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Article — Published Version

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Journal of Economic Surveys

Suggested Citation: Nuredini, Kaltrina (2021) : Investigating altmetric information for the top 1000 journals from Handelsblatt ranking in Economic and Business Studies, Journal of Economic Surveys, ISSN 1467-6419, Wiley, Hoboken, Vol. 35, Iss. 5, pp. 1315-1343, https://doi.org/10.1111/joes.12414

JOURNAL OF ECONOMIC SURVEYS

doi: 10.1111/joes.12414

INVESTIGATING ALTMETRIC INFORMATION FOR THE TOP 1000 JOURNALS FROM HANDELSBLATT RANKING IN ECONOMIC AND BUSINESS STUDIES

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Abstract. In this study, the top 1000 journals from Handelsblatt ranking (often used in German-speaking countries) in Economics (E) and Business Studies (BS) as an extension of the two previous studies from Nuredini and Peters are explored. Moderate shares of articles from E and BS journals for publication years 2011–2018 are found in Mendeley (47%) and Altmetric.com (around 44%). This study shows that altmetric information is significantly higher in coverage for articles published between 2016 and 2017. The top 5 most used altmetric sources for E and BS journals are Twitter, News, Facebook, Blogs, and Policy documents. Top highly ranked journals (with classes A+ and A) in E from Handelsblatt ranking are highly mentioned in Altmetric.com, making them also popular in social media platforms (i.e., attention sources). Mendeley counts are positively correlated with citations both at the article and journal level.

Keywords. Altmetrics; Article level; Economics; Journal level; Journal ranking; Online attention; Readership information

1. Introduction

Ten years ago, a public declaration (manifesto)[1] was made, which considered the rapid increase of scientific output and the growing number of researchers incorporating web tools into their work and suggested new impact filters for sifting scientific literature (Priem *et al*., 2010). The manifesto presented altmetrics as new indicators, which can be gathered from online scholarly tools (e.g., Mendeley) for different scientific outputs (e.g., articles, codes) and show another impact besides citations. Moreover, the manifesto claimed that the three primary existing traditional filters for scientific outputs, namely, peer review, citation counts, and journal impact factor (JIF), are failing.

JIF developed by Science Citation Index (SCI), which is used to assess journal performance based on citations (Garfield, 1972), now maintained from Clarivate Analytics,[2] is by far the most debatable and a number of different limitations have been identified in its usage. For example, JIF considers citations accumulated for articles published in a journal over a two-year period (Seglen, 1997). This two-year citation window only encapsulates the short-term impact of scientific articles and is suggested as problematic because it benefits mostly disciplines that gather citations faster than others (DORA[3] declaration, Seglen, 1997; Larivière and Sugimoto, 2019). Citation counts used for individual articles

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Journal of Economic Surveys (2021) Vol. 35, No. 5, pp. 1315–1343

instead can help to improve the assessment of scientific literature, can help to find relationships between articles, and can be used to discover research trends by finding out how often articles are cited (Lawrence *et al*., 1999). But, for a certain fraction of articles, a large percentage of articles will take at least two years or more (depending on the discipline) to receive the first citations (Brody *et al*., 2006), and second many influential articles might remain uncited (MacRoberts and MacRoberts, 1989). The study of Abramo *et al*. (2011) claimed that the real scientific impact of articles could be properly determined when we observe the citation speed from the date when the article is published. In physics, for example, the peak in citations occurs two years after the article is published, whereas, in mathematics, the peak occurs after five years. In Economic (E) and Business Studies (BS), citation counts are very sparse, meaning that these disciplines need more time to accumulate citations (Sugimoto and Larivière, 2018).

Peer review, known as the mechanism for quality control, is identified as an essential process in science because it allows a research article to be read and scrutinized by experts of the field. This process might be useful to improve the quality of the article and detect errors and fraud (Smith, 2006). However, peer review is also identified as flawed because of its defects. It takes a long time for an article to be reviewed, expensive, highly subjective, bias against authors, etc. (Smith, 2006). Moreover, reviewers' judgments are suggested to be biased because these judgments are based not only on the scientific merit of the article but also on the authors' qualities (Bornmann, 2011).

Altmetrics, according to literature, are complements of traditional indicators for research evaluation (Priem *et al*., 2012; Bar-Ilan *et al*., 2012), suggesting that altmetrics reflect a different type of impact (Loach and Evans, 2015) and that they can be used side by side with citations. A great number of empirical studies have investigated the presence of altmetrics in different disciplines (e.g., health, biomedical research, social science, etc.) considering various altmetric providers. The studies revealed disciplinary differences based on the coverages of articles and correlations with citation counts and altmetric sources represented in altmetric providers (Mohammadi and Thelwall, 2014). Nonetheless, very few studies have investigated altmetrics for E[4] and BS disciplines in particular (Nuredini and Peters, 2015; 2016; Thelwall and Nevill, 2018; Drongstrup *et al*., 2019), especially when considering a larger scale of journals. Drongstrup *et al*. (2019) explored altmetrics in particular "policy counts" and found out that the articles from top journals in E receive higher policy counts. Thelwall and Nevill (2018) studied Altmetric.com for 30 fields where articles indexed in Scopus are categorized, including E. The author suggested that Mendeley counts tracked by Altmetric.com are predictors for future citations in almost all covered disciplines.

Motivated by altmetrics and the demand for more studies needed to investigate these indicators in E fields, this research aims to explore altmetric information for a large scale of E and BS journals. The findings of this study can, for example, contribute to suggesting altmetrics for real-world applications (e.g., libraries), especially those that have an E focus, as a strategy for reducing information overload by providing novel insights for users to filter the needed information. The findings of the studies of Nuredini and Peters (2015, 2016), nevertheless, consider only a small set of journals in E and BS upon which their results are based on. The authors investigated altmetrics from Mendeley and Altmetric.com for journals in Handelsblatt ranking,[5] a journal ranking list based on weighting schemes for two different disciplines E and BS, mainly used in German-speaking countries (i.e., Germany, Austria, and Switzerland; Krapf, 2010). The top 30 journals belong to the most important A+ class journals, according to Handelsblatt ranking. However, this list covers around 2% of the entire journals, and their findings do not highlight the altmetric behavior for lower ranked journals. Nuredini and Peters (2015, 2016) found good coverage of the top 30 journals and their articles within these disciplines; however, they reveal that altmetrics are still sparse even though their presence increased for recently published articles. For this reason, when using altmetrics in libraries, the authors suggested higher aggregation levels, such as journal level can overcome the sparsity of altmetrics for each library records.

This study's scope is to consider a larger number of journals in E and BS, which will extend the knowledge of altmetric information gained from the two previous studies. Specifically, one objective is

to consider journals below class A+ by investigating whether these journals receive any online attention. The coverage of different ranked journals is important in this research because more precise conclusions can be made about altmetrics in these disciplines. Moreover, we can generalize further the findings of two previous studies or highlight new insights instead.

Accordingly, with this research study, the following research questions will be answered:

RQ1. What is the coverage of the top 1000 E and BS journals (articles) from Handelsblatt ranking in Crossref, Mendeley, and Altmetric.com?
RQ2. To what extent readership information from Mendeley and altmetric sources from Altmetric.com are present for E and BS journals?
2.1. Which category of readership information from Mendeley (i.e., academic status, country, and discipline) is mostly used for E and BS literature?
2.2. Concerning altmetric attention sources provided by Altmetric.com (i.e., Twitter, Facebook, blogs, etc.), which sources have higher coverages of E and BS journals/articles?
RQ3. Are highly ranked E and BS journals also popular on social media platforms?

This study is organized as follows: first, a literature review regarding two altmetric providers will be covered; next, the methods and data sources for performing this study will be highlighted. Afterward, altmetrics from Mendeley and Altmetric.com will be shown for the top 1000 journals in E and BS.

2. Literature Review

Altmetric.com is a tool that collects information for research output found online from specific sources, such as social media platforms, traditional media, and online reference managers. Altmetric.com was founded in 2011 by Euan Adie (Liu and Adie, 2013) and in 2012, Altmetric Explorer[6] was released, which enables users (e.g., authors of articles, libraries, researchers) to search their database and find online attention for different scientific outputs. Altmetric.com offers the Altmetric Attention Score,[7] a counting number that shows that the total amount of the attention research outputs (i.e., articles) has already received online from social media sources. The score is based on an algorithm provided by Altmetric.com, weighting[8] different social media sources based on their reach to reflect the relative values of these sources. Altmetric.com monitors 12 types of sources[9] for tracking scientific outputs' online activity (e.g., books, articles, presentations, thesis, and more). Some source types are divided into subtypes; for example, "social media" includes services such as Facebook, Twitter, LinkedIn, Google+, Weibo, and Pinterest or "multimedia sources" includes Youtube, Reddit, and Q&A from Stackoverflow. The sources are tracked based on two methods: (1) by searching them for URLs of scientific articles and (2) by examining a text (e.g., blogs) for mentions based on the article title, journal, or author names.

Another altmetric tool, which is extensively used for exploring scientific articles for altmetric information, or precisely readership information, is Mendeley.[10] Mendeley is a social reference management system that allows users to search for articles, add them to their libraries along with their metadata, and organize them in folders for better retrieval (Mohammadi and Thelwall, 2014). Based on Mendeley's user libraries and demographic data, Mendeley provides readership data, which are seen as altmetric information that shows the early online attention of scientific articles (Maflahi and Thelwall, 2018). Four readership information provided from Mendeley are: reader count, academic status, discipline, and country. Using readership information, one can determine the saving behavior of articles by different user types (e.g., articles read by PhD students, Zahedi *et al*., 2017).

Each article saved in Mendeley has a reader count – a number of unique Mendeley users (or readers) who have saved a given article in their own Mendeley library. However, the reader count does not certainly reflect the "read" activity of articles since the users can save the article in their library but do not necessarily mean that they have read that article (Maflahi and Thelwall, 2018). According to previous

studies, Mendeley reader counts can be used as an early indicator to determine the impact of later citation impact for journal articles (Thelwall, 2018).

Earlier studies of Mendeley have only received the top 3 Mendeley readership categories for each article. Retrieving only the top 3 academic statuses per article as seen as a negative aspect of Mendeley API, since user types, which fall under the top 3 reader groups are not considered and underestimated (Haustein and Larivière, 2014). Nonetheless, Zahedi and Van Eck (2018) performed the first study that covered the full user statistics for each article found in Mendeley without any data restriction (e.g., top 3 reader groups). The authors highlighted that with the advantage of having the full received user statistics from Mendeley, one could determine more insights about the impact of research output saved in Mendeley.

3. Methods and Data Sources

The dataset for this study is formed with the use of journals from Handelsblatt journal ranking. Two separated journal lists from Handelsblatt ranking for both E and BS came in Excel sheets with columns such as journal ISSNs, journal names, and their classes (e.g., A+). Handelsblatt ranking sorts journals according to academic importance: highly cited journals are depicted as A+ and A and are ranked higher than other journals. The remaining journals are listed below and are ranked under classes B, C, D, E, and F (Krapf, 2010).

For E researchers, journal ranking plays a core role, especially when selecting the relevant journals for publishing or reading (Schläpfer, 2012; Aistleitner *et al*., 2018). Even though journal rankings seem to assess research performance and rank journals based on their quality, rankings are constantly criticized (Vogel *et al*., 2017). First, researchers who publish articles in the top journals should adjust their writing style and research, based on journals' criteria and standards. These standards can limit different ways of experimenting and writing research, which might affect innovation and academic freedom.

Several journal rankings have been developed for evaluating the impact of E journals, making it challenging to decide which rankings one should use and for what purpose (Bornmann *et al*., 2018). Some of the popular journal rankings in E and BS beside JIF, according to literature, are Handelsblatt ranking, RePEc,[11] and British Association of Business Schools – ABS (Rafols *et al*., 2012; Stern, 2013; Sturm and Ursprung, 2017). Moreover, Handelsblatt ranking covers all journals that are ranked by Jourqual 2.1,[12] a ranking developed by VHB (German Academic Association for Business Research), journals that belong to the Social Science Citation Index (SSCI), as well as journals that are listed in the Erasmus Research Institute of Management (EJL), making this ranking more correlated to Journal Citation Reports from WoS - Web of Science (Wohlrabe, 2013; Lorenz and Löffler, 2015), compared to other rankings (e.g., RePEc). Handelsblatt ranking ranks journals for two different disciplines: E (in German known as "Volkswirtschaftslehre" – VWL) and BS ("Betriebswirtschaftslehre" – BWL; Krapf, 2010). These rankings are so-called prominent rankings in academia used for research evaluation, which lasted for a long time because of their public visibility and data quality (Sturm and Ursprung, 2017).

The newest Handelsblatt ranking for E journals was published in 2017. This ranking includes the SCImago[13] journal indicator (SJR) that measures the influence of scientific journals based on the number of citations received by the journal (Forschungsmonitoring, 2017). Citations used in the SJR come from the Scopus database. Journals with higher SJR values have greater influence compared to other journals. According to Handelsblatt ranking calculations, the top 5 journals with the highest SJR (i.e., *American Economic Review*, *Econometrica*, *Journal of Political Economy*, *Quarterly Journal of Economics*, and *Review of Economic Studies*) in E receive a weight of 1. Other journals with an SJR score equal to or greater than the average SJR score of the top 5 journals will also gain a weight of 1; specifically, in this ranking, 11 journals have a weight of 1 according to Forschungsmonitoring (2017). Journals selected in Handelsblatt ranking start with a weight of 0.025 and are all journals listed in *EconLit*.[14] *EconLit* is an

E literature database that covers articles published in the field of E beginning in 1969. Following SJR values, journals are classified from A+ to F. Journals with weight one belong to class A+, followed by journals that have the highest SJR values that belong to class A, the remaining journals of the top 10% belong to B, and the journals of 25%, 50%, and 100% are classified to C, D, and E. Lastly, journals that are in *EconLit* but do not have SJR values belong to the class F (Forschungsmonitoring, 2017).

Handelsblatt published the newest ranking for BS journals in 2018. The methodology is described in the Forschungsmonitoring (2018) description document, where two of their weighting schemes are highlighted. The first scheme for ranking BS journals is based on the SJR citations and the second scheme is based on VHB-Jourqual 3,[15] which is published by the members of VHB who arrange the journals in different categories. The SJR scheme is used here similarly as in the ranking for E journals mentioned above. It should be noted that journals listed in VHB-Jourqual include journals that publish interdisciplinary research articles, thus important for the E community. For example, the list[16] contains the journal "Value in Health," which is depicted under the category "Gesundheitswesen" or "Health care system."

The total number of journals in Handelsblatt raking from both disciplines (E and BS) is 3664 (including the identical journals for both disciplines). Our study is focused on the top 500 journals from the E Handelsblatt ranking list (2017) and the top 500 from the BS Handelsblatt ranking list (2018). The reasons we selected the top 500 from each discipline are the following:

(1) *Crossref coverage*: At the beginning of this study, all journals (3664) listed in Handelsblatt ranking for both E and BS disciplines were selected. All journal ISSNs were used to crawl Crossref[17] to retrieve the journal's metadata, especially articles DOIs. Crossref is a data service that provides the connection between journals and articles as well as their metadata and their citations. The DOIs of articles found in E and BS journals were important for this study because for querying altmetric providers (i.e., Mendeley and Altmetric.com) and retrieving altmetric data, article identification numbers were needed. When crawling Crossref for metadata, around 50% of the ISSNs metadata (i.e., DOIs) could not be retrieved from it (e.g., for the journal "Social and Economic Studies"). This issue was addressed to Crossref and they assume that those journals are not indexed in their database. One reason for not finding journals in Crossref can be that publishers perhaps have used other Registration Agencies (e.g., DataCite,[18] mEDRA,[19] etc.) to deposit their journals and articles beside Crossref.

(2) *Journals that don't provide DOIs*: Another possible reason for not indexing these journals in Crossref might be that some journals listed in Handelsblatt ranking do not usually offer DOIs for their publications. For example, the journals "MIT Sloan Management Review," "Land Economics Monographs," "Economia Internazionale," and "Arthaniti," etc., are not found in Crossref because they do not provide DOIs. The article "Can you measure the ROI of your social media marketing" published in the "MIT Sloan Management Review" is found with no available DOI in EconBiz[20] (library portal for E literature) as well as at the journal web page. This issue makes it difficult to crawl altmetric providers and retrieve altmetric information without a DOI.

The journals that are listed in the top 500 are found with good coverage in Crossref (e.g., for BS, 474 journals are found with metadata). The journals listed below 500 for both disciplines were less found because of the issues presented above at (1) and (2). These issues will lead to low article coverages for these journals, which would affect this study's results. The bias would happen when representing different journal coverages. Specifically, some journals (above 500) would present higher numbers of articles where other journals (below 500) would present a lower number of articles. Therefore, to avoid biased coverages between journals caused by missing data, we decided to select the top 500 journals for each discipline. Two different datasets are saved for journals: top 500 journals in BS and top 500 journals in E. Journals that might not be useful for creating the dataset are detected and removed. According to the

study of Nuredini and Peters (2015), multidisciplinary journals like "Nature" or "Science" are excluded from the dataset because of the large number of articles they include, which can lead to bias of the results. The authors mentioned that "Nature" is ranked among the top 15 journals in the Handelsblatt ranking, but because of its comparably large number of articles published (66,813) that would bias the results, "Nature" was excluded and replaced with "Quarterly Journal of Economics" (Nuredini and Peters, 2015; p. 382). Similarly, for this study, "Nature" and "Science" are excluded from the list and are replaced with the following journals right after the top 500.

Additionally, duplicate journals are removed and added other journals that are placed below the 500 for both E and BS journals. For example: in the top five journals, the journal "Energy Policy" is the common journal for E and BS. To avoid duplicates of data for the journal list in E, we removed the "Energy Policy" and replace that journal with the journal ("Economics Letters") following the top 5.

The top 1000 journal ISSNs from both E and BS are checked, updated, and edited for further use. The final list of top 1000 ISSNs is used to query Crossref by ISSN for retrieving the number of articles each journal has as well as their metadata such as DOI, title, publisher, etc. Articles published between January 1, 2011–December 31, 2018 are considered since recently published articles gather more altmetric information than old (e.g., 1994) published articles (Nuredini and Peters, 2016). After retrieving DOIs for each article published in the selected journals, altmetric providers such as Mendeley and Altmetric.com are queried.

The process with crawling Crossref started on February 12, 2019 and ended on February 13, 2019. Mendeley API was crawled using article DOIs, on March 24, 2019 and ended on March 28, 2019. Altmetric.com data were downloaded from Altmetric Explorer on March 28, 2019. Altmetric Explorer was used with a free research-based account. The Altmetric Explorer enables the user to download altmetric information for a set of identifiers (i.e., DOIs, ISSNs, PubMed IDs, etc.). Our study searched Altmetric Explorer for DOIs, where the limited number for each search is 25,000 DOIs. Because of this limitation, the search has been performed multiple times, each chunk containing 25,000 DOIs. The results retrieved from Altmetric.com as .csv files were checked for errors before loading in a database for further analysis.

4. Results

First, Crossref is examined by presenting the metadata and coverage of all articles found for E and BS journals with publication date 2011–2018. Second, Mendeley is investigated for coverage and readership information for the articles DOI found from Crossref. And third, Altmetric.com is explored for altmetric attention score, coverage, and different attention sources for the same articles retrieved from Crossref.

4.1 *Crossref Coverage for Journals in E and BS*

This study identified 621,585 articles from Crossref for the publication years 2011–2018, of which 58% of articles belong to journals in BS and 42% of articles belong to E journals. From the top 1000 journals for both E and BS disciplines, 918 journals (around 92%) are found with metadata in Crossref.

For BS, a total of 474 journals has been found, which is a coverage of 95% (see Table 1). The total number of article DOIs between the publication years 2011–2018 is 359,433 within the BS disciplines and 262,152 within the E disciplines. E journals in Crossref have 89% coverage with 444 ISSNs out of 500 ISSNs, showing a lower coverage compared to BS journals.

The top 10 journals in both E and BS found in Crossref with the highest number of DOIs (or articles published) are identified, which do not necessarily publish only E articles; apart from it, they seem to publish articles in other disciplines and articles that have interdisciplinary research. For example, the journal "Value in Health[21]" publishes literature within the topics in *Pharmacoeconomics*, *Health*

Table 1. Journal Coverage in Crossref for the top 1000 Journals in E and BS.

Top 500 E journals found in Crossref			
Total number of journals	%	Total number of articles (2011–2018)	%
444	89%	262,152	
Top 500 BS journals found in Crossref			
Total number of journals	%	Total number of articles (2011–2018)	%
474	95%	359,433	
Total E and BS journals		**Total E and BS journal articles**	
918	92%	621,585	

Economics, *Outcomes Research*, and *Health Care Research*. The top 10 journals and their journal output (i.e., ISSN, number of DOIs, number of issues per year) can be found in the online Appendix (Table 1). Based on the metadata found in Crossref, three journals (i.e., "Environmental Science and Technology," "Value in Health," and "Journal of Cleaner Production") have published more than 8000 DOIs within eight years. Only one journal in E (i.e., "Energy" with ISSN 0360-5442) has more than 8000 article DOIs found in Crossref.

The general coverage of E and BS journals in Crossref is shown in Table 1. The percentage of total articles found in Crossref for E and BS journals cannot be calculated since the retrieval is based only on the number of articles that Crossref indexed for each journal and not on how many articles the journals publishes in total.

Figure 1 shows the article distribution of the E and BS journals found in Crossref based on publications from 2011 to 2018. Journals that belong to BS appear to have more articles registered in Crossref than journals in E. In 2011, more articles were published and registered in Crossref compared to other publication years for both disciplines E and BS.

However, a considerable drop for articles published between 2014 and 2018 and registered in Crossref is shown. This drop was addressed to Crossref to identify any issue. Crossref confirmed that the data retrieved for this study are properly crawled, and the reason why this drop is presented remains unknown. One assumption for this drop might be that publishers perhaps have used other DOI Registration Agencies (e.g., DataCite, mEDRA, etc.) to deposit articles beside Crossref.

4.2 *Mendeley Coverage for Journals in E and BS*

This section explores Mendeley as a source of altmetrics. A total of 719 (72%) journals from both E and BS that have articles saved in Mendeley has been identified, where 92% of the BS journals and 51% of the E journals are covered in Mendeley. The general coverage of journals and articles in E and BS in

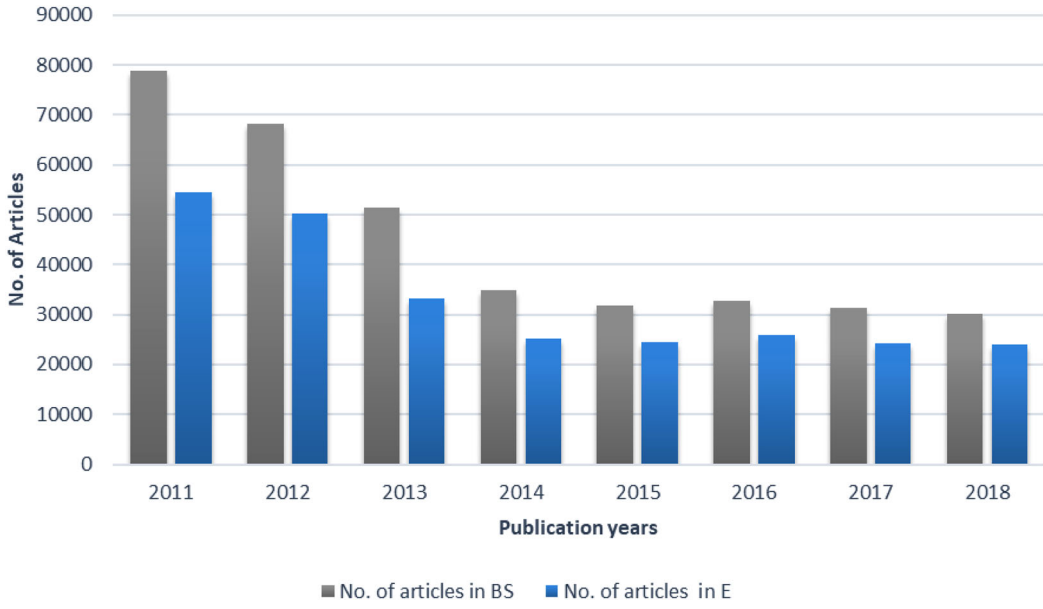

Figure 1. Article Distribution through Years Found in Crossref for E and BS Journals. [Colour figure can be viewed at wileyonlinelibrary.com]

Mendeley is shown in Table 2. From the total number of articles (621,585) in both disciplines, 295,582 (around 48%) are found by the Mendeley crawl. Half of Crossref's articles are not found either because of missing DOIs in Mendeley's metadata or because the articles are not of interest to the Mendeley community. These results confirm other studies when investigating Mendeley's coverage from different disciplines (Mohammadi and Thelwall, 2014; Zahedi e*t al*., 2015).

The BS journals appear to be better present in Mendeley compared to E journals. The number of articles found with DOIs in Mendeley for BS is way broader than for E.

4.2.1 *Mendeley Readership Information: Reader Counts*

In this section, readership counts from Mendeley for E and BS journals are explored. Figure 2 presents the top 10 journals listed in Handelsblatt ranking with the highest readership counts in Mendeley on journal level from both E and BS as well as the number of articles (DOI count) found in Mendeley and Crossref for these journals. The readership count on journal level is calculated by the sum of all counts each article received in a journal. The top 10 journals in BS are presented on the left and the top 10 in E on the right side.

Figure 2 presents that BS journals have higher reader counts in Mendeley than E journals, suggesting that many articles from BS journals are more saved on Mendeley and more read by the Mendeley community than E journals. In BS, the "Journal of Cleaner Production" has the highest Mendeley reader count (354,352) as well as the highest number of articles found in Mendeley (8194). From E journals, "Energy" has the highest Mendeley reader count (246,443) and the highest number of articles found in Mendeley (8526). The journal "*International Journal of Project Management*" from BS falls in the top 10 journals with the highest Mendeley reader counts, but it has the lowest number of published articles compared to

Table 2. Journals and Article Coverage in Mendeley for the Top 1000 Journals in E and BS.

Top 500 E journals found in Mendeley			
Total number of journals	%	Total number of articles	%
257	51%	77,161	29%
Top 500 BS journals found in Mendeley			
Total number of journals	%	Total number of articles	%
462	92%	218,341	61%
Total E and BS journals		**Total E and BS journal articles**	
719	72%	295,582	47%

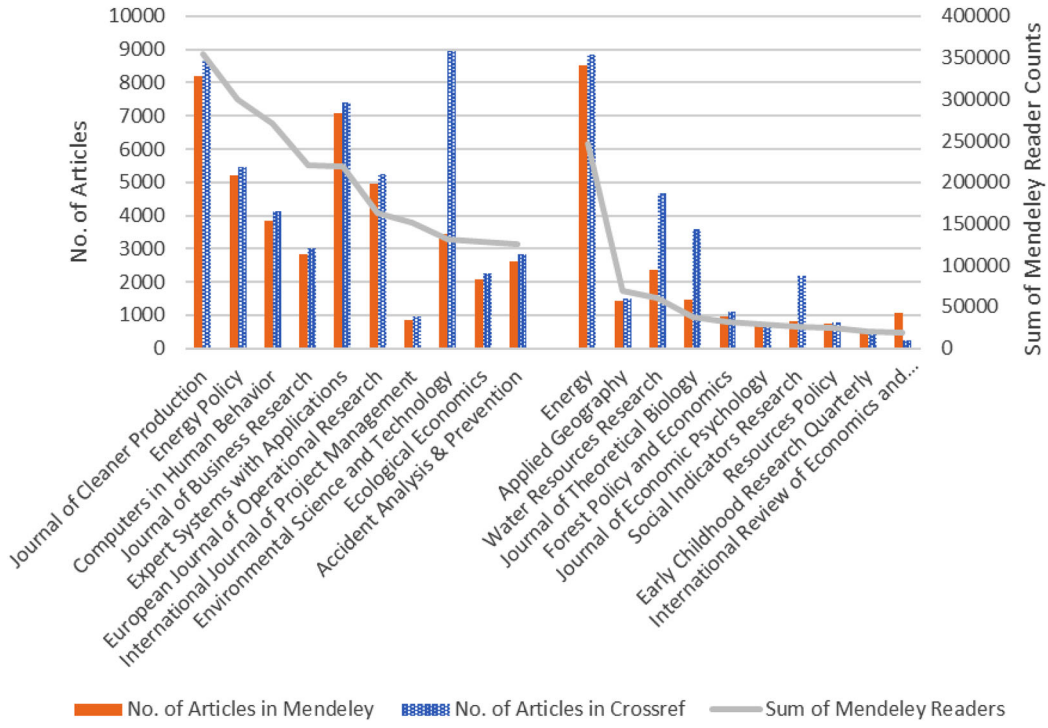

Figure 2. Top 20 Journals with Highest Mendeley Reader Counts in BS and E (Shaded). [Colour figure can be viewed at wileyonlinelibrary.com]

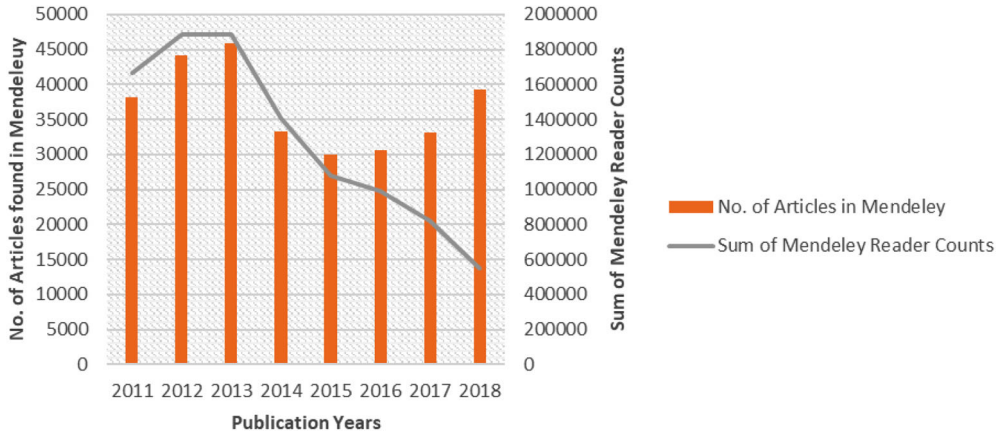

Figure 3. The Year-Wise Distribution of Articles and Readers in Mendeley. [Colour figure can be viewed at wileyonlinelibrary.com]

other journals, even though the article coverage for this journal in Mendeley is around 90%. The "Energy" journal from E is the best covered in Mendeley and "Environmental Science and Technology" is least findable, although it has the largest number of articles published. Since Handeblsblatt raking follows journals, for example, ranked by Jourqual, journals that belong to the SSCI and more – it is important to note that the list contains multidisciplinary journals. The journal "Energy" is listed in Handelsblatt ranking since this journal publishes "Economic"[22] and "Policy issues" articles as well.

The top 20 journals with high Mendeley reader counts for E and BS belong to B and C classes in Handelsblatt ranking. Given this insight, journals that are not highly ranked in Handelsblatt ranking are, however, mostly read in Mendeley. These journals do not necessarily always publish only articles with an E focus but also publish other scientific findings from different disciplines.

One-third (33.83%) of the articles found in Mendeley, which have the highest reader counts, already cover more than 80% of the total readers. Even 5% of articles cover more than 30% of readers (see online Appendix Table 2).

When investigating the readership counts for each publication year and the number of articles found in Mendeley, it can be seen that readers in Mendeley, after a drop from 2013 to 2015, add current articles to their libraries more often each year – resulting in good coverage of newer research. However, when it comes to reader counts, older articles found in Mendeley from publication years 2011–2013 gain comparably higher counts than recently published articles (see Figure 3).

For the publication year 2018, around 72% of articles found in Crossref from both E and BS had at least one Mendeley reader count in Mendeley. The steady increase of Mendeley reader counts for early publications and decreasing patterns of Mendeley reader counts for recently published articles were also spotted in the study of Zahedi *et al*. (2017) for WoS publications between 2004 and 2013 and by Maflahi and Thelwall (2016) for Library and Information Science journals between 1996 and 2013.

Although the coverage of newly published articles (i.e., articles published in 2018) is high in Mendeley (72%), the reader counts for these articles are low compared to other articles published earlier than 2018. In 2018,[23] articles received 33% less Mendeley counts than in 2017. One of the possible reasons that lead to the decrease of Mendeley readership counts for recent publications is that the readers of Mendeley are not aware of very newly published articles and there is a delay until they notice them and save them to their libraries (Zahedi *et al*., 2017). Although Mendeley readership counts seem to have a

strong correlation with citations for journal articles, Mendeley counts can appear one year before citations (Thelwall, 2018). They are seen as more beneficial because of the ability to show an earlier impact of scientific outputs compared to citations (Thelwall, 2017a).

4.2.2 *Mendeley Readership Information: Discipline*

In the study of Nuredini and Peters (2015), 25 disciplines were identified for the top 30 journal articles in BS and E. But, by exploring the top 1000 journals in the similar disciplines (E and BS), 29 different disciplines (see Table 3) are identified in Mendeley. In terms of discipline, when retrieving the data from the Mendeley API, for each article, within this research, we received all possible disciplines that the user might have. Moreover, this study's results cover all disciplines that articles from E and BS journals can receive from its readers.

The discipline names retrieved in 2015 from Mendeley distinct from the names retrieved in 2019. For example, the discipline "Arts and Humanities" retrieved from this study cannot be found in the study of 2015 since Mendeley provided two categories: one for "Arts" and the second category for "Humanities." Besides the new representation of discipline names, Mendeley also added new disciplines that appeared at the 2019 crawl and were not listed in the 2015 study. Four new disciplines are "Veterinary Science," "Immunology and Microbiology," "Energy," and "Decision Sciences." Most of the readers from the journals in BS found in Mendeley have a background in "Business Management and Accounting" where for the journals in E, the readers have a background in "Economics, Econometrics, and Finance."

In Table 3, all the disciplines of all E and BS journals are shown. The first column represents the names of the disciplines that the articles from both E and BS journals received based on Mendeley users. Each discipline in Mendeley has a reader count, which is a number that represents the readers of that particular discipline (in this case, this reader count is named as rcDB for BS and rcDE for E). The rcDB is presented in the second column that lists all the readers each discipline achieved from BS journal articles. rcDB is calculated by the sum of all readers' disciplines each article accumulated and aggregated on discipline level. For example, "Agricultural and Biological Sciences" have 43,460 readers meaning that 0.49% of all Mendeley readers have this discipline saved in their profile information for BS journals. The third column presents the percentage of readers for each discipline.

The percentage of readers for each discipline is calculated with the fraction of:

The percentage (%) of readers for each discipline $= \frac{rcDB}{rc}$ for BS journals and where rc are all reader counts for articles that received readers in Mendeley.

The percentage (%) of readers for each discipline $= \frac{rcDE}{rc}$ for E journals where rc are all reader counts for articles that received readers in Mendeley.

"*The unspecified"* discipline means that none of the users saving these articles into their Mendeley library do show their discipline on their profile and Mendeley categorizes these articles as an unspecified category. Even though only 25.8% of users for both E and BS have their discipline public, more than 90% of articles (268,350) have readers who provide discipline information on their profiles. For BS journals, 6% of the readers are coming from the discipline "Business, Management and Accounting" and for E journals, 8.5% of readers have the same discipline.

Since not all Mendeley users save discipline information on their profiles, another calculation is performed that includes the percentage of readers only for those that have published discipline information on their profiles (rcBD for BS journals and rcED for E journals).

The percentage (%) of readers with shared discipline information $= \frac{rcDB}{rcBD}$ for BS journals and where rcBD are all reader counts for BS articles that received readers in Mendeley.

The percentage (%) of readers with shared discipline information $= \frac{rcDE}{rcED}$ for E journals where rcED are all reader counts for E articles that received readers in Mendeley.

Table 3. Users Discipline for Journal Articles in E and BS.

Disciplines from Mendeley	No. of Readers Per Discipline in BS	% of All Readers for Each Discipline in BS	% of Readers with Published Discipline Information	No. of Readers Per Discipline in E	% of All Readers for Each Discipline in E	% of Readers with Published Discipline Information
Agricultural and Biological Sciences	43,460	0.49%	2.40%	8878	0.62%	1.81%
Arts and Humanities	19,534	0.22%	1.08%	10,063	0.71%	2.05%
Biochemistry, Genetics and Molecular Biology	6138	0.07%	0.34%	1079	0.08%	0.22%
Business, Management and Accounting	546,926	6.14%	30.20%	120,783	8.48%	24.57%
Chemical Engineering	3903	0.04%	0.22%	345	0.02%	0.07%
Chemistry	19,378	0.22%	1.07%	1170	0.08%	0.24%
Computer Science	54,693	0.61%	3.02%	33,667	2.36%	6.85%
Decision Sciences	7574	0.09%	0.42%	2781	0.20%	0.57%
Design	5385	0.06%	0.30%	3272	0.23%	0.67%
Earth and Planetary Sciences	17,247	0.19%	0.95%	3144	0.22%	0.64%
Economics, Econometrics and Finance	322,643	3.62%	17.82%	29,060	2.04%	5.91%
Energy	4043	0.05%	0.22%	1452	0.10%	0.30%
Engineering	83,345	0.94%	4.60%	67,472	4.74%	13.72%
Environmental Science	81,576	0.92%	4.50%	12,091	0.85%	2.46%
Immunology and Microbiology	855	0.01%	0.05%	158	0.01%	0.03%
Linguistics	3039	0.03%	0.17%	1723	0.12%	0.35%
Materials Science	3570	0.04%	0.20%	733	0.05%	0.15%
Mathematics	26,616	0.30%	1.47%	4052	0.28%	0.82%
Medicine and Dentistry	15,524	0.17%	0.86%	9291	0.65%	1.89%
Neuroscience	5459	0.06%	0.30%	1250	0.09%	0.25%
Nursing and Health Professions	4424	0.05%	0.24%	3878	0.27%	0.79%
Pharmacology, Toxicology and Pharmaceutical Science	1367	0.02%	0.08%	388	0.03%	0.08%

(*Continued*)

Table 3. (Continued).

Disciplines from Mendeley	No. of Readers Per Discipline in BS	% of All Readers for Each Discipline in BS	% of Readers with Published Discipline Information	No. of Readers Per Discipline in E	% of All Readers for Each Discipline in E	% of Readers with Published Discipline Information
Philosophy	3146	0.04%	0.17%	1028	0.07%	0.21%
Physics and Astronomy	4807	0.05%	0.27%	1334	0.09%	0.27%
Psychology	109,088	1.23%	6.02%	34,984	2.46%	7.12%
Social Sciences	215,840	2.42%	11.92%	75,745	5.32%	15.41%
Sports and Recreations	2551	0.03%	0.14%	3819	0.27%	0.78%
Unspecified	198,206	2.23%	10.95%	57,891	4.07%	11.77%
Veterinary Science and Veterinary Medicine	461	0.01%	0.03%	134	0.01%	0.03%

For BS journals, 30% of readers and for E journals 24.6% with published discipline information on their profile are coming from Business Management and Accounting discipline.

4.2.3 *Mendeley Readership Information: Academic Status*

Mendeley's academic status is another important readership information that helps determine the impact the research articles have based on readers' academic status. This readership can affect the usage of research articles; for example, Mohammadi *et al*. (2015) found out that younger researchers read and cite more articles in contrast to senior researchers. Additionally, PhD students seem to browse and often use articles more than professors. In this study, the full scale of Mendeley data is retrieved and the results are based on all academic statuses of Mendeley users that read journals in E and BS.

Early studies on Mendeley readership information confirm that PhD students are the core Mendeley readers for different disciplines performed by various research studies (Haustein and Larivière, 2014; Mohammadi *et al*., 2015; Nuredini and Peters, 2015). For example, Mohammadi *et al*. (2015) explored Mendeley user categories for different research fields (i.e., clinical medicine, engineering and technology, social science, physics, and chemistry) and found out that the majority of Mendeley readers are PhD Students (90.7%). This study, similar to earlier studies performed for Mendeley, found out that PhDs are the core readers of E and BS journal articles. In Table 4, all occupational categories from Mendeley, however, restricted to our 1000 journals, are merged and shown additionally with the percentage of readers counts received in E and BS journals.

PhD students are the central Mendeley readers for both E and BS journals and are represented with 35% for BS journals and 33% for E journals (see Table 4). Next, master students are found with 23% for BS and 22% for E journals. The number of readers for BS and E journals is calculated based on the sum of counts each academic status received for all journals. The "% of readers" is the number of readers for each academic status over the total number of readers who have academic statuses.

Several academic statuses listed by Mendeley are comparable, for example, PhD student and doctoral student or master students and postgraduates. Following the study of Mohammadi *et al*. (2015) and

Table 4. Percentage of Readers for Each Academic Status in Both BS and E Journals.

Business Studies Journals			Economics Journals			
Academic Status	No. of Readers	% of Readers in BS	Academic Status	No. of Readers	% of Readers in E	Category Type
Student > PhDStudent	3,095,007	34.75%	Student > PhD Student	475,982	33.43%	Scientific
Student > Master	2,076,096	23.31%	Student > Master	308,386	21.66%	Educational
Researcher	865,264	9.71%	Researcher	176,777	12.41%	Scientific
Student > Bachelor	738,669	8.29%	Student > Bachelor	115,408	8.10%	Educational
Professor > Associate Professor	546,976	6.14%	Professor > Associate Professor	89,088	6.25%	Scientific
Professor	363,942	4.08%	Professor	58,579	4.11%	Scientific
Lecturer	299,066	3.35%	Lecturer	47,980	3.37%	Educational
Librarian	57,127	0.64%	Librarian	9642	0.67%	Professional
Other	268,839	3.01%	Other	44,128	3.09%	Professional
Unspecified	603,281	6.77%	Unspecified	99,687	7.00%	Unspecified

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Table 5. Percentage of Readers in the Top 15 Countries for BS and E Journals.

Country	No. of Readers in BS	% of Readers in BS	Country	No. of Readers in E	% of Readers in E
United States	87,249	15.83%	United States	15,580	17.93%
United Kingdom	59,074	10.72%	United Kingdom	9369	10.78%
Brazil	39,905	7.24%	Brazil	4915	5.66%
Germany	37,639	6.83%	Germany	4898	5.64%
Spain	23,459	4.26%	Spain	3404	3.92%
Netherlands	16,244	2.95%	Colombia	3124	3.59%
Portugal	15,729	2.85%	Japan	2741	3.15%
Malaysia	14,879	2.7%	India	2656	3.06%
Canada	14,298	2.59%	Canada	2407	2.77%
India	14,226	2.58%	Italy	2391	2.75%
Indonesia	14,185	2.57%	France	2226	2.56%
France	13,916	2.52%	Netherlands	2143	2.47%
Italy	13,509	2.45%	Malaysia	2079	2.39%
Japan	12,923	2.34%	Portugal	1997	2.3%
Colombia	12,658	2.3%	Australia	1858	2.14%

Haustein and Larivière (2014), Mendeley's academic statuses are merged into single fields (see Table 4). For example, assistant professor and lecturer are merged into assistant professors, which are intended for the educational category. Associate Professor and Senior Lecturer are merged to associate professor, PhD student is merged with doctoral student and categorized as scientific, and master student is merged with postgraduate student into the category of educational. Besides the publication year 2013, where Master students are identified as main readers in our dataset, from 2011 to 2018, PhD students are the leading readers in Mendeley identified with the highest counts.

For both E and BS journals, most of the readers are scientific; very few readers of these journals are professional (e.g., librarians). The grouping of the academic statuses shows how research articles are used by different user types, reflecting their role and purpose when using Mendeley (Zahedi and Van Eck, 2018). For example, the scientific group that includes professors and PhD students, assumably use Mendeley for publishing where, on the other hand, master students and bachelor students reflect more on the educational way of using the literature.

4.2.4 *Mendeley Readership Information: Country*

Among 195 countries around the world,[24] Mendeley users for articles in E and BS are coming from 119 different countries. The top 15 countries for E and B journals are shown in Table 5. The top 3 countries with the most readers in E and BS are the United States, the United Kingdom, and Brazil.

Country readership information from Mendeley is found for 146,484 or 49.5% of articles. The Mendeley readership information country is calculated based on the users' demographic information on their profiles for users who have saved articles from the top 1000 journals in their Mendeley library.

Around 16% of the readers for journals in BS are coming from the United States, about 11% from the United Kingdom, and 7% from Brazil. The readers for E journals have similar countries but with less

Table 6. Journals and Article Coverage in Altmetric.com for the top 1000 Journals in Economics and Business Studies.

Top 500 E journals found in Altmetric.com			
Total number of journals	%	Total number of articles	%
438	87.6%	106,649	40.6%
Top 500 BS journals found in Altmetric.com			
Total number of journals	%	Total number of articles	%
475	95%	165,856	46%
Total E and BS journals		**Total E and BS journal articles**	
913	91.3%	272,507	43.8%

number of readers. In general, 4.4% of all users (who have saved at least one of the top 1000 journal articles from E or BS) have provided country information in their Mendeley profile. While 22.6% of users are found with academic status and 25.8% of users have discipline information in their profile.

4.3 *Altmetric.com Coverage for Journals in E and BS*

Within this section, Altmetric.com is explored and a total of 913 (91.3%) journals from both E and BS that have articles saved in Altmetric.com. BS journals are found with 95% and E journals are found with 87.6%. The general coverage of journals from E and BS in Altmetric.com is shown in Table 6.

In Crossref, a total of 621,585 research articles from both disciplines are found, of which 272,507 (43.8%) articles are found in Altmetric.com with DOIs. Although less than 50% of articles are found with altmetrics, most of the journals are saved at least once in Altmetric.com. Different disciplines have different coverages of articles represented in Altmetric.com. For example, in the study of Costas *et al*. (2015), social sciences and humanities articles are covered with 22% and life and earth sciences with 20%. In contrast, natural sciences, engineering, mathematics, and computer science are covered with less than 10%.

4.3.1 *Altmetric Attention Score*

In this section, the AAS for the journals in E and BS is examined. Figure 4 presents the top 10 journals from E and BS that have the highest AAS, which is the sum of all articles' AAS. The first five journals shown in green have the highest AAS in BS and the other five belong to the E journals with the highest AAS, shown in blue shaded. The journal "Psychological Science" has the highest AAS (149,303), which is 10% of the total AAS accumulated by all BS journals in this study.

The journal "Environmental Science & Technology" has the highest number of articles compared to other journals shown in Figure 4, meaning that its articles are at least mentioned online in average. For E

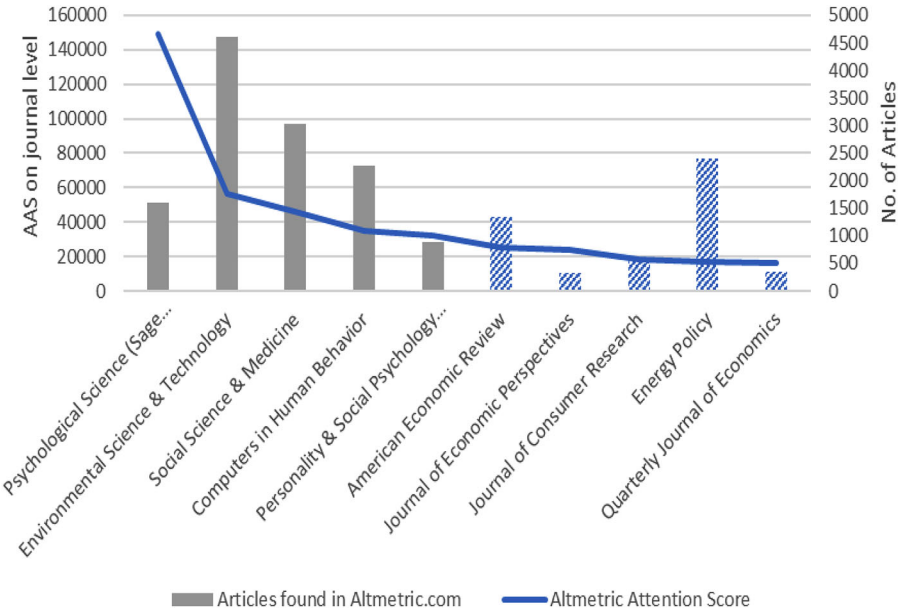

Figure 4. Top 10 Journals with Highest AAS in BS and E (Shaded). [Colour figure can be viewed at wileyonlinelibrary.com]

journals, "American Economic Review" is identified with the highest Altmetric Score of 25,023, which is 4% of the total AAS accumulated by all E journals in this study.

The E journals "American Economic Review," "Journal of Economic Perspectives," "Journal of Consumer Research," and "Quarterly Journal of Economics" all belong to the classes A+ or A in the Handelsblatt ranking. These journals are highly ranked based on Handelsblatt ranking and also have received a higher AAS than other journals.

According to the top 5 highly ranked journals in E, we can suggest that these journals are also popular on social media platforms. On the other hand, the top 5 journals from BS that received high AAS, fall into the classes B, C, or D in Handelsblatt ranking but also are identified as journals that include articles of different disciplines (e.g., not necessarily publish only E articles). These journals do not belong to the highly ranked classes A or A+, but they can be popular on social media platforms.

Additionally, the normalized AAS for the journals of E and BS are examined. Figure 5 presents the top 10 journals from E and BS that have the highest normalized AAS, which is calculated by dividing the AAS via the number of articles for each journal. Compared to the results retrieved from Figure 4, only the journal "Psychological Science" from BS journals is found in both investigations, whereas the other four are different. From E journals, "Journal of Economic Perspectives" and "Quarterly Journal of Economics" are found in both investigations. The other journals retrieved with high normalized AAS have published a lower number of articles than the journals mentioned in Figure 4 with the highest AAS. Additionally, these journals have mostly an E rather than heterogeneous focus (e.g., like social science and medicine).

Huang (2016) studied the correlation between the quality and quantity of journal publication among different disciplines and found a positive correlation between the number of articles and the journal's impact factor. The author highlighted that journals with a high impact publish more articles. With this

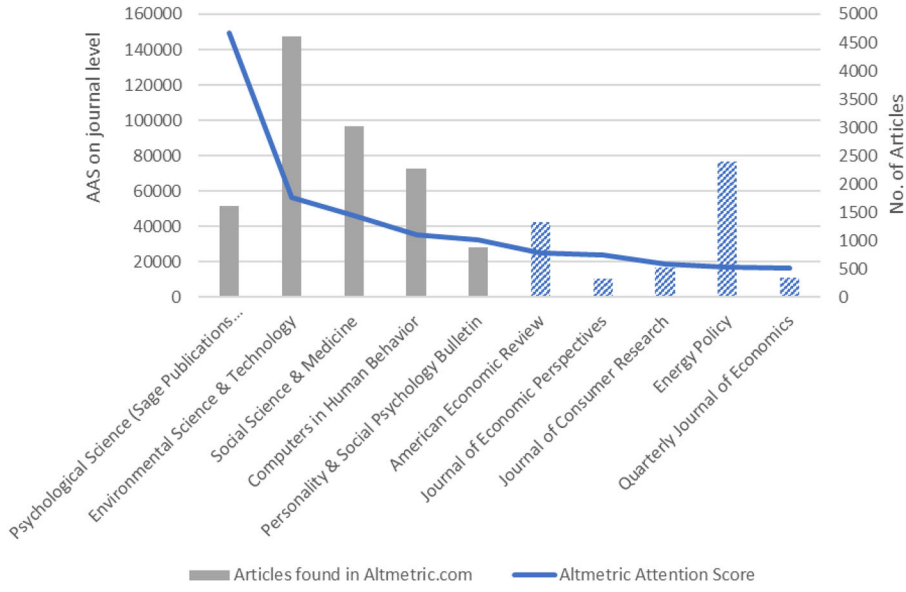

Figure 5. Top 10 Journals with the Highest Normalized AAS in BS and E (Shaded). [Colour figure can be viewed at wileyonlinelibrary.com]

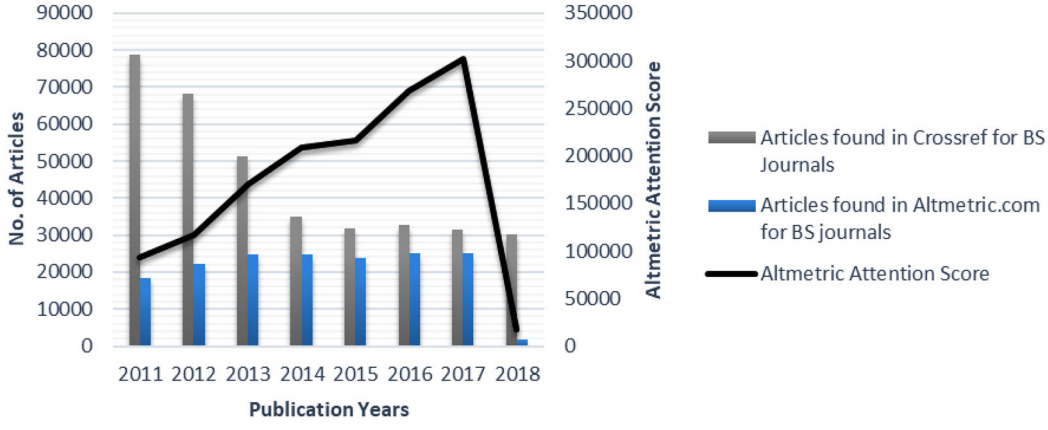

Figure 6. Year-Wise Representation of Articles Found in Crossref and Altmetric.com for Business Studies Journals. [Colour figure can be viewed at wileyonlinelibrary.com]

investigation, using the highest AAS, journals that publish more articles are identified, whereas using the normalized AAS, journals that publish fewer articles are identified instead.

Figure 6 and Figure 7 show a year-wise representation of the total number of articles found in Crossref and Altmetric.com for journals in BS and E and the sum of their AAS received online for each publication year. In Figure 6, although the number of articles published found from Crossref is higher in 2011, the coverage of articles in Altmetric.com is greater for the years 2017 (15%) and 2013 (14.9 %) as for 2011.

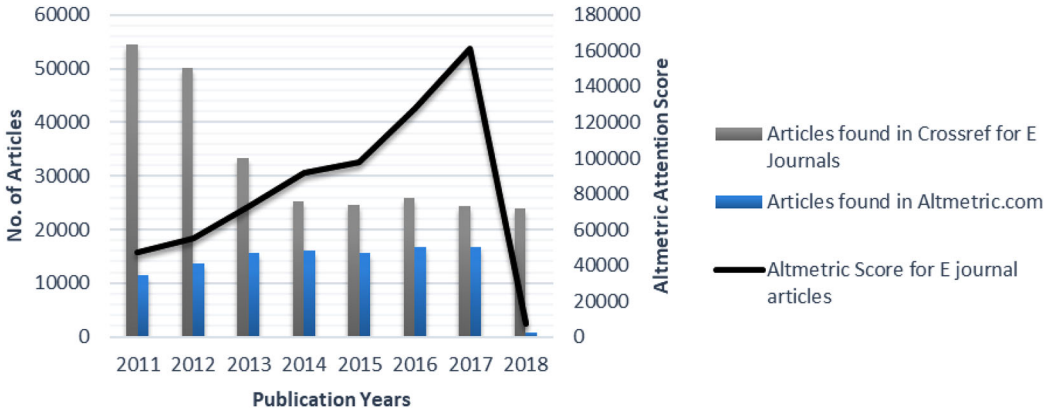

Figure 7. Year-Wise Representation of Articles Found in Crossref and Altmetric.com for Economic Journals. [Colour figure can be viewed at wileyonlinelibrary.com]

The year 2018 has a very low coverage of journal articles in Altmetric.com (3.4% found with altmetrics) and therefore the lowest coverage of AAS (7322).

Similarly, like BS journal articles, E journal articles (see Figure 7) also have a higher AAS in the publication year 2017. The coverage of articles published in 2018 is higher for E journals than for BS journals. Current published research is being more often shared than the older articles from 2011. The AAS for both E and BS journals is significantly increasing by around 23% on average each year from 2011 to 2017.

The reason for finding more articles published in 2017 with altmetrics might be that Altmetric.com tracks recent publication years of articles. Articles published in 2016 have 24% more shares than articles published in 2015 and articles published in 2017 have 39% more attention than those in 2015. Our results show that Altmetric Attention Scores are increasing over time; present articles gain more attention than the older ones beside the publication year 2018. In 2018, a low number of articles and low altmetric shares are retrieved. The decrease of the article coverage and article attention for this publication year might be because, in our dataset, 2018 is the last publication year explored for altmetrics, meaning that it includes articles published recently. Articles in 2018 still need some time to accumulate altmetrics, suggesting that general altmetric scores from Altmetric.com may not be as immediate as anticipated. For articles to collect more coverage and shares, according to Yu *et al*. (2017), altmetrics need a particular time and they can appear starting from 180 to 364 days after article publication. Yu *et al*. (2017) explored the different levels of the immediacy of altmetrics, specifically between Weibo altmetrics Twitter and general altmetrics from Altmetric.com. Based on this insight, E and BS articles published in 2018 and retrieved with altmetric information in early 2019 have low altmetric coverage and shares because more time is possibly needed to accumulate altmetric information.

Fang and Costas (2020) explored the immediacy of altmetrics from Altmetric.com for WoS articles published between 2012 and 2016 and have a DOI. They found out that the immediacy of altmetrics depends on the Altmetric Attention Sources tracked by Altmetric.com, the type of document that is shared online as well as the discipline of that research work. Some Altmetric Attention sources (e.g., Twitter) collect altmetrics as soon as the article is published online, whereas sources such as policy documents, for example, accumulate online attention slowly. Documents such as "Editorial material" and "Letters" collect faster altmetrics than the type "Review" and "journal articles." The authors also highlighted that the discipline "Physical Sciences and Engineering" and "Life and Earth Sciences" collect

Table 7. Distribution of Articles from E Journals within Different Altmetric Attention Sources.

Altmetric Attention Sources	Total Number of Articles per Source	% of Total Number of Articles per Source	Total Number of Counts per Source	% of Total Number of Counts per Source
News	7142	6.60%	28,229	5.15%
Blogs	9994	9.23%	16,119	2.94%
Policy	10,439	9.64%	17,664	3.22%
Patent	241	0.22%	373	0.07%
Twitter	62,733	57.98%	457,999	83.69%
Peer review	86	0.08%	103	0.01%
Weibo	226	0.21%	403	0.07%
Facebook	11,745	11%	18,448	3.37%
Wikipedia	2776	2.57%	3577	0.65%
Google +	1514	1.39%	2437	0.44%
LinkedIn	10	0.009%	10	0.001%
Reddit	834	0.77%	1319	0.24%
Pinterest	16	0.01%	19	0.003%
F1000	83	0.07%	86	0.015%
Q&A	109	0.10%	124	0.022%
Videos	237	0.22%	308	0.05%
Syllabi	0	0%	0	0%

faster altmetrics from different Altmetric Attention Sources compared to other disciplines such as "Social Science," "Biomedical and Health Sciences," "Mathematics," and "Computer Science."

4.3.2 *Altmetric Attention Sources*

When exploring Altmetric.com, it should be noted that although Altmetric.com shows that Mendeley reader counts for each research article, the AAS is calculated only for those articles for which at least one other social media metric (such as Twitter, News, etc.) has been found. Mendeley is not included in the AAS[25] of Altmetric.com. Hence, some studies working with this provider's data exclude Mendeley (data tracked by Altmetric.com) from their analyses (e.g., Costas *et al*., 2015).

Nineteen different Altmetric Attention Sources are identified while exploring Altmetric.com data for our top journals in E and BS (see online Appendix Table 3). The categorization of Altmetric Attention Sources is based on the Altmetric.com general information page about its sources.[26]

Table 7 provides information for Altmetric Attention Sources for journals in E. The total number of articles found in the sources shows the number of DOIs found in Altmetric.com that accumulated attention in each of the sources. Nevertheless, some articles are found both on Twitter as well as in blogs or other Attention Sources.

The "Total No. of counts per Source" is calculated by the sum of each count the source has reached. The "% of Total No. of articles per Source" is the total number of articles found per each source divided by the total number of articles found generally in Altmetric.com. The "% of Total No. of counts per Source" is the sum of all counts per each source divided by the sum of all counts for all sources. For E journals, Twitter has the highest coverage of articles (around 58%), followed by Facebook with 11% and

Table 8. Distribution of Articles from BS Journals within Different Altmetric Attention Sources.

Altmetric Attention Sources	Total Number of Articles per Source	% of Total Number of Articles per Source	Total Number of Counts per Source	% of Total Number of Counts per Source
News	13,228	7.03%	84,417	7.03%
Blogs	16,365	8.94%	30,170	2.51%
Policy	13,187	7.20%	21,515	1.79%
Patent	1005	0.18%	2249	0.18%
Twitter	103,697	56.62%	1,001,988	83.47%
Peer review	2055	1.12%	2490	0.20%
Weibo	371	0.20%	938	0.08%
Facebook	21,732	11%	37,988	3.16%
Wikipedia	4459	2.43%	5676	0.47%
Google +	3913	2.13%	8574	0.71%
LinkedIn	92	0.05%	99	0.0008%
Reddit	1621	0.88%	2566	0.21%
Pinterest	32	0.02%	34	0.003%
F1000	163	0.09%	169	0.01%
Q&A	199	0.11%	236	0.02%
Videos	834	0.50%	1080	0.09%
Syllabi	1	0.0006%	102	0.008%

Policy Posts with 9.6%. Twitter is, respectively, the most active medium for mentioning E journal articles. Besides the highest coverage of articles, Twitter also has the highest number of shares with 83.7%.

Similarly, Altmetric Attention Sources for journals in BS are shown in Table 8. Journal articles in BS are mostly found on Twitter with 103,697 (56.6%) articles of which have a total of 83.5% of Tweets, Facebook with 11%, and blogs with 8.94%. Twitter is also the medium in which BS journal articles are frequently mentioned. These results are similar to Hassan et al. (2017) findings, highlighting that Twitter has a higher coverage of articles and altmetric attention than other social media sources.

Since Mendeley data tracked from Altmetric.com are not considered at the AAS calculation, Mendeley is calculated separately from the aforementioned sources. In E, 104,171 articles are found with Mendeley saves, which covers 97.7% of articles retrieved with altmetrics. BS journals with Mendeley saves are found 162,890 articles that cover 98% of articles retrieved with altmetrics.

Based on the retrieved data from Altmetric.com, 2% of articles (3167) from BS journals only have accumulated Mendeley reader counts and have not received any extra attention from other sources, and for E journals, 2762 (2.6%) articles have only Mendeley counts. These types of articles are not counted in the calculation of AAS. There are 46,520 articles with AAS = 0 for BS and 32,065 for E. Mendeley is by far the most prominent attention source for both E and BS journals. For BS, 98.2% of articles found in Altmetric.com have at least one Mendeley count and so do 89% of articles from E journals.

4.3.3 *Correlation of Citation Counts and Altmetrics*

This section explores the correlation between the citation counts retrieved from Dimensions badges in Altmetric.com and altmetric information (e.g., Tweets and Mendeley Readership counts). The

Dimensions[27] database was launched in 2018, consisting of 128 million documents, of which 89 million are articles (e.g., from journals or conference proceedings) and the rest are patents, clinical trials, policy documents, etc. (Orduña-Malea and López-Cózar, 2018). The Dimensions database is partly free of access and partially paid and attaches citation data for 50 million documents and altmetric data for 9 million documents.

We use the Spearman correlation ρ instead of the Pearson correlation r to explore the correlation between citation counts and altmetrics because of the skewness of our data (Thelwall, 2018). The calculation of the Spearman correlation is performed in SPSS[28] – software used for advanced statistical analysis. The Spearman correlation is calculated for article level and journal level. For article level, Spearman correlation is calculated between citations, Altmetric Attention Score, Twitter (Tweets), and Mendeley readership counts.

The correlation between Dimensions citations and AAS on article level for BS journals is $\rho = 0.106$, showing that there is a very low correlation between these two variables. Similarly, a low correlation is spotted on article level for E journals between those two variables is $\rho = 0.110$. Tweets are very low or not correlated with citations from Dimensions on article level for BS, $\rho = -0.020$, and E, $\rho = -0.038$. Another interesting insight from the correlation on article level is that Mendeley readership counts have a strong and positive correlation with Dimensions citations on article level. The Spearman correlation for BS journals on article level is $\rho = 0.705$ and for E journals, it is $\rho = 0.730$, suggesting that articles with high Mendeley count most likely also have high citation counts. The Spearman correlations on article level are shown in online Appendix (Table 4 for BS journals and Table 5 for E journals).

The Spearman correlation on journal level between citation counts from Dimensions, Altmetric Attention Scores, Twitter, and Mendeley readership counts is calculated. For BS journals, we spotted a strong correlation $\rho = 0.732$ between citations and the AAS (see online Appendix Table 6). For E journals, this correlation is higher than for BS journals with a value of $\rho = 0.814$ (see online Appendix Table 7).

We also calculated the correlation between Tweets and citations from Dimensions on journal level resulting in a strong correlation for BS journals with $\rho = 0.666$ and $\rho = 0.739$ for E journals. Another strong correlation is found between the Mendeley counts and Dimensions citations. For journals in BS, the correlation is $\rho = 0.958$ and for E journals, it is $\rho = 0.970$, denoting that highly saved journals in Mendeley seem to be highly cited as well.

We also calculated the correlation between citations from Dimensions and Altmetric Attention Sources. The Spearman correlation between Blogs and citations for BS journals is found with $\rho = 0.618$, which shows a positive correlation; however, this value is lower compared to other sources (e.g., Mendeley). News is identified with a Spearman correlation $\rho = 0.694$ for BS journals and $\rho = 0.762$ for E journals, showing a strong and significant correlation, especially for E journals.

The correlations found in this study between different indicators are generally stronger on journal level than on article level. This happens because a great number of articles have low values or even no values at all for some of the indicators, which has a negative effect on the correlations. By summing up multiple articles for higher aggregation (i.e., journal level), this negative effect of those articles is reduced, leading to stronger correlated values. Similar findings have been highlighted in the study of Costas *et al*. (2015) as well.

Within this study, the Spearman correlation between citation counts from Dimensions with AAS and Mendeley counts for articles grouped based on their publication years (see Figure 8) is calculated. These correlations are performed for both E and BS journal articles. The correlation between citation counts and AAS is positive but low. The correlations seem to be stronger for articles published in 2011, followed by a drop of the Spearman coefficient each year.

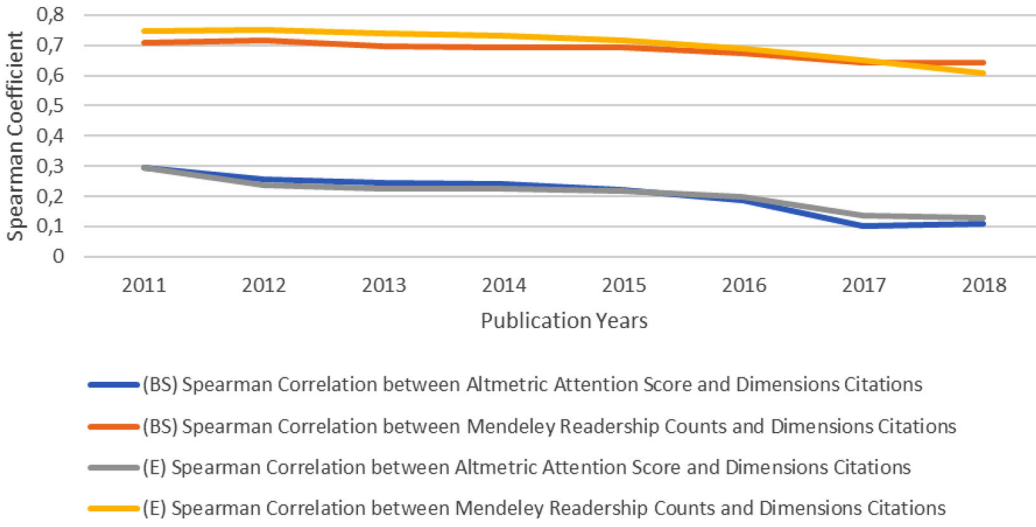

Figure 8. Year-Wise Spearman Correlation for Articles in E and BS between Altmetric Attention Scores, Mendeley, and Citation Counts. [Colour figure can be viewed at wileyonlinelibrary.com]

5. Conclusion

From the top 1000 E and BS journals in Handelsblatt ranking, in Crossref, 92% of journals with article DOIs and their metadata has been found. In Mendeley, 72% of journals with article publication years 2011–2018 are found, of which around 48% of articles have at least one Mendeley reader. BS journals are more findable in Mendeley compared to E, in which similar results are also found within the study of Nuredini and Peters (2015), with the top 30 journals. In Altmetric.com, 91.3% of E and BS journals are found, and moderate shares of articles (around 44%) for publication years 2011–2018 are discovered. However, the publication year 2011 includes full-scale Almetric.com data from July 2011 and onward; therefore, when considering a full-scale altmetrics for libraries, altmetrics from the publication year 2012 are suggested for use instead (Thelwall *et al*., 2013). Moreover, this analysis reveals that altmetrics from both providers are still sparse, even when considering many journals and articles. Therefore, when using altmetrics for library portals, especially those with E focus, journal level aggregations are suggested since, for each library record, altmetric information could be shown. These findings relate to the earlier results of Nuredini and Peters (2016).

The AAS for both E and BS journals is significantly increasing by around 23% on average each year from 2011 to 2017. The ASS trend shows that altmetrics for articles published between 2012 and 2017 could be used as helpful sources in library systems, for example, for filtering research trends (articles published within the past two years and having received high online attention).

Mendeley readership information such as discipline, academic status, and country tend to show users' reading behavior in Mendeley for both E and BS journal articles. These fields are not mandatory; therefore, only 4.4% of all users (who have saved at least one of the top 1000 journal articles from E or BS) have provided country information in their Mendeley profile. A total of 22.6% of users are found with academic status and 25.8% of users have discipline information in their profile. Compared with the earlier Mendeley research for E and BS journals (Nuredini and Peters, 2015, 2016) that only considered the top 3 user statistics for each article, within this research study, the behavior of Mendeley readers can be correctly determined because the results are based upon all Mendeley readership information for

each article. Based on the insights, E and BS journals generally have similar Mendeley user patterns independently of the journals' position in the Handelsblatt ranking. For example, in Mendeley, most of the central users are PhDs, which this fact is confirmed within this study and in the study of Nuredini and Peters (2015) that investigated Mendeley only for the top 30 journals. Given this case, Mendeley might be suggested as a good altmetric source to find research articles in E and BS journals for economists with the academic status PhD.

A large scale of Mendeley users in this study are coming from "Business, Management and Accounting" for BS journal articles with 30% of readers and "Economics, Econometrics, and Finance" for E journal articles with 18% of readers. While in the study of Nuredini and Peters (2015), most of the readers of the top 30 journal articles for both disciplines are coming from Business Administration. However, this discipline seems to be recently updated in Mendeley and replaced with "Business, Management and Accounting."

Even though the country information is not favorably represented for all users of E and BS articles – this readership information can still play an important role for readers. It has been investigated that Mendeley readers tend to read articles authored from their own country. This insight can further help readers of E and BS articles to check for country information an article has, based on Mendeley users, which might indicate which specialism their country is interested in Thelwall and Maflahi (2015). Within this study, the top 3 user countries are United States, United Kingdom, and Brazil, of which the users of Mendeley read E and BS journal articles (for the top 1000 journals), whereas in Nuredini and Peters (2015), the top 3 countries are United States, Germany, and United Kingdom. According to this information, one possible suggestion could be that Mendeley users from Germany might read more articles that are published in the top 30 journals from Handelsblatt ranking. The most prominent sources found from Altmetric.com for articles in E and BS journals are Mendeley, Twitter, News, Facebook, Blogs, and Policy Documents; similar results are also shown within the study of Nuredini and Peters (2016).

Journal articles in BS are mostly found on Twitter (56.6% of articles) followed by Facebook that covers 11% of articles and blogs with 8.9%. For E journals, Twitter has the highest coverage of articles with 58% followed by Facebook with 11% and Policy Posts with 9.6%. Moreover, since Twitter as a source tracked by Altmetric.com was found with a large number of E and BS journal articles, E researchers are encauraged to check for Tweets, which can make it easier for them to find recently published articles for reading. Twitter, moreover, is believed to show a societal impact of scholarly articles (Eysenbach, 2011) as well as predict highly cited articles right after their publication. Therefore, economists that are authors are encauraged to share their articles by promoting them on social media mediums, especially on Twitter, which is supposed to increase the number of citations (Ortega, 2016).

Within this study, top highly ranked journals (with classes A+ and A) in E from Handelsblatt ranking are highly mentioned in the sources tracked by Altmetric.com, making them also popular in social media platforms (i.e., attention sources). Additionally, besides the popularity of highly ranked journals in social media platforms, that journals ranked below class A, which have been assigned to classes B and C in Handelsblatt ranking, are highly saved in Mendeley. These journals also do not necessarily always publish only articles with an E focus, but they also publish other scientific findings from different disciplines as well. Some possible reasons why low-ranked journals from Handelsblatt are highly saved in Mendeley might be first because of the heterogeneous nature of those journals (publishing a variance of scientific content besides E). Second, a large scale of Mendeley readers, in this case, master students, does read/save the articles but does not often author their own, leading to low citation counts and low rankings of these journals (Thelwall, 2017b). Or another option can be that the readers of these journals (e.g., researchers) might not author articles, which are indexed in Scopus – where Scopus is the main contributor of citations to Handelsblatt ranking, and therefore, we believe that the Handlesblatt ranking (based on citations) for these journals is lower.

Based on the correlation coefficients retrieved for our datasets, Altmetric Score and Tweets are low correlated with Dimension citations on article level. Therefore, this study can not suggest Altmetric Score or Twitter as an indicator that will filter articles with high online impact and that are therefore highly cited soon after their publications. Blogs and News are positively correlated with citation counts on journal level, which can be used as sources that can identify highly cited journals for E and BS journals.

During the altmetric investigation process for E and BS journal articles, a strong correlation between Mendeley counts and Dimensions citations for E and BS both on journal and article level is identified. This correlation suggests Mendeley readership information for E and BS journal articles as alternative indicators to citations, reflecting the scientific impact of articles within a shorter time frame than citation counts. With this finding Mendeley counts can be recommended to libraries as useful indicators respectively as popularity factors (complementary to citations) that might help to provide a better ranking of search results for library services. However, to precisely confirm the level of immediacy of altmetrics, especially Mendeley counts, in future studies, monthly observations of these indicators for E and BS journal articles should be performed.

5.1 *Limitations*

The research explored in this study is confined by two essential limitations: (1) the selection of journals based on a specific discipline and 2) limitations related to altmetric providers (Altmetric.com and Mendeley). Moreover, the research analysis and results of this study consider only the top 1000 journals in E and BS disciplines and do not consider the entire list of journals in the Handelsblatt ranking ($n = 3664$). The limitation of journals to 1000 is based on several data retrieval issues, which are mentioned in the methods and data sources. These issues (e.g., not every article published in one of the 3664 journals had a DOI) made it difficult to include all journals for this research. The altmetric information suggested in this study is dependent on the lifetime of the two altmetric providers. Altmetric information is also limited because Altmetric.com only tracks certain sources and neglects other social media sources or attention sources that might be useful and relevant for readers of E and BS journal articles. For example, Altmetric.com has permission to track data from Wikipedia but not from other encyclopedias such as Britannica. This limitation misrepresents the online attention scientific articles gain since there is a bias toward the included sources, whereas missing sources are neglected (Gumpenberger *et al*., 2016). Last but not least, one should mention that Mendeley's information generally suffers from missing and incorrect values in the metadata, which makes the whole crawling process challenging. Also, the data that are retrieved from Mendeley are only based on the users who practice Mendeley.

Notes

1. Altmetrics: a manifesto: http://altmetrics.org/manifesto/
2. Clarivate Analytics: https://clarivate.com/
3. DORA declaration: https://sfdora.org/read/
4. In this study, the acronyms E for Economic journals and BS for Business Studies journals used interchangeably.
5. Handelsblatt: https://www.handelsblatt.com/politik/deutschland/journal-ranking/9665428.html?ticket=ST-6344762-wsWoaDjTg5DUtdhWzyMD-ap3
6. Altmetric Explorer: https://help.altmetric.com/support/solutions/articles/6000146655-introduction-to-the-altmetric-explorer
7. How is the Altmetric Attention Score calculated: https://help.altmetric.com/support/solutions/articles/6000060969-how-is-the-altmetric-attention-score-calculated-

8. Numbers behind Numbers: https://www.altmetric.com/blog/scoreanddonut/
9. Altmetric.com Sources: https://www.altmetric.com/about-our-data/our-sources/
10. Mendeley: https://www.mendeley.com/
11. RePEc: http://www.repec.org/
12. Jourqual: https://vhbonline.org/en/service/jourqual/vhb-jourqual-3/
13. SCImago: https://www.scimagojr.com/
14. Econlit: https://www.aeaweb.org/econlit/
15. VHB-Jourqual -3: https://vhbonline.org/vhb4you/jourqual/vhb-jourqual-3/
16. List of journals in VHB-Jourqual-3 https://vhbonline.org/vhb4you/vhb-jourqual/vhb-jourqual-3/gesamtliste
17. Crossref: https://www.crossref.org/
18. DataCite: https://datacite.org/
19. meEDRA: https://www.medra.org/
20. Article found in EconBiz portal: Can you measure the ROI of your social media marketing https://www.econbiz.de/Record/can-you-measure-the-roi-of-your-social-media-marketing-hoffman-donna/10008859294
21. The journal "Value in Health": https://www.journals.elsevier.com/value-in-health
22. About the "Energy journal": https://www.journals.elsevier.com/energy
23. The publication year of articles "2018" for our study depicts the recently published articles in E and BS since the altmetric data for articles are retrieved in the beginning of 2019.
24. Countries around the World: https://www.worldometers.info/geography/countries-of-the-world/
25. How is the Altmetric Attention Score is calculated: https://help.altmetric.com/support/solutions/articles/6000060969-how-is-the-altmetric-attention-score-calculated-
26. What outputs and sources does Altmetric.com track? https://help.altmetric.com/support/solutions/articles/6000060968-what-outputs-and-sources-does-altmetric-track-
27. Dimensions database: https://www.dimensions.ai/
28. SPSS Statistical analysis software : https://www.ibm.com/analytics/spss-statistics-software

ACKNOWLEDGMENTS

I would like to thank the anonymous reviewers for their valuable comments and suggestions, which significantly contributed to the quality of the article. I also thank Altmetric.com and Mendeley for offering the opportunity to access and use altmetric data.

Open access funding enabled and organized by Projekt DEAL.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table 1 Description of journal output for the top 10 journals in Economics and Business Studies.
Table 2 Percentage of readers for all articles in Mendeley.
Table 3 Altmetric Attention Sources identified in Altmetric.com for E and BS journals.
Table 4 Spearman correlation between citation counts, tweets from Twitter, Mendeley counts and ASS on article level for BS journals.
Table 5 Spearman correlation between citation counts, tweets from Twitter, Mendeley counts and ASS on article level for E journals.
Table 6 Spearman correlation between AAS, Twitter, Mendeley Readership Information and Dimensions Citations on journal level for BS journals.
Table 7 Spearman correlation between AAS, Twitter, Mendeley Readership Information and Dimensions Citations on journal level for E journals.