The Citation Impact of German Sociology Journals: Some Problems with the Use of Scientometric Indicators in Journal and Research Evaluations

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Abstract: We analyze the citation impacts (‚cited') and citation practices (‚citing') of sociological journals which publish mainly in German, and discuss major drawbacks of using the journal impact factor (IF) to assess the quality of these journals. First, sociological literature moves very slowly in terms of citations, whereas journal impact factors (IF) measure short-term impact at research fronts. Second, the citation distributions are heavily skewed because of the so-called Matthew effect (Merton) of cumulative advantages; one should not use quasi-averages (such as the IF) given this skewness. The alternative of using non-parametric statistics (e.g., percentiles), however, requires delineation of the reference sets. We discuss the unsolved problems in the case of (inter)disciplinary delineations and show empirically the ecological fallacy in nevertheless attributing journal characteristics to individual papers. Algorithmic constructs (*e.g.*, the various rankings) cannot be used for policy or management purposes without validation or specification of statistical error.

1. Introduction

What has started as a selection tool for journals has turned into the most widely used and best known bibliometric indicator: the journal impact factor (IF). Although also the most contested one, the IF has been the best known measure of the ‚impact' and ‚quality' of a journal, advertised by editors and publishers to attract both (quality) submissions and readership. Despite its drawback as an indicator, even when it comes to assessing the quality of a journal, the IF has also been used to assess the ‚impact' of individual researchers and research groups based on the ranks of the venues in which they publish. So, what is a journal impact factor? It is a *ratio* of the number of citations in a given year to the papers published in a given journal in the two preceding years as a numerator, and the number of citable items (defined as normal articles and reviews) published in those two years as the denominator. Therefore, IF is size-independent. However, this measure makes two important assumptions: (a) that there is an average journal article, and (b) that the advancement of knowledge in all fields moves very fast.

The IFs are published annually by the Institute of Scientific Information (ISI) – currently owned by Thomson Reuters – in a *Journal Citation Report* (JCR). The ISI produces three separate citation indexes based on disciplinary affiliations: the *Science Citation Index* (SCI), *Social Science Citation Index* (SSCI), and *Arts and Humanities Citation Index* (A&HCI). JCR is available only for SCI and SSCI. ISI deliberately abstained from producing a JCR with impact factors for the arts and humanities index, because citation is sparse in the *A&HCI,* and probably has other functions and dynamics in the communication (Garfield 1982; Hammarfelt 2012; Leydesdorff / Hammarfelt / Salah 2011).

The IF is not an ‚absolute' measure of impact. It becomes more meaningful when compared to other journals within the same subfield or discipline. Such journals exhibit similar referencing behavior, both in terms of the numbers of references and their age (Milojević 2012), and hence influence the possible IF values within it. This leads to the third major assumption: that it is possible to delineate disciplines and subfields unequivocally.

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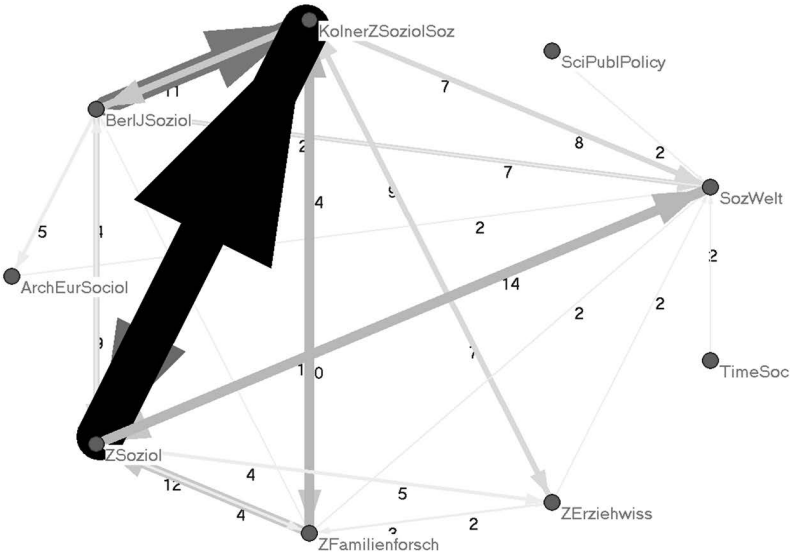
In this paper we examine the impact factor of the journal *Soziale Welt – Zeitschrift für Sozialwissenschaftliche Forschung und Praxis* (SW) by studying its larger context, both in terms of the other German-language sociology journal, *Zeitschrift für Soziologie* (ZfS), and other sociology journals. We consider the role the above-mentioned assumptions play in the calculations and interpretations of IF. We will also discuss the possible effect of publishing in German. In 2013 SW had a journal Impact Factor (IF) of 0.432. However, the IF of the larger journal, ZfS, is not much higher (0.481). The latter journal obtained the 103rd rank (in the third quartile) among 138 journals attributed to the Web-of-Science Category of ‚Sociology' in 2013, whereas *Soziale Welt* ranks in 108th place (in the fourth quartile).

2. Language bias

English has become the dominant language of science (Sivertsen 2003). However, other languages still play an important role, especially in the social sciences and humanities (Archambault et al. 2006; Nederhof 2006). In a study of the language usage in sociology, Yitzhaki (1998) stated that ‚although between one-third and one-half of world social sciences research literature is published in languages other than English, studies show very scant use of it by American and British scholars' (Yitzhaki 1998: 243). So, the question is: Are the low impact factors due to publishing in German more than in English, so that the citing audiences are smaller? To answer this question we examine three factors: (a) the publication trends within SW in terms of languages; (b) citation relations among the journals citing SW; and (c) major journals cited by SW. The percentages of publications in English during the last ten years (2004-2013) were 7.2% for SW and 6.8 for ZfS. During the reference years of the IF 2013 (that is, the publication years 2011 and 2012), *Soziale Welt* had no publications in English; but seven of the 19 papers in 2010 (36.8%) were in English. Thus, the language factor varies over time.

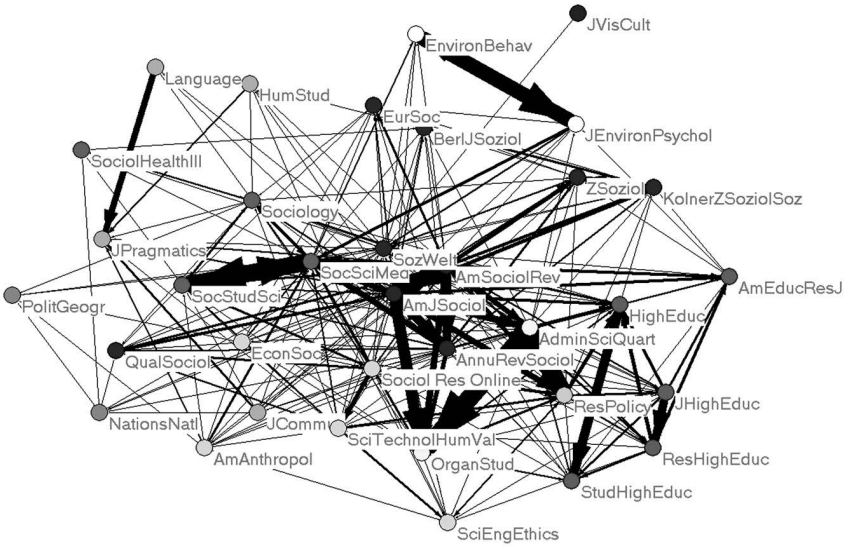
Figure 1 shows the citation of papers published in SW (since its inclusion in the *Science Citation Index* in 1994) during 2013. Articles in SW are cited most frequently (14 times) by articles in ZfS, but only four times by articles in journals publishing in English (twice in *Time and Society* and twice in *Science and Public Policy*). Figure 1 shows that the German journals in the social sciences can be considered as a specific domain in terms of mutual citation relations.

Figure 1: Citation relations among nine journals citing Soziale Welt during 2013



From a sociological perspective, active citation (‚citing') is more interesting than the being-cited impact of the journal because citing patterns inform us about the reproduction of disciplines and inter-disciplinary relations. Figure 2 shows that the authors in *Soziale Welt* are firmly embedded in a sociology cluster. In addition to the German journals (*Zeitschrift für Soziologie* and the *Kölner Zeitschrift for Soziologie and Sozialpsychologie*), the knowledge base includes major American journals such as the *American Sociological Review* and the *American Journal of Sociology*. However, the aggregated referencing pattern of authors in *Soziale Welt* is also diverse and suggests interdisciplinarity (Leydesdorff / Goldstone 2014): eleven clusters are distinguished by a community-finding algorithm (Blondel et al. 2008), and colored accordingly in Figure 2.

Figure 2: Citation network among 35 journals cited by Soziale Welt in 2013. Q = 0.643 (11 clusters; Blondel et al. 2008); Kamada / Kawai (1989) used for the layout



3. Impact factors in sociology

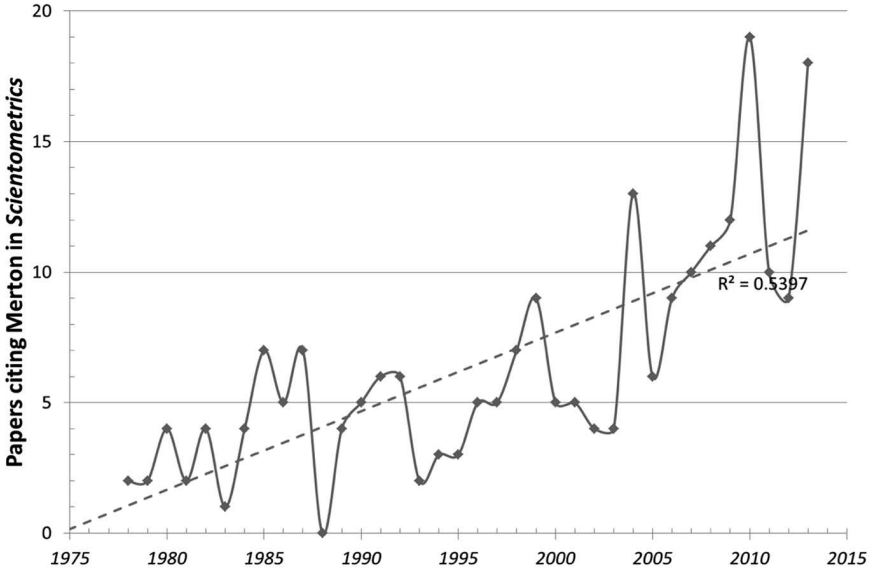
When Garfield (1972; cf. Garfield / Sher 1963) proposed the IF he based it on the research by Martyn and Gilchrist (1968) which showed that the last two years can be used as a reliable representation of total citations in the biomedical sciences (Bensman 2007). Whereas the IF may be considered as a reliable indicator for fields with an active research front and a rapid turn-over of citations (in the previous two years), sociology is not such a field.

Two measures are important here: the median age of the citations (that is, the so-called ‚cited half-life time‘) and the immediacy factor. The immediacy factor was introduced by Price (1972) in order to distinguish between fields with and without research fronts; it measures the number of citations to publications in a journal that appeared in the current year, divided by the total number of publications in this journal in this same year (for the normalization). The median age of the citations to publications in *Soziale Welt* is more than a decade, so the immediacy factor is zero (!) for this journal. Among sociology journals, *Soziale Welt* is no exception because the median age of the citations is also longer than ten years for the *American Journal of Sociology* and the *American Sociological Review.* All these journals have immediacy factors in the range of 0.3 to 0.5, whereas *Zeitschrift für Soziologie* and similar (German) journals in the social sciences do not score on this measure above 0.1.

In other words, the process of citation is slow in sociology, and circulation is further impeded by the language barrier, so the IF cannot be considered as a reliable indicator of impact. Actually, processes of codification of citations and recognition take longer than five years. Baumgartner and Leydesdorff (2014) distinguished between ‚sticky‘ and ‚transitory‘ knowledge claims: transitory knowledge claims generate a citation peak in the first two or three years, but then typically the curve decays rapidly. Sticky knowledge claims occur in

all fields of science, but cannot be counted using impact factors or similar measures which focus on citation in current or most recent years.

Figure 3: Numbers of papers citing Robert K. Merton in the journal Scientometrics during the period 1978-2013



For example, Figure 3 shows the citation of Merton in the journal *Scientometrics* since the founding of this journal in 1978. Whereas Merton is still cited regularly (albeit somewhat less) in sociological journals, his influence in scientometrics has gained prominence over the decades. For example, Merton's (1968) expression of the Matthew effect in science – ‚For to all those who have, more will be given, and they will have an abundance; but from those who have nothing, even what they have will be taken away' – explains the ‚cumulative advantages' theorized by Price (1976: 292): citation-rich authors and publications tend to attract further citations, in part *because* they are heavily cited (Cole / Cole 1973). In social network analysis this effect is now formalized as ‚preferential attachment' (Barabási / Albert 1999), but without references to either Merton (1968) or Price (1976). Codification to the extent that a reference is no longer needed, is called ‚obliteration by incorporation' in scientometrics (Garfield 1975; Cozzens 1989: 438).

4. The skewness of the citation distributions

The impact factor is essentially a two-year *average*, where the citations in year *t* to publications in the years (*t*-1) and (*t*-2) are divided by the number of publications in the latter two years. Thus, in addition to assuming a research front with a rapid turn-over of the citation, the impact factor also assumes that the citation curve is distributed normally (*quod non*), instead of using non-parametric statistics (such as percentiles). However, the citation distribution is heavily skewed due to the mechanism of preferential attachment or cumulative advantages (Seglen 1997). This may be due to competitive pressure, but the differences can also be reinforced by symbolic generalization, as in the above noted case of Merton. Codifi-

cation decays at a much slower speed than variation in the knowledge claims at a research front (Luhmann 1990; cf. Verstak et al. 2014).

Figure 4: Citation distributions for papers in the *Zeitschrift für Soziologie*: (a) citations for papers in 2011 and 2012 (♦); (b) for all years included (1972-2013; ■); and idem but logarithmically scaled (▲)

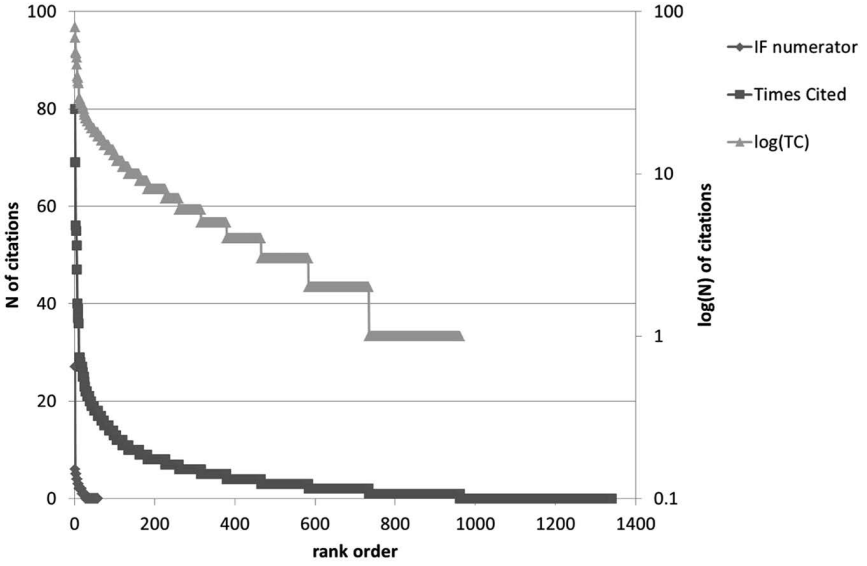


Figure 4 shows the citation distribution in the case of the *Zeitschrift für Soziologie* (We used this journal instead of *Soziale Welt* because of the larger numbers.). First, in the left-bottom corner, the distribution of the last two years of citations used for calculating the numerator of the IF is shown as blue diamonds. One of the papers (Auspurg / Hinz 2011) had obtained 27 citations by the date of this search (November 16 2014). The second most-frequently cited paper in this set, however, has only six citations, followed by two other papers with five citations, etc.

The curve of red blocks in Figure 4 shows the citation distribution for all 5,518 citations assigned to the 1,340 papers published in ZfS since its first volume in 1972. One cannot conclude on this basis that papers in ZfS are expected to be cited (c / p = 5,518 / 1,340 =) 4.12 times. Of these 1,340 papers, 379 (28.3%) were never cited, and 227 (16.9%) were cited only once. The uncited papers actually provide the mode of the distribution.

In order to work with these skewed distributions, scientometricians often transform using the logarithm. This transformation leads us to the third curve with green triangles at the top of Figure 4 (using the right y-axis for the scaling). The log(5518)/log(1340) = 1.20, but this number is no longer an arithmetic mean. Instead, one should use the median (in this case, the median is 2.0), and derive percentile ranks from this (Leydesdorff et al. 2011). Leydesdorff and Bornmann (2011) have developed the Integrated Impact Indicator (*I3*) which is based on integrating – instead of averaging – the percentiles of the papers in a set into a normalized measure of impact; for example, for a journal, a country, or a university.

5. The ecological fallacy in citation impact measurement

We have shown the problems with IF stemming from language bias, great variability in the movement of research fronts, and skewness of citation distributions. But the problems in using IF for evaluation are even larger when applied to units of analysis other than journals. Namely, these quasi-average values of impact are first calculated for each journal, but then attributed to each paper in the journal as an expected value of the impact at the level of papers. In sociology, this inference is also known as the ecological fallacy (Robinson 1950).

An ecological fallacy is implied when inferences about the nature of single records (here: papers) are deduced from inferences for the group to which these records belong (here: the journal where the papers were published). A tree, however, can be dying in a healthy forest, and thus the correlation between the health of the tree and the health of the forest can even be negative (Kreft and De Leeuw 1988).

Figure 5: Top of p. 83 of the Annual Report 2013 of the Amsterdam School of Communication Research (ASCoR) listing the refereed papers with their journal impact factors

Refereed articles (ISI)

Azrout, R., Van Spanje, J. H. P., & De Vreese, C. H. (2013). A threat called Turkey: Perceived religious threats and support for EU entry of Croatia, Switzerland and Turkey. *Acta Politica, 48*, 2-21.
- SSCI IMPACT FACTOR 0.361

Azrout, R., Van Spanje, J. H. P., & De Vreese, C. H. (2013). Focusing on differences? Contextual conditions and anti-immigrant attitudes' effects on support for Turkey's EU membership. *International Journal of Public Opinion Research, 25*, 480-501.
- SSCI IMPACT FACTOR 1.125

Beentjes, J. W. J., & Konig, R. P. (2013). Does exposure to music videos predict adolescents' sexual attitudes? *European Societies, 9*, 1-20.
- SSCI IMPACT FACTOR 0.548

Bleakley, A., **Piotrowski, J.**, Hennessy, M., & Jordan, A. B. (2013). Predictors of parents' intention to limit children's television viewing. *Journal of Public Health, 35*, 525-532.
- SSCI IMPACT FACTOR 1.993

Bornmann, L., & **Leydesdorff, L.** (2013). Macro-indicators of citation impacts of six prolific countries: InCites data and the statistical significance of trends. *PLoS One, 8*, e56768.
- SCI IMPACT FACTOR 3.730

Bornmann, L., & **Leydesdorff, L.** (2013). The validation of (advanced) bibliometric indicators through peer assessments: A comparative study using data from InCites and F1000. *Journal of Informetrics, 7*, 286-291.
- SSCI IMPACT FACTOR 4.153

Bornmann, L., **Leydesdorff, L.**, & Mutz, R. (2013). The use of percentiles and percentile rank classes in the analysis of bibliometric data: Opportunities and limits. *Journal of Informetrics, 7*, 158-165.
- SSCI IMPACT FACTOR 4.153

Bornmann, L., **Leydesdorff, L.**, & Wang, J. (2013). Which percentile-based approach should be preferred for calculating normalized citation impact values? An empirical comparison of five approaches including a newly developed one (P100). *Journal of Informetrics, 7*, 933-944.
- SSCI IMPACT FACTOR 4.153

Figure 5, for example, cites the Annual Report 2013 of the institute to which one of us belongs. On p. 83 of this report, the refereed papers are carefully listed with the impact factor for the previous year (2012) attributed to each of the publications. Since the impact factor can be considered as an average value, social scientists are inclined to assume this as an expected value of the impact. However, the observed citation rates cannot be statistically tested against these expected ones.

At the date of this research (November 2014), the first article in the left column of Figure 5 (Azrout et al. 2013) had been cited twice, and the first article in the right column (Bornmann / Leydesdorff 2013) only once, whereas the impact factors of the two journals – *Acta Politica* and *PLoS One*, respectively – suggest a citation impact of the latter paper ten times higher than that of the former. Although the quality of journals can indeed be considered as a co-variate in the prediction of the *long-term* impact of papers (Bornmann et al. 2013), the short-term impact (in the last two years) is not a reliable predictor of the long-term impact –

especially not in fields without a rapidly evolving research front – and the expected value of the short-term impact as expressed by the impact factor of a journal is not an indicator of neither the short- or long-term impact of a given paper (Wang 2013).

In summary:

1. The impact factor is a quasi-average of a heavily skewed distribution;

   1.1 one should use non-parametric statistics (e.g., percentiles) given the shape of the citation distributions;
   1.2 if a standard deviation were added to the quasi-average value of the IF, it would become clear that the suggested precision of three decimals is misleading;
2. The impact factor is defined at the level of the entire set of all journals included in the *Science* and *Social Science Citation Indices*, whereas citation practices differ among disciplines and specialties leading to differences by orders of magnitude;
3. In fields with more slowly developing research fronts (e.g., physics as compared to bio-medicine) or fields without research fronts such as sociology, short-term (e.g., two-year) citation impacts cannot be considered as a reliable predictor (e.g., Bornmann et al. 2013).
4. The application of impact factors as predictors at the paper level (as in Figure 5) is subject to the ecological fallacy because low impact papers may appear in high-impact journals and *vice versa* (Oswald 2007); correlations in the case of an ecological fallacy may even be negative (Kreft / de Leeuw 1988).

Under the pressure of the critique of the impact factors (e.g., Alberts 2013), scientometricians have invented a host of new measures for the impact of journals. Among other things, the journal impact factor is trade-marked by the owner of the *SCI*, Thomson-Reuters, and Elsevier therefore had to invent new measures as an alternative to the *SCI* when *Scopus* was introduced in 2004. Elsevier's SNIP indicator (SNIP stands for *S*ource-*N*ormalized *I*mpact per *P*aper), for example, does not measure paper impact but journal impact, although the name implies impact at the paper level.

SNIP uses a three-year (parametric) impact factor in the numerator, but normalizes using (non-parametric) medians in the denominator (Moed 2010; Waltman et al. 2013). The result is a quotient of two numbers, but no longer a statistics that allows for the specification of uncertainty (for example, a standard deviation or confidence interval). Like other such indicators, these are algorithmic artifacts which are sometimes partially validated on specific subsets, and then generalized to the level of the entire set of all journals (e.g., Mingers 2014).

6. The unsolved problem of institutional evaluations

Whereas the impact factor suggested that one can compare across disciplines by normalizing for size (that is, the numbers of papers in the denominator of the IF), percentile-based approaches require that appropriate reference sets be distinguished. A paper can only belong to the top-10% if the 100% set can be defined. The problem of the distinction of appropriate reference sets, however, has not been solved, and is perhaps unsolvable because of the complex dynamics of the (social) sciences under study (Leydesdorff 2007). One may, for example, agree that both SW and ZfS belong to a set of German journals in sociology, one can question whether these ten or so German journals constitute a reference set or the 138 assigned by the *Social Science Citation Index* to the subject category ‚sociology.' Leydesdorff and Bornmann (2015; early view) found that in library and information science, journals in Spanish and Portuguese showed a citation pattern significantly different from journals in English.

Although the subject classifications offered by the database owners such as the Web-of-Science Subject Categories (WCs)[1] or the field and subfield categories in the case of Scopus[2] are often used in scientometric evaluations as ‚best practices' (e.g., Rehn et al. 2014; Thomson Reuters, s.d.), the Leiden Rankings 2014 of research universities are no longer based on these categories because of their notorious unreliability. The reference sets are since 2014 (unlike 2013) determined by clustering citations at the level of the papers (Waltman / Van Eck 2012: 828), ‚fields of science' are then algorithmically generated as clusters of citation relations.

Because these ‚fields' are algorithmic artifacts, they cannot easily be named (as against numbered), and therefore cannot be validated. Furthermore, a paper has to be cited or contain references in order to be classified, since the approach is based on direct citation relations.[3] However, algorithmically generated classifications of journals have characteristics very different from content-based (that is, semantically meaningful) classifications (Rafols / Leydesdorff 2009). The new Leiden system is not only difficult to validate, it also cannot be accessed or replicated from outside its context of production in Leiden (cf. Ruiz-Castillo / Waltman, in preparation).

The issue of determining reference sets is thus far from solved. A paper may score very differently in terms of percentiles in one reference set or another, and many papers can be attributed to a variety of reference sets (Rafols et al. 2012). Because of the highly-skewed distributions, misclassifications can have significant effects. In other words, the classifications are uncertain, but this uncertainty is not specified. For example, should this study itself be considered as a sociological contribution because it is published in a sociological journal? Is this a research article or a review? Much of this paper's (future) normalized citation impact as measured by the databases will depend on how it is classified. Furthermore, authors may be able to manipulate these systems a bit when reflexively aware of the mechanisms (e.g., Schreiber 2014).

7. Conclusion

During the last twenty years, a market for scientometric indicators has emerged because of the emphasis on accountability and transparency in new public management. Scientometrics – the quantitative branch of science and technology studies – has been used to legitimate the indicators; but we have argued that the applications of theoretical ideas in terms of indicators has often been premature and sometimes even oblivious to available insights into problems in both operationalization and measurement.

We first mentioned the change in perspective from citation practices (‚citing') to impact evaluations (‚cited'). Wouters (1998) argued that the citation index could be considered as a semiotic artifact generated by this inversion of the database by the database producer. In the search for evaluative tools, Garfield and Sher (1963) proposed the impact factor (Garfield 1972). Taking a quasi-average over the last two years of citation in the current year, the IF was further developed as a measure for activities at research fronts. However, the IFs do not provide a valid measure of impact in fields which have no research front, such as sociology.

1 A list of the Web-of-Science categories can be found at: http://images.webofknowledge.com/WOKRS515B5/help/WOS/hp_subject_category_terms_tasca.html, last access: 9.6.2015.

2 The classification codes of Scopus can be retrieved at: http://info.sciencedirect.com/scopus/scopus-in-detail/content-coverage-guide/journalclassification (last access: 9.6.2015) and can be related to the journals included in Scopus using the Excel sheet available at: http://www.journalmetrics.com/values.php, last access: 9.6.2015.

3 The journal names are used as a second index key to attribute non-cited papers to the most similar clusters.

Impact in such fields is also generated by longer-term codification processes as shown in Figure 3 for the case of Robert K. Merton being cited in *Scientometrics.*

Because of the cumulative advantages or the Matthew effect, citation distributions can be extremely skewed for all units of analysis, such as journals, document sets, universities, nations, etc. This characteristic skewness invalidates the use of central tendency statistics such as the mean. Normalization in terms of percentiles (top-1%, top-10%, etc.), however, requires the specification of reference sets. The decomposition of the database in terms of reference sets is sensitive to parameter choices. The alternative – to rely on an algorithmic decomposition without the possibility of validation – has become increasingly popular in evaluative bibliometrics during the last few years given the focus on ‚big data'. Unfortunately, the algorithmic results can often not be reproduced outside the laboratories of the producers.

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