Book Bibliometrics – A New Perspective and Challenge in Indicator Building Based on the Book Citation Index

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Abstract
This study aims to gain a better understanding of communication patterns in different publication types and the applicability of the Book Citation Index (BKCI) for building indicators for use in both informetrics studies and research evaluation. The authors investigate the differences not only in citation impact between journal and book literature, but also in citation patterns between edited books and their monographic authored counterparts. The complete 2005 volume of the Web of Science Core collection database including the three journal databases and the BKCI has been processed as source documents. Annual cumulative citation rates in a three-year (x3) and a nine-year (x9) citation window are applied to compute the citation impact of different types of publications. The ratio x3/x9 is utilized as a kind of prospective Price index to examine the extent of ageing. The results of this study show that books are more heterogeneous information sources and addressed to more heterogeneous target groups than journals. Comparatively, the differences between edited and authored books in terme:s of the citation impact are not so impressive as books vs. journals. Humanities have the most different citation impact between books and journals, whereas life sciences have the most similar impact between two groups.

Conference Topic
Journals, databases and electronic publications; Citation and co-citation analysis

Introduction

Some consequences of the absence of books in bibliometric analyses

In contrast to the natural and life sciences, social scientists and humanists publish in different formats, specifically, they rather produce books and contributions to edited volumes and monographs than journal articles (Bourke & Butler, 1996; Pestaña, Gómez, Fernández, Zulueta & Méndez, 1995; Nederhof, 2006; Sivertsen & Larsen, 2012). Books should not be ignored by bibliometrics, not only because they are a major output type but also due to their high impact. Hicks (1999) states that the best social science is often found in books, which is reflected in their citation rates. The danger of ignoring books is illustrated by research, which explores the differences between the worlds of book and journal publishing (e.g., Nederhof, van Leeuwen & van Raan, 2010; Butler & Visser, 2006; Amez, 2013; Clemens, Powell, Mcllwaine & Okamoto, 1995; Hicks & Potter, 1991; Bourke & Butler, 1996; Chi, 2014a). Furthermore, citations to and from books are distributed differently from those to and from journal articles, and often originate from outside the cited work's specialty (Broadus, 1971). Some studies show that books reference more books than articles, and journal articles refer to more articles than books (Larivière, Archambault, Gingras & Vignola-Gagné, 2006; Line, 1979), indicating that citations from journal articles are not the largest source of citations obtained by book publications.

Even though the importance of books in scholarly communication, notably in the social sciences and humanities, was proved by previous studies, only few and small-scale case studies investigating the characteristics of books were conducted by bibliometricians due to the lack of a reliable and comprehensive data source providing citation links. These studies either investigate the citations of so-called non-source items in the references of Web of

Science (WoS) journal papers (Butler & Visser, 2006; Hammarfelt, 2011; Amez, 2013; Chi, 2014a) or analyse citations in other alternative databases such as Google Books or Google Scholar (Kousha & Thelwall, 2009; Kousha, Thelwall & Rezaie, 2011; Samuels, 2011, 2013). All in all, large-scale bibliometric studies analysing the citation patterns of book literature have not been conducted in the past decade.

A new approach to explore citation patterns of books and its limitations

In 2011, Thomson Reuters released a new collection in the WoS, Book Citation Index (BKCI), to allow users to discover book literature and trace its comprehensive citation links alongside journal literature (Adams & Testa, 2011). BKCI covers over 60,000 editorially selected books starting from 2005 with an additional 10,000 new titles each year (Book Citation Index, 2015).

Even though the BKCI broadens the coverage of WoS and allows researchers to tackle studies based on numerous and qualified bibliographic data of books and book chapters in different aspects, the new database is not fully developed yet (Leydesdorff & Felt, 2012; Torres-Salinas, Robinson-García, Jiménez-Contreras & Delgado López-Cózar, 2012; Gorraiz, Purnell & Glänzel, 2013; Torres-Salinas, Robinson-García, Campanario & Delgado López-Cózar, 2013a; Torres-Salinas, Rodríguez-Sánchez, Robinson-García, Fdez-Valdivia & García, 2013b; Torres-Salinas, Robinson-García, Cabezas-Clavijo & Jiménez-Contreras, 2014). Some limitations mentioned in previous studies include:

- Coverage
  BKCI indexes 61% of 60,000 books in the social sciences and humanities (in November 2014, see Book Citation Index, 2015), which is not too arguable due to the nature of the publication behavior of scholars in different fields. However, its indexing bias in terms of language, country, and publisher is large. For example, 96% of the indexed books are written in English (Torres-Salinas et al., 2014) and the United States and England account for 35% of all publications and 75% of publishers in BKCI (Gorraiz et al., 2013; Torres-Salinas et al., 2014). Furthermore, Springer, Palgrave and Routledge alone account for 50% of the total database (Torres-Salinas et al., 2014) evincing a rather high concentration of publishers.
- Completeness of records
  Gorraiz et al. (2013) report the absence of affiliation data in BKCI but it has been confirmed by Torres-Salinas et al. (2014) that their later downloaded data does include affiliation information which could be used to analyse research units such as countries or institutions. Moreover, the low share of BKCI indexed items with references data (<30%, see Chi, 2014b) would also limit the validity of relevant studies.
- Document type classification
  A further limitation of the BKCI comes from the lack of a clear distinction of document types due to the different forms of book literature.
  - *Books*
    Gorraiz et al. (2013) argue that 'book' might be considered to be at a higher hierarchical level as 'journal' instead of being treated as a document type, and consequently point out the lack of cumulative citation counts from different hierarchies in BKCI. It is in line with the warning raised by Leydesdorff and Felt (2012) that monographs may be underrated in terms of citation impact or overrated using publication performance indicators. Furthermore, Gorraiz et al. (2013) question the fuzzy boundaries of subtypes of book and how to treat new editions.

  - *Monographs and edited volumes*

It was discovered that edited books usually have a greater impact than non-edited books (Leydesdorff & Felt 2012, Torres-Salinas et al., 2014, Chi, 2014a; Amez, 2013). This may be because of the effects of working collectively with a more diverse content and the higher average number of book chapters per book (Torres-Salinas et al., 2014). However, a global consensus on how to cite the book editor(s), the book author(s) or the author(s) of the book chapter is lacking (Gorraiz et al., 2013). Even though it is possible to distinguish bibliometrically between monographs and edited volumes among the type 'book', a normalization for the credit of a monograph is required (Leydesdorff & Felt, 2012).

- *Book series and annual series*
  BKCI covers annual series, which are part of the journal and series literature and indexed by other collections of WoS as well. They are assigned to the pubtype 'Journal' in BKCI (the other two pubtypes are 'Books' and 'Books in series'), and all are published by the publisher Annual Reviews. Leydesdorff and Felt (2012) indicate the problems from ignoring differences between book series and annual series. As noticed by Torres-Salinas et al. (2012, 2013b), this publisher presents an outlier pattern showing a behavior more closely linked to journals rather than monographs.

The research purposes of this study

In this study, we analyse and compare BKCI items jointly with journals literature to answer the following open questions based on the revealed limitations of using the database. Some of these questions have already been addressed but not yet answered by, e.g., Adams & Testa (2011) and Gorraiz et al. (2013). These issues apply to differences in citation impact between journal and book literature but also to the question whether edited books with different contributors for each chapter essentially deviate in their citation patterns from their monographic authored counterparts.

1. What is the feature of books in the sciences (including life sciences, natural sciences, technical sciences), social sciences and humanities through the lens of the BKCI?
2. Is there any difference between the ageing of periodical and monographic literature?
3. Is there a difference in citation patterns of edited and authored books?

The findings are expected to allow a better understanding of communication patterns in different publication types and the applicability of the BKCI for building indicators for use in both informetrics studies and research evaluation.

Methodology

Data sources

The complete 2005 volume of the Web of Science Core collection database including the three journal databases Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI) as well as the Book Citation Index (BKCI) has been processed as source documents. The two proceedings editions of the core collection have been excluded because of the large overlap among the book, proceedings and journal databases (cf. Gorraiz et al., 2013). The choice of volume 2005 was made for two reasons, particularly, because 2005 was the first BKCI volume and this allowed us to trace citations till end of 2013, i.e., for a full period of nine years.

In addition, we have split up the BKCI database into two parts, namely those books that could be identified as edited books and the rest, which was considered to refer to authored books. Overlap with proceedings and journals were removed to obtain a correct dataset for the

analysis. Only so-called citable document types have been taken into account, that is, articles, letters and reviews for journals, books and citable book chapters for the BKCI. All documents extracted from the BKCI have been analysed both individually and aggregated to the book level.

Subject classification

All items extracted from the database have been assigned to the 74 individual subfields according to the *modified* Leuven-Budapest classification system. Multiple assignments are quite frequent at this level of granularity. The original scheme was introduced by Glänzel and Schubert (2003) and has been recently modified to provide a better categorisation for the social sciences and humanities. The modified version has been developed for the use with the BKCI but is also fully compatible with the journal and proceedings editions of the WoS Core Collection as it is based on the WoS and Journal Citation Reports (JCR) subject categories. Major fields and subfields in the sciences of the previous version have not been changed. The modified classification scheme is presented in Figure 1.

THE LEUVEN – BUDAPEST CLASSIFICATION SCHEME FOR THE SCIENCES, SOCIAL SCIENCES AND HUMANITIES

0. **MULTIDISCIPLINARY SCIENCES**
   - X0 multidisciplinary sciences

1. **AGRICULTURE & ENVIRONMENT**
   - A1 agricultural science & technology
   - A2 plant & soil science & technology
   - A3 environmental science & technology
   - A4 food & animal science & technology

2. **BIOLOGY (ORGANISMIC & SUPRAORGANISMIC LEVEL)**
   - Z1 animal sciences
   - Z2 aquatic sciences
   - Z3 microbiology
   - Z4 plant sciences
   - Z5 pure & applied ecology
   - Z6 veterinary sciences

3. **BIOSCIENCES (GENERAL, CELLULAR & SUBCELLULAR BIOLOGY; GENETICS)**
   - B0 multidisciplinary biology
   - B1 biochemistry/biophysics/molecular biology
   - B2 cell biology
   - B3 genetics & developmental biology

4. **BIOMEDICAL RESEARCH**
   - R1 anatomy & pathology
   - R2 biomaterials & bioengineering
   - R3 experimental/laboratory medicine
   - R4 pharmacology & toxicology
   - R5 physiology

5. **CLINICAL AND EXPERIMENTAL MEDICINE I (GENERAL & INTERNAL MEDICINE)**
   - I1 cardiovascular & respiratory medicine
   - I2 endocrinology & metabolism
   - I3 general & internal medicine
   - I4 hematology & oncology
   - I5 immunology

6. **CLINICAL AND EXPERIMENTAL MEDICINE II (NON-INTERNAL MEDICINE SPECIALTIES)**
   - M1 age & gender related medicine
   - M2 dentistry
   - M3 dermatology/urogenital system
   - M4 ophthalmology/otolaryngology
   - M5 paramedicine
   - M6 psychiatry & neurology
   - M7 radiology & nuclear medicine
   - M8 rheumatology/orthopedics
   - M9 surgery

7. **NEUROSCIENCE & BEHAVIOR**
   - N1 neurosciences & psychopharmacology
   - N2 psychology & behavioral sciences

8. **CHEMISTRY**
   - C0 multidisciplinary chemistry
   - C1 analytical, inorganic & nuclear chemistry
   - C2 applied chemistry & chemical engineering
   - C3 organic & medicinal chemistry
   - C4 physical chemistry
   - C5 polymer science
   - C6 materials science

9. **PHYSICS**
   - P0 multidisciplinary physics
   - P1 applied physics
   - P2 atomic, molecular & chemical physics
   - P3 classical physics
   - P4 mathematical & theoretical physics
   - P5 particle & nuclear physics
   - P6 physics of solids, fluids and plasmas

10. **GEOSCIENCES & SPACE SCIENCES**
    - G1 astronomy & astrophysics
    - G2 geosciences & technology
    - G3 hydrology/oceanography
    - G4 meteorology/atmospheric & aerospace science & technology
    - G5 mineralogy & petrology

11. **ENGINEERING**
    - E1 computer science/information technology
    - E2 electrical & electronic engineering
    - E3 energy & fuels
    - E4 general & traditional engineering

12. **MATHEMATICS**
    - H1 applied mathematics
    - H2 pure mathematics

13. **SOCIAL SCIENCES I (GENERAL, REGIONAL & COMMUNITY ISSUES)**
    - Y1 education, media & information science
    - Y2 sociology & anthropology
    - Y3 community & social issues

14. **SOCIAL SCIENCES II (ECONOMIC, POLITICAL & LEGAL SCIENCES)**
    - L1 business, economics, planning
    - L2 political science & administration
    - L3 law

15. **ARTS & HUMANITIES**
    - K0 multidisciplinary
    - K1 arts & design
    - K2 architecture
    - K3 history & archaeology
    - K4 philosophy & religion
    - K5 linguistics
    - K6 literature

Figure 1. The modified version of the Leuven-Budapest classification scheme for the WoS.

Data processing

In order to analyse citation impact and ageing patterns over subfields, we have calculated the following statistics:

- Annual citation rates (both increments and cumulated) for the year of publication 2005 (1) till 2013 (9). In this study, however, we only use cumulative citation impact in a three-year (x_3) and a nine-year (x_9) citation window.
- The ratio x_3/x_9 as a kind of prospective Price index and an indicator of ageing.

We have calculated all statistics on the basis of both individual book chapters, where available, and for the complete books. Chapters were considered the equivalent of journal articles in terms of the aggregation level. Unfortunately, chapter-based citation statistics proved not to be reliable since citations to individual chapters could not be identified in many cases as they were assigned to the book in the database. This is not necessarily due to the database producer: often the authors of the citing documents are responsible for this uncertainty. In order to avoid biased indicators or otherwise incomplete or distorted results we decided to use only citation indicators for complete books, which, of course, results in a serious loss of information and a more intricate interpretation. This applies above all to edited books, where chapters are authored by different contributors, and a distinction between different chapters would be of paramount importance.

A further issue is the small size of the publication set resulting from this restriction. We have found many subfields with fewer than 30 books each: This threshold might be critical for the interpretation and reliability of statistics like mean values and shares (e.g., Glänzel & Moed, 2013). Furthermore, we have not assigned books to corporate addresses of authors/editors because the availability of author affiliation in books is rather low (see, e.g., Gorraiz et al., 2013).

Results

It is not the aim of the present paper to study the subject coverage of the BKCI database since, on one hand, we can refer to the study by Adams and Testa (2011) in the context of broader subject areas and, on the other hand, a subject analysis at the level of subject categories can easily be conducted using the analyse tool of the web version of Thomson Reuters WoS Core Collection. Nevertheless we would just like to mention in passing that we can confirm that subfields in the social sciences and humanities have a better representation in the BKCI than in the other databases of the WoS.

Ten subfields had a share larger than 5% in the 2005 volume of the BKCI: Among those 10 subfields applied mathematics was the only representative of the sciences. Slightly more than 12% of all books could be assigned each to business, economics, planning and political science & administration, respectively. All books in the humanities (except for multidisciplinary and arts & design) as well as education, media & information science and sociology & anthropology in the social sciences were among the top ten in terms of subject representation.

In the first step we looked at citation patterns of book and journals literature by disciplines in a nine-year citation window. What we intended to do was not to compare citation impact over across fields but to compare subject-specific citation patterns between journals and books. It is a well-known fact that the subject is one of the factors influencing citation impact; the document type is another one (cf. Glänzel, 2013). Thus the publication type such as journal, proceeding, or monograph is expected to play a role in this context as well. Figure 2 plots the mean citation rates of subfields based on the nine-year citation window of books against the corresponding journal indicators. The volume year of the source items was 2005. Only subfields have been chosen in which at least 30 books have been published in that year. Subfields are ranked according the subfield impact in the BKCI. The results are somewhat unexpected here: Not the life sciences – as expected from journal literature – exhibit the highest citation impact for books but disciplines in chemistry and the geosciences. Consequently, the correlation between the corresponding x_9 values is medium ($r = 0.420$). In this respect, there are no dramatic differences between edited and authored books. The correlation between these two book types with $r = 0.762$ is relatively strong.

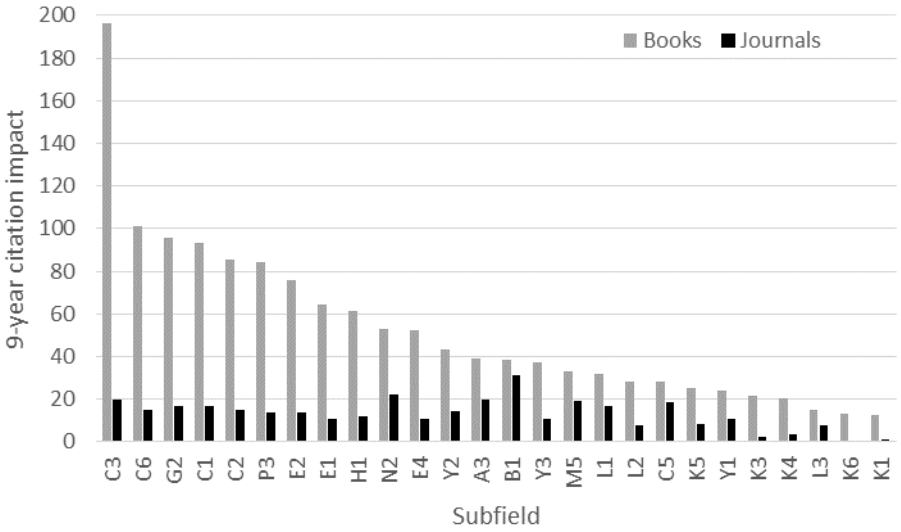

Figure 2. Most cited subfields in the mirror of the BKCI vs. SCIE/SSCI/AHCI. [Data sourced from Thomson Reuters Web of Science Core Collection].

It is known from journal literature that ageing is the fastest in the life and the natural sciences, followed by applied sciences, mathematics, social sciences and humanities (see Glänzel & Schoepflin, 1999). Ageing patterns can be characterised as a combination of phases of maturing and decline in citation processes (Glänzel & Schoepflin, 1995; Moed, van Leeuwen & Reedijk, 1998). The transition from the first to the second phase is marked by a peak in the annual increments of citation impact. This peak ranges according to the ageing of the discipline under study typically between the second and the fifth year beginning with the date of publication. The ratio (x_3/x_9) can thus serve as a proxy for literature ageing in the mirror of citation processes.

The plot of the prospective 'Price Index' (x_3/x_9) of books indexed in the 2005 volume of the BKCI against the corresponding journal indicators for the same volume is shown in Figure 3. The x_3/x_9 ratios are ranked in descending order according to the journal database editions of the WoS. At the left-hand side the disciplines with the fastest aging (highest ratios) can be found, while the low end is formed by slow-ageing subfields (cf. black bars in Figure 3). The grey bars representing the subfields in the BKCI show a rather subject-balanced situation. High (between 20% and 25%) as well as low (between 10% and 15%) shares can be found in both science and SSH subfields. The correlation between the x_3/x_9 ratios for books and journals is practically zero. This is illustrated in Figure 4. We just mention in passing that also the correlation between the corresponding ratios of edited and authored books is low ($r = 0.110$) as well. This substantiates that citation processes of books are more complex as these apparently depend on more factors than in the case of journal literature. Notably ageing seems not to be principally characterised by subject-specific peculiarities. Books are thus more heterogeneous information sources and addressed to more heterogeneous target groups than journals (and possibly proceedings).

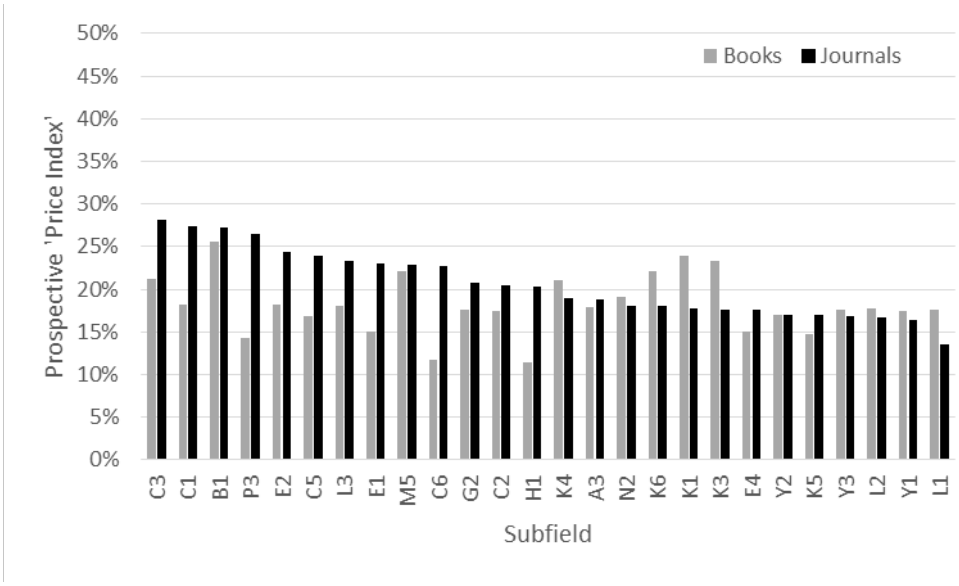

Figure 3. Prospective 'Price Index' of subfields in the BKCI vs. SCIE/SSCI/AHCI. [Data sourced from Thomson Reuters Web of Science Core Collection].

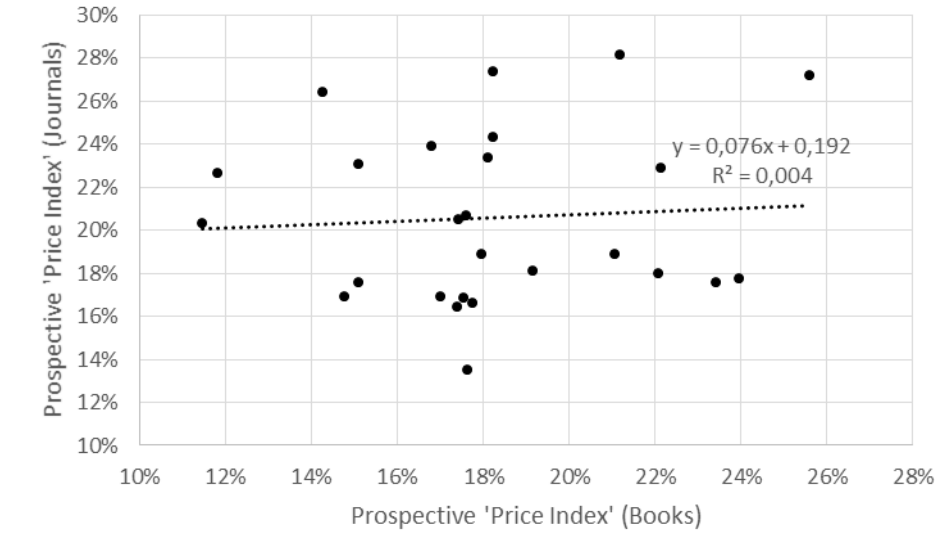

Figure 4. Scatter plot of prospective 'Price Index' of subfields in the BKCI vs. SCIE/SSCI/AHCI. [Data sourced from Thomson Reuters Web of Science Core Collection].

Conclusion

It is confirmed in this study that subfields in the social sciences and humanities have a higher representation in the BKCI (59%) than they have in the other databases of the WoS (12%). Disciplines in chemistry and the geosciences, instead of life sciences, have the highest citation impact for books. Humanities is the field having the highest difference between citation impact of books and journals. In contrast, life sciences have the most similar impact in books and journals. Compared to other sciences, technical sciences have relatively moderate characteristics in different perspectives.

It is not surprising to see that the social sciences and humanities have the largest increase of both the coverage and citation impact in the BKCI compared to journal literature in the other databases of the WoS. The BKCI could be an initial approach to explore wider targets of bibliometric analyses in the social sciences and humanities. The books in the basic sciences have unexpectedly high citation impact, whereas books in the life sciences do not reflect the

dominant position in journal literature but have been found to be on a relatively similar scale of citation counts as journals. This may imply that using BKCI data for bibliometric analyses in basic sciences would be a powerful approach to drag in more citation information.

For the ageing of periodical and monographic literature, the results of this study indicate a clear boundary between the two groups. The differences between books and journals are obvious, but the ageing of books is balanced between subjects. The differences between edited and authored books in terms of the 9-year citation impact are not so impressive as the other group books and journals. However, their disparities in ageing ratios are more evident than those of citation impact. The more complex citation processes of books, compared to journal literature, are shown in this study, the more heterogeneous characteristics of books should therefore be addressed.

The different ageing patterns of book and journal literature, i.e., books do not have as strong discipline specific patterns as journals, may lead to a universal condition for applying or building indicators in the collections of BKCI. It especially needs to be taken into account while designing indicators that are sensitive to the observed citation period. Moreover, the heterogeneous characteristics of books from their different formats such as edited or authored volumes result in more complex citation patterns than journals. These findings on the differences between periodical and monographic literature are worth further studies of indicator design to take into account.

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