Analyzing the Degree of Changes in Indexed Journals: The Case of SJR Database

Eungi Kim[1] · Madhu Atteraya[2]

Abstract

The objective of this study was to analyze the degree of changes in indexed journals within a database using SCImago Journal Rank (SJR) as a proxy for Scopus. We downloaded SJR-listed journal data to examine journal evolution over the past decade (2013–2022) and analyzed them in terms of the following metrics: the number of journals, growth rates, normalized growth and the Jaccard index. The findings revealed a significant increase in Scopus-indexed journals during this period, with journals growing from 23,957 in 2013 to 27,033 (12.8 percent) but declining after peaking at 28,099 in 2019. Open access (OA) journals exhibited remarkable growth and higher turnover (48.3 percent) than non-OA journals (2.3 percent). For a thorough assessment of journal growth and overlap, we propose using a quadrant analysis. Using this approach, we found an inverse relationship between the normalized growth rate and the Jaccard index across different subject areas and countries. The methods described in this study can be used to analyze changes in indexed journals in other databases and thus contribute to a better understanding of its indexed journals.

Keywords Scholarly communication · SCImago Journal Rank · Database coverage · Scopus · Jaccard index · Growth rate

✉ Eungi Kim
  egkim@kmu.ac.kr

  Madhu Atteraya
  atteraya@kmu.ac.kr

1 Department of Library and Information Science, Keimyung University, 1095 Dalgubeoldaero, Dalseo-Gu, Daegu 42601, Korea

2 Department of Social Welfare, Keimyung University, 1095 Dalgubeoldaero, Dalseo-Gu, Daegu 42601, Korea

Introduction

Journals undergo periodic additions or removals from indexed bibliographic databases to ensure the consistent delivery of reliable, relevant and up-to-date scholarly content. The longitudinal information within these databases captures trends and patterns in research fields, reflecting continuous evolution through the addition of new journals and the removal of others over time. Examining changes in the composition of journals with consideration of additions and removals provides valuable insights into emerging research fields, evolving publishing models and global trends in scholarly publishing.

In this context, it is useful to measure the degree of change in the indexed journals within a database. While traditional methods rely on the percentage of changes, this paper proposes to use the Jaccard index and other primitive indicators, such as the growth rate, together to measure changes in indexed journals. This comprehensive approach provides insight into the evolving landscape of indexed journals and captures both the extent of change and the relationship between growth and similarity over time.

The overarching objective of this study is therefore to conduct a detailed analysis of the degree of change in indexed journals within a database. Specifically, we aim to explore the intricate relationship between journal growth and indexed journal similarity between two periods by conducting a thorough empirical analysis using SCImago Journal Rank (SJR) (SCImago, n.d.) as a proxy for Scopus over the last decade. To assess the degree of changes in journals indexed in Scopus, this study analyzed both open access (OA) and non-OA journals, along with an in-depth investigation of journals categorized in various subject areas and countries.

In addition, a quadrant analysis is introduced, in which the data points on a scatterplot representing the normalized growth indicator and the Jaccard index are systematically divided into four quadrants. This analytical method is used to examine in detail the relationship between the growth and similarity of indexed journals within a selected group.

Literature Review

Prior literature on the evolution of scholarly publishing pertinent to this study addresses significant research topics, including database coverage of indexed journals, OA publishing, discipline-specific trends and country-level analyses.

Firstly, several studies have scrutinized the characteristics of bibliometric databases, with a particular focus on content quality. Pranckutė (2021) noted that journals indexed in Web of Science and Scopus are generally perceived as high quality, while Baas et al. (2020) argued that Scopus has unparalleled coverage across all disciplines, positioning it as a more comprehensive database compared to others, such as Web of Science. These studies, along with Zhu and Liu (2020) demonstrating the widespread use and trustworthiness of Web of Science and Scopus among researchers, underscore the significance of regularly monitoring

database evolution to understand how content policies may have influenced the composition of journals within the databases. However, before examining issues related to the content quality of databases, it is beneficial to first assess how journals are added or removed over time in a database to understand the dynamic characteristics of a database.

Secondly, the adoption and dynamics of OA publishing have received considerable scholarly attention in the past two decades. Björk and Korkeamaki (2020) revealed varying market shares of OA publishing across scientific disciplines, ranging from 27 percent in agriculture to 7 percent in business, were potentially influenced by factors such as funding availability and research communication cultures. Matthias et al. (2019) found that a substantial number of active publishing journals (152+) have shifted from OA to subscription models since 2005, suggesting the necessity for further scholarly investigation into scholarly publishing. Based on the Directory of Open Access Journals (DOAJ), Pandita and Singh (2022) reported an exponential growth rate of OA journals (51.46 percent). Furthermore, Kim and Atteraya (2023) showed that the number of OA journals indexed by SJR has rapidly increased between 2011 and 2021 compared to non-OA journals.

Thirdly, studies have consistently shown that the growth and composition of journals vary across different subject areas. Several studies, such as Stern and O'Shea (2019), Zhu and Liu (2020), and Kim and Jeong (2023), examined disciplinary differences with regard to scholarly journals. Kim (2023) conducted an examination of the evolving landscape of Library and Information Science (LIS) based on journals listed in SJR. Jamali et al. (2022) examined journals published in Australia and found that journals indexed in Scopus and Web of Science were more prevalent in Health, Life and Physical Science disciplines. Based on the SJR data from 2000 to 2019, Pandita and Singh (2023) found that the Arts and Humanities recorded the highest growth in the introduction of new journals.

Lastly, numerous studies have analyzed journals at the country level to examine regional differences and the influences that have shaped scholarly publishing over the past decade. Understanding regional differences in publishing international journals is beneficial to comprehending the evolving landscape of journal publishing and its implications for the composition of scholarly databases. For example, Rhee (2019) provided a case study of scholarly journal publishing practices in Korea, while Moed et al. (2018) examined trends in Russian research production. Both studies showed that journal publishing and scholarly publishing differed significantly across countries. Kim and Kim (2022) conducted a comparative analysis of Asian law journals published in different regions and uncovered startling differences in publishing standards and practices in Asia. Pandita and Singh (2023) found that, out of 109 countries that publish journals, nearly 90 percent of journals were published in twenty leading journal-publishing countries.

In sum, the aforementioned studies mainly addressed trends and variations that have influenced the growth and dynamics of international journal productions over the past decade. However, there are research gaps concerning the assessment of journal changes in a database to understand the evolving journal publishing landscape. Hence, our aim is to fill this gap by providing an extensive quantitative analysis of the changes in journals in SJR over the past decade.

Methodology

Metrics to Assess the Degree of Changes in Indexed Journals

In this study, to monitor growth and dynamics in indexed journals in a database, we propose to use the following metrics:

- number of journals
- growth rate
- normalized growth rate
- Jaccard index.

The number of indexed journals in databases simply serves as a basic indicator for journals indexed in a database. The growth rate of journals in a database between two given periods is defined as the following:

$$\text{Growth rate} = \frac{\text{no. of journals in year } A - \text{no. of journals in year } B}{(\text{no. of journals in year } A) \times 100}$$

The growth rate can be normalized to a range of 0 to 1. The normalized growth rates of journals are defined as follows:

$$\text{Normalized growth rate} = \frac{\text{growth rate} - \text{MIN growth rate}}{\text{MAX growth rate} - \text{MIN growth rate}}$$

The Jaccard index (Jaccard, 1901), commonly known as the Jaccard similarity coefficient, is a widely used metric in various fields to quantify the degree of similarity or overlap between two sets (Duan & Guan 2021; Ji et al. 2020; Rahman et al. 2010). Jaccard index between A and B can be defined as the following:

$$\text{Jaccard index}(A, B) = \frac{A \cap B}{A \cup B}$$

For example, suppose $A = \{J1, J2, J3, J4\}$ and $B = \{J3, J4, J5\}$. Then, we can calculate the Jaccard index between A and B as follows:

$$A \cap B = \{J3, J4\}$$

$$A \cup B = \{J1, J2, J3, J4, J5\}$$

$$\text{Jaccard index } (A, B) = \frac{A \cap B}{A \cup B} = \frac{2}{5} = 0.4$$

Jaccard index ranges from 0 to 1, with 0 indicating no overlap and 1 indicating complete overlap between the two sets. In this study, we used the Jaccard index to

quantify the extent of shared journals between two periods of time. By utilizing both the normalized growth rate and Jaccard index simultaneously, we analyzed how indexed journals have changed in the last decade.

Data Collection and Analysis

For an empirical analysis utilizing the proposed metrics, we accessed journal data from the SJR portal. All journals listed in SJR, excluding trade journals, were downloaded as proxies for journals indexed in Scopus. SJR journal information was collected on a yearly basis from 2013 to 2022. SJR provides files in a CSV format with a semicolon as the separator.

The downloaded file can be read into the *R* program using a command such as the following:

```
df ← read.csv("scimagojr 2022.csv", sep = ";", encoding = "UTF-8", fill = TRUE,
header = TRUE)
```

Data processing, metric calculations and trend visualizations for journal indexing were conducted using the *R* language. The example code illustrating the metrics and the quadrant approach used in this study is available on GitHub at https://github.com/egkim68/journal_changes_analysis. The code demonstrates how to calculate journal count, Jaccard index, growth rate and normalized growth rate, as well as the quadrant approach to categorizing journals into Q1 to Q4 based on Jaccard index and normalized growth rate.

In this study, we investigated changes in journals across different categories, such as journal type (OA versus non-OA), subject areas and countries. Scopus uses the DOAJ and the Directory of Open Access Scholarly Resources (ROAD) databases (Steiginga & Evans 2015) to determine the OA status of its indexed journals. Thus, non-OA journals in this study included all those not registered in DOAJ, encompassing traditional subscription and hybrid publishing models. To distinguish between OA and non-OA journals, we separately obtained the list of OA journals from SJR for the same year. An anti-join procedure identified non-OA journals by comparing SJR and OA lists, selecting entries without corresponding matches. The country of journals provided by SJR was used, representing the publisher's country where the journal is published. Furthermore, we employed 27 major subject areas as categorized by SJR to analyze journal change metrics in terms of subject areas. Lastly, we categorized data points into Q1 to Q4 based on their Jaccard index and normalized growth rate. This is referred to as a quadrant approach, and it is used to analyze relationships within the dataset. The workflow procedure used in this study is summarized in Figure 1.

Figure 1 Workflow procedure used in this study
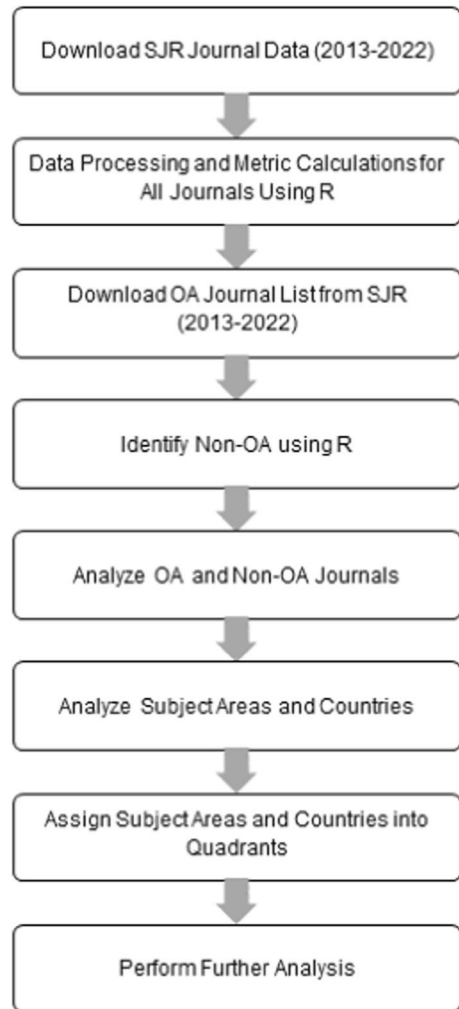
Empirical Results

Yearly Changes in Indexed Journals and Various Journal Metrics

The yearly changes in journals based on journal types from 2013 to 2022 are shown graphically in Figure 2. This figure illustrates a significant increase in total Scopus-indexed journals ("All") during the studied period, growing from 23,957 in 2013 to 27,033 (12.8 percent) but declining after peaking at 28,099 in 2019. It also highlights the differences between non-OA and OA categories. The number of non-OA journals shows a general upward trend, peaking in 2019 and declining slightly in subsequent years, followed by stabilization between 2020 and 2022. In contrast, the number of OA journals rose continuously until 2019 and remained stagnant after
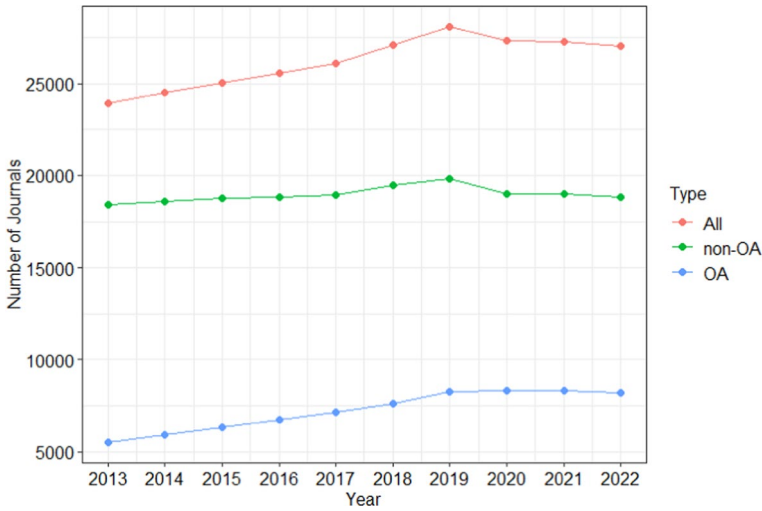
Figure 2 Yearly changes in Scopus-indexed journals by type

this period. Overall, this figure reflects changing trends in the number of journals indexed by Scopus. However, the degree of overlapping journal titles is not presented in this figure.

For an in-depth understanding of the changes in the indexed journals, it is useful to compare the growth rates and Jaccard index of OA journals to those of non-OA journals between two periods to observe shifts in publishing practices. Table 1 presents the number of journals listed in SJR, along with their respective growth rates and Jaccard indices for the years 2013 and 2022. The data illustrate that the total number of indexed journals increased from 23,957 in 2013 to 27,033 in 2022, representing a growth rate of 12.8 percent. In particular, the intersection of journals indexed in both periods was 20,075, while the union included 20,618, resulting in a Jaccard index of 0.68. This means that approximately 68 percent of the journals indexed in 2013 are still in the index in 2022, indicating a considerable amount of overlap.

Table 1 demonstrates a distinct difference in the composition of journals between 2013 and 2022 in terms of growth rate and Jaccard index for various journal types: OA, non-OA and ALL. Although non-OA journals substantially outnumber OA journals, OA journals have experienced substantial growth (48.3 percent) compared

Table 1 Various journal metrics across journal types

Categories	Year 2013	Year 2022	Growth rate (%)	Intersect	Union	Jaccard index
ALL	23,957	27,033	12.8	20,618	30,320	0.68
OA	5,515	8,180	48.3	5,000	8,683	0.58
Non-OA	18,436	18,850	2.3	15,615	21,640	0.72

to a lower growth rate for non-OA journals (2.3 percent). The Jaccard index for OA journals is 0.58, indicating a relatively lower degree of overlap between the two periods. In contrast, non-OA journals exhibit a higher Jaccard index of 0.72, denoting a greater level of overlap. The lower Jaccard index for OA journals can be attributed to the removal of OA journals as part of Scopus's quality control efforts, targeting predatory and low-quality journals (Holland et al. 2021). The result suggests that maintaining Scopus indexing status may be more challenging for OA journals, despite having a faster growth rate than non-OA journals.

It is vital to take into account the time span between the two periods when interpreting the Jaccard index. A shorter time span tends to yield a higher Jaccard index, indicating a greater overlap between the compared sets. However, in Table 1, the

Table 2 Various metrics across subject areas

Subject areas	N (2013)	N (2022)	Growth rate (%)	Normalized growth rate (%)	Jaccard index
Agricultural and Biological Sciences	2,008	2,318	15.44	0.51	0.69
Arts and Humanities	3,095	4,169	34.70	0.89	0.63
Biochemistry, Genetics and Molecular Biology	1,968	2,088	6.10	0.33	0.70
Business, Management and Accounting	1,245	1,541	23.78	0.68	0.68
Chemical Engineering	541	641	18.48	0.57	0.66
Chemistry	806	916	13.65	0.48	0.71
Computer Science	1,448	1,834	26.66	0.73	0.64
Decision Sciences	333	467	40.24	1.00	0.64
Dentistry	188	214	13.83	0.48	0.73
Earth and Planetary Sciences	1,075	1,240	15.35	0.51	0.69
Economics, Econometrics and Finance	957	1,223	27.80	0.75	0.67
Energy	388	520	34.02	0.88	0.57
Engineering	2,821	3,258	15.49	0.51	0.67
Environmental Science	1,277	1,658	29.84	0.80	0.60
Health Professions	509	654	28.49	0.77	0.62
Immunology and Microbiology	545	600	10.09	0.41	0.68
Materials Science	1,070	1,284	20.00	0.60	0.68
Mathematics	1,357	1,666	22.77	0.66	0.71
Medicine	7,316	7,216	−1.37	0.18	0.67
Multidisciplinary	117	142	21.37	0.63	0.53
Neuroscience	546	602	10.26	0.41	0.72
Nursing	591	633	7.11	0.35	0.68
Pharmacology, Toxicology and Pharmaceutics	778	696	−10.54	0.00	0.66
Physics and Astronomy	1,013	1,158	14.31	0.49	0.75
Psychology	1,124	1,325	17.88	0.56	0.72
Social Sciences	5,560	7,466	34.28	0.88	0.63
Veterinary	227	265	16.74	0.54	0.70
Average	1,440.85	1,696.07	18.77	0.58	0.67

nine-year discrepancy (2013 and 2022) resulted in more significant changes in the composition of SJR journals, leading to a smaller intersection and lower Jaccard indices compared to those depicted in Figure 2.

Journal Changes and Subject Areas

Table 2 presents changes in the number of journals indexed by the SJR in various subject areas over the past decade. Notable growth rates are observed in various subject areas. The subject area of Decision Sciences displays the highest growth rate at 40.24 percent, indicating a significant increase in indexed journals. Arts and Humanities closely follows with a growth rate of 34.70 percent, reflecting an increased presence of SJR journals. Contrarily, the subject area of Pharmacology, Toxicology and Pharmaceutics shows a negative growth rate (–10.54 percent).

The Jaccard indices shown in Table 2 demonstrate variations in the consistency and composition of indexed journals across subject areas. The subject area of Physics and Astronomy exhibits the highest Jaccard index (0.75), suggesting a significant level of consistency in the publication of SJR indexed journals. In contrast, the Jaccard index of Multidisciplinary journals for the period from 2013 to 2022 is the lowest (0.53), signifying substantial fluctuations and instability in the composition of indexed journals within this subject area.

Journal Changes and Countries

Table 3 presents various journal metrics of the top-20 countries with the highest number of indexed journals in 2022. In 2022, the United Kingdom holds the top position in terms of the number of SJR journals (6,411), while the United States ranks second with 6390 journals. Although the United States displays modest growth of 1.22 percent, it retains its dominant position in terms of the sheer number of SJR journals. In contrast, the United Kingdom shows a higher growth rate of 8.42 percent, indicating its continuous contribution to global journal publishing. The Russian Federation stands out with an impressive growth rate of 229.41 percent. However, countries such as Japan and Australia have experienced negative growth rates of –16.54 percent and –12.72 percent, respectively. This suggests that these countries are facing challenges in maintaining their journals listed in SJR.

Table 3 also shows that some countries are publishing more journals with greater overlap between the two periods compared to others, while countries with lower

Table 3 Various journal metrics across top-20 countries

Country	N (2013)	N (2022)	Growth rate (%)	Normalized growth rate (%)	Jaccard index
Australia	228	199	–12.72	0.02	0.51
Czech Republic	160	222	38.75	0.22	0.58
Turkey	197	245	24.37	0.17	0.48
Canada	275	283	2.91	0.08	0.59
Iran	132	284	115.15	0.54	0.40
South Korea	00	323	61.50	0.32	0.53
Japan	508	24	–16.54	0.00	0.72
Brazil	335	430	28.36	0.18	0.68
India	502	481	–4.17	0.05	0.56
Russian Federation	53	04	229.41	1.00	0.23
Poland	363	523	44.08	0.25	0.53
France	03	534	–11.44	0.02	0.68
Italy	467	600	28.48	0.18	0.54
Spain	501	728	5.51	0.25	0.53
Switzerland	555	730	31.53	0.20	0.63
China	600	850	41.67	0.24	0.60
Germany	1,447	1,468	1.38	0.07	0.75
Netherlands	1,662	1,844	10.88	0.11	0.73
United States	6,313	6,390	1.22	0.07	0.73
United Kingdom	5,912	6,411	8.42	0.10	0.80
Average	1,099.21	1,224.95	35.87	0.21	0.59

Jaccard indices maintain fewer SJR journals with fewer overlaps. For instance, the United Kingdom (0.80), the Netherlands (0.73) and Germany (0.75) have relatively high Jaccard indices, indicating a substantial overlap in the production of SJR journals between the two periods. Japan also demonstrates a Jaccard index of 0.72, indicating a higher degree of similarity and stability in its indexed journals. In contrast, the Russian Federation's Jaccard index is 0.23, indicating significant changes in the composition of indexed journals and reflecting a dynamic research environment.

The Quadrant Approach

The quadrant approach proposed in this study facilitates a detailed examination of the relationship between the Jaccard index and normalized growth rate within diverse subsets of the dataset. The formation of quartile groups involved systematically categorizing data points based on their assignments, creating a structured framework for a thorough investigation. Each data point was assessed against specific criteria outlined in the quadrant definitions. Utilizing the mean values of the Jaccard index and normalized growth rate, four distinct quadrants—labeled I, II, III and IV—were delineated. These quadrants offer a comprehensive framework for

analyzing the relationship between the Jaccard index and the normalized growth rate in the context of indexed journals.

The criteria for assigning quadrants are based on their Jaccard index (ji) and normalized growth rate (ngr) values in relation to the mean values. The following mathematical expressions define criteria for assigning data points to each quadrant:

- Quadrant I: ji > mean ji and ngr > mean ngr
- Quadrant II: ji ≤ mean ji and ngr > mean ngr
- Quadrant III: ji ≤ mean ji and ngr ≤ mean ngr
- Quadrant IV: ji > mean ji and ngr ≤ mean ngr.

These quadrant assignments also facilitate a clear visual representation in subsequent scatterplots, enabling us to observe trends and patterns of variables of interest within each quadrant. We selected subject areas and countries of Scopus-indexed journals as variables of interest to illustrate our quadrant approach.

Quadrants and Subject Areas

Using the Jacquard index and normalized growth rate shown in Table 2, subject areas were assigned to quadrants to visualize their relative positions and
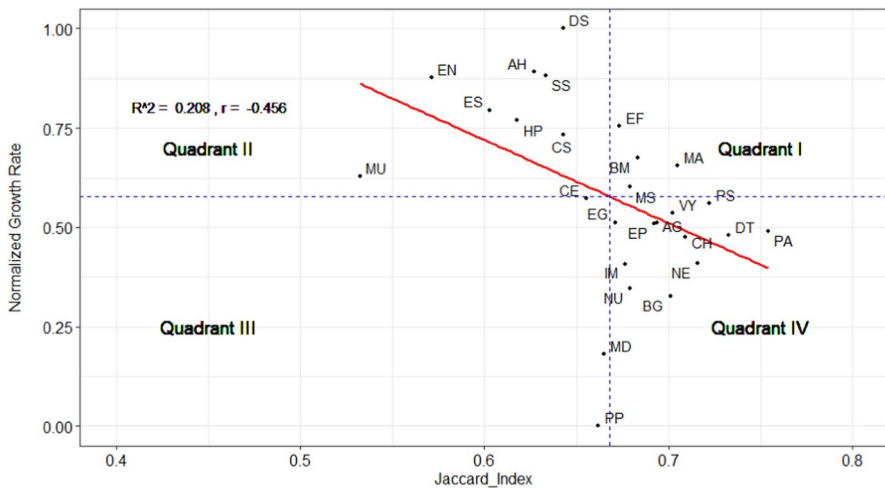
Figure 3 Quadrants and subject areas: Jaccard index versus growth rate. Agricultural and Biological Sciences (AG); Arts and Humanities (AH); Biochemistry, Genetics and Molecular Biology (BG); Business, Management and Accounting (BM); Chemical Engineering (CE); Chemistry (CH); Computer Science (CS); Decision Sciences (DS); Dentistry (DT); Earth and Planetary Sciences (EP); Economics, Econometrics and Finance (EF); Energy (EN); Engineering (EG); Environmental Science (ES); Health Professions (HP); Immunology and Microbiology (IM); Materials Science (MS); Mathematics (MA); Medicine (MD); Multidisciplinary (MU); Neuroscience (NE); Nursing (NU); Pharmacology, Toxicology and Pharmaceutics (PP); Physics and Astronomy (PA); Psychology (PS); Social Sciences (SS); Veterinary (VY)

relationships (Figure 3). The red line indicates the linear regression line. We can observe that there is a negative relationship between the normalized growth rate and the Jaccard index in both subject areas ($r = –0.456$), indicating that subject areas that have a high number of overlapping journals tend to experience slower growth.

In Quadrant I, subject areas such as Mathematics (MA) exhibit both high Jaccard indices and high normalized growth rates, indicating a significant overlap in indexed journals and a high growth rate of SJR journals. In Quadrant II, subject areas, including Arts and Humanities (AH) and Computer Science (CS), show moderate Jaccard indices but a high normalized growth rate, suggesting a moderate overlap in SJR journals published between the two periods and a high growth rate in publishing SJR journals. In Quadrant III, subject areas such as Pharmacology, Toxicology and Pharmaceutics (PP) demonstrate both a low normalized growth rate and Jaccard index, suggesting a limited overlap in indexed journals and low growth in the production of SJR journals. However, there are not many subject areas presented in this quadrant. In Quadrant IV, subject areas such as Agricultural and Biological Sciences (AG), Dentistry (DT), and Physics and Astronomy (PA) exhibit high Jaccard indices but a low normalized growth rate, indicating a significant overlap but a low growth rate of journals published in those subject areas.

Quadrants and Countries

Using the Jacquard index and normalized growth rate shown in Table 3, countries were assigned to quadrants to visualize their relative positions and relationships (see Figure 4). As shown, China (CN) is the only country in Quadrant I, falling near the boundary. A country in this quadrant usually indicates a significant overlap in SJR journals between two periods and substantial growth in publishing SJR journals. In Quadrant II, we find countries such as the Russian Federation (RU), Iran (IR) and South Korea (KR). The Jaccard indices of these countries are low to moderate, indicating low overlapping but a high growth rate in SJR journal production over time. Russia stands out as an outlier country with the highest normalized growth rate (1.00). In Quadrant III, countries such as Australia (AU) and Turkey (TR) exhibit low to moderate Jaccard indices, implying lower overlapping SJR listed journals over time and a low growth rate, indicating a decline in SJR journal production. In Quadrant IV, countries such as the Netherlands (NL), the United States (US) and the United Kingdom (GB) have high Jaccard indices, indicating overlapping SJR journals between two periods but slower growth in production.

Figure 4 also reveals a strong correlation (–0.788) between the normalized growth rate and the Jaccard index. This indicates that changes in the number of indexed journals for a country are closely associated with changes in the overlap between those journals. A positive correlation would suggest that countries with higher growth rates tend to have higher Jaccard indices, indicating greater similarity and consistency in the composition of their indexed journals over time. In contrast, a negative correlation would indicate that countries with higher growth rates tend to have lower Jaccard indices, suggesting more substantial changes in the composition of their indexed journals over the last decade.
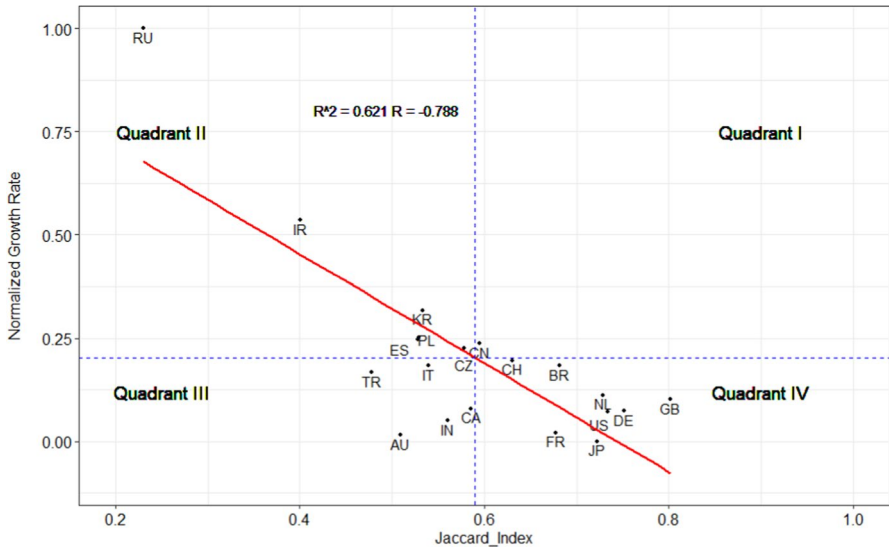
Figure 4 Quadrants and top-20 Countries: Jaccard index versus growth rate. Australia (AU); Czech Republic (CZ); Turkey (TR); Canada (CA); Iran (IR); South Korea (KR); Japan (JP); Brazil (BR); India (IN); Russian Federation (RU); Poland (PL); France (FR); Italy (IT); Spain (ES); Switzerland (CH); China (CN); Germany (DE); Netherlands (NL); United States (US); United Kingdom (GB)

Figure 5 illustrates a scatterplot depicting the relationship between the Jaccard index and the normalized growth rate of SJR journals published by all 104 countries from 2013 to 2022. To ensure a consistent growth rate calculation, countries that did not publish any journals in both periods were excluded. The correlation between normalized growth rate and Jaccard index, when measured with all 104 countries, was found to be moderately negative (–0.528), indicating a moderate association between changes in the number of indexed journals and the overlap between journals indexed by each country. As shown previously, the correlation for the top-20 countries was even more negative, measuring –0.788. The Jaccard indices shown in this table exhibit a wide range of values from 0 to 1, indicating varying levels of similarity in the composition of indexed journals across countries. Quadrant I indicates a lack of countries with both a relatively high normalized growth rate and the Jaccard index. Quadrant II shows outlier countries with a high normalized growth rate but a low Jaccard index, including Belarus (BY), Ecuador (EC) and Iraq (IQ). Quadrant III includes outlier countries with the lowest Jaccard indices, such as Bahrain (BH), Zimbabwe (ZW), Tanzania (TZ) and Libya (LY). Belarus (BY) emerges as the country with the highest normalized growth rates, while Bahrain (BH) displays the lowest. Quadrant IV encompasses countries with the highest Jaccard indices but a low normalization rate, including Malawi (MW), Uganda (UG) and Oman (OM).

It is worth pointing out that the composition and origin of the quadrants, representing the average intersection between normalized growth rates and Jaccard indices, can vary depending on the specific dataset and periods being examined as the normalized growth rate can exhibit relative changes in relation to other groups.
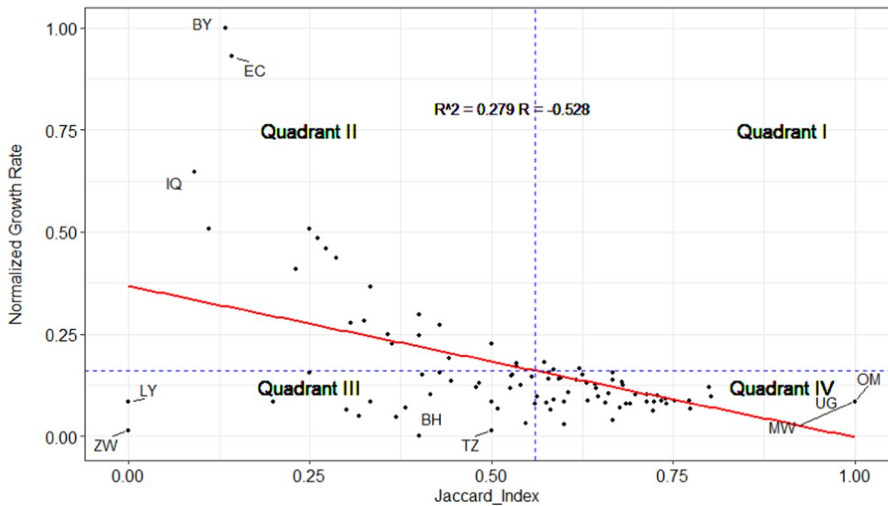
Figure 5 Quadrants and all Countries: Jaccard index versus growth rate. Uganda (UG); Zimbabwe (ZW); Belarus (BY); Bahrain (BH); Oman (OM); Libya (LY); Ecuador (EC); Tanzania (TZ); Malawi (MW); Iraq (IQ)

Nonetheless, there is a lack of countries in Quadrant I, indicating that, when considering all countries, there are few that have published both high growth and high overlapping journals in the last decade. This figure suggests that as the number of countries examined increases, the Jaccard indices exhibit greater variation, indicating diverse levels of similarity in the composition of indexed journals. In contrast, the normalized growth rate remains volatile regardless of the number of countries examined.

Table 4 presents various journal metrics for outlier countries that published at least one journal in 2013 and 2022. The normalized growth rate values in this table represent their growth in relation to all 104 countries that published at least one journal during these two years. These outlier countries generally have a low initial number of journals compared to the top-20 countries mentioned earlier. It is important to note that even small changes in journal production for countries with a small initial number of journals can result in a significant increase or decline in the growth rate and Jaccard index changes. For example, Belarus increased its journals by 650 percent, while Bahrain decreased its SJR journals by –60 percent. A comparison of outlier countries with the 20-top countries shows much greater extremes in growth rates. As a result, the growth of journals can be interpreted differently depending on the initial reference point. Thus, small changes relative to a small initial value can have a substantial impact on the growth rate or Jaccard index, while larger changes relative to a larger initial value may have a smaller effect.

In sum, the presence and characteristics of outlier countries are contingent on dataset selection, while the quadrant analysis provides valuable insights into the general trends and relationships between countries' normalized growth rates and Jaccard indices. Russia could be considered an outlier due to its high normalized

Table 4 Various journal metrics across outlier countries

Country	Abbreviation	N (2013)	N (2022)	Growth rate (%)	Normalized growth rate (%)	Jaccard index
Uganda	UG	1	1	0	0.08	1.00
Zimbabwe	ZW	2	1	−50	0.01	0.00
Belarus	BY	2	15	650	1.00	0.13
Bahrain	BH	5	2	−60	0.00	0.40
Oman	OM	3	3	0	0.08	1.00
Libya	LY	1	1	0	0.08	0.00
Ecuador	EC	1	7	600	0.93	0.14
Tanzania	TZ	2	1	−50	0.01	0.50
Malawi	MW	1	1	0	0.08	1.00
Iraq	IQ	2	10	400	0.65	0.09

growth rate. However, when all countries are considered, Table 4 displays the outlier countries. Regardless, the outlier countries highlighted in the analysis could offer valuable information about the dynamics and evolution of scholarly publishing within specific regions or countries.

Discussion and Conclusion

The empirical analysis of historical coverages of SJR suggests that significant changes have occurred in the composition of their journals over the past decade. The number of SJR journals reached its peak in 2019 but has since declined steadily. It is important to note that the number of SJR journals may be directly influenced by external factors, such as the strengthened evaluation of Scopus-indexed journals (Holland et al. 2021). While this study has this type of limitation, it provides valuable insights into the scholarly landscape, offering a detailed analysis of the changing dynamics of journal indexing and publishing by researching changes in SJR journal coverage.

We found a remarkable growth in the number of OA journals compared to non-OA journals, as shown in Kim and Atteraya (2023). While the growth of OA journals underscores the increasing importance of OA journals, there seems to be higher turnover or changes in the composition of OA journals compared to non-OA journals. This could be due to several factors, such as difficulties in maintaining OA publishing models and changes in journal indexing practices. The ultimate decision to index or not lies with Scopus, and there could be complex factors influencing the drop in indexed journals in recent years. Thus, further investigation is necessary to uncover the reasons behind these differences and their implications for the journal publishing landscape.

We stress that the relationship between journal overlap and growth rate may be dependent on empirical data. In the case of SJR journals, our analysis uncovered

considerable variations among subject areas and countries, with intriguing outliers at each level. Among the top-20 countries that published the most number of journals, the United States and the United Kingdom, as expected, exhibited their dominance in SJR journals. Contrarily, countries like Russia displayed remarkable growth, indicating an increase in their production of indexed journals. In contrast, Japan and France had a negative growth rate, suggesting a potential decline or shift in indexed journal production within the countries. Some outlier countries, such as Belarus, achieved substantial growth from 2 to 25 (650 percent) in publishing SJR journals, but their production is relatively low globally. These disparities emphasize distinct dynamics in the global production of SJR journals at the country level. The outlier countries' journal production implies the necessity of considering various metrics for an improved understanding of the production of SJR journals, particularly given their relatively smaller number of SJR journals.

We observed an inverse relationship between the growth rate and the Jaccard index in subject areas and countries. This suggested that higher growth rates corresponded to lower degrees of overlap in journals, while lower growth rates were associated with higher degrees of overlap. At the country level, there was a discernible correlation between the normalized growth rate and the Jaccard index, indicating that changes in indexed journals were closely tied to changes in journal overlap within each country. The negative correlation was stronger when all 104 countries were considered, as opposed to only the top-20 countries that published the highest number of journals. This suggested the observed negative correlation became more reliable and representative of the overall trends in publishing SJR journals.

The quadrant analysis used in this study offers advantages. It allows us to analyze changes in journal indexing at the group level, such as by country and subject. By assessing the normalized growth rate within each quadrant, we can determine the degree of journal growth within each group. Each quadrant represents a certain level of similarity in terms of Jaccard index and normalized growth rates, revealing variations and differences within and between groups. This approach facilitates the study of the relationship between the Jaccard index and normalized growth rate, and allows us to identify both similarities and differences in the overlap and growth of indexed journals across countries and subject areas.

SJR is invaluable for researchers in scholarly communications and bibliometrics, providing informative historical journal indexing data for Scopus-indexed journals. The absence of publicly accessible portals like SJR suggests the need not only for a comprehensive database that indexes journals but also for providing accurate historical journal coverage information to researchers. This transparency allows the database to be evaluated effectively and enables researchers in the scholarly community and bibliometrics to utilize the indexed journals effectively, including the assessment of changes in journal indexing within a database over time.

In conclusion, the strength of this study lies not only in its empirical findings but also in the methods used to assess the degree of changes in journal indexing across databases. The various journal metrics used in this study, including the number of journals, growth rate, normalized growth rate and Jaccard index, along with the quadrant analysis, can also be applied to investigate changes in journal indexing in other databases, provided that historical indexing data can be obtained. Future

studies should assess the degree of journal changes in other databases and investigate diverse factors that potentially influence the empirical findings reported in this study. This will lead to an improved understanding of their impact on journal dynamics and trends in scholarly publishing. Furthermore, we recommend exploring diverse data sources and considering other dimensions, such as journal rankings and publications, to further enhance the comprehensiveness of our approach. Examining these additional dimensions can provide deeper insights into the evolving journal landscape in a database and contribute to a better understanding of the reasons for the changes in scholarly publishing.

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