have also considered the category "History" in an exploratory way. However, in these disciplines it will be crucial to determine which types of publications contribute most to excellence, and this will be part of our future studies.

Future analyses could also be extended to include the effect of interdisciplinarity. Unfortunately, InCites does not offer the possibility to measure this effect, because the subject classification is made on journal level, except for the multidisciplinary journals (on publication level). The recent introduction of the publication based "Citation Topics" may be an improvement in InCites. This topic will also be part of our future analyses.

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