

Characteristics of papers published in journals: an analysis of open access journals, country of publication, and languages used

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Abstract This study explores how the citation of open access (OA) journal articles occurs by analyzing the impact of certain journal characteristics, namely, whether the journal is OA and whether its country of publication is the same as the affiliation of a paper's author. As the language of a paper is an important factor contributing to paper citations, this study uses papers in English. This analysis included publications from 77 countries from 2010 to 2012. This analysis included 19,530 journals and 3,215,742 papers without duplication. The results showed that papers published in OA and international journals were cited in more countries than non-OA and domestic journals, and a higher percentage of these were being cited by foreign countries. From these findings, it was determined that the more widely accessible OA journals were effectively being accessed by researchers from multiple countries. However, of the top 10% most cited papers in international journals, a higher percentage of these came from non-OA compared to OA journals. Among domestic journals, no such difference was found. Papers published in non-OA international journals were most cited in foreign countries with a large number of published papers. Hence, the effect of OA's expanded accessibility, while having an apparent effect on heightening the interest of foreign readership, has a limited impact in terms of increasing citations.

Keywords Journal · Open access · Country of publication · Languages used

Introduction

In recent years, the number of academic journals has increased worldwide, including the number of open access (OA) journals. In 2012, OA journals already accounted for about 15% of all journals, an increase from about 7% in 2004 (Fig. 1) according to Elsevier Scopus XML Data (extracted on February 19, 2015).

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According to the OECD (2015), the first official definition of OA emerged from a 2001 conference held in Budapest. The Budapest OA definition is as follows:

By “open access” to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited (Budapest Open Access Initiative 2002).

This definition implies that OA journals contain papers published online that can be accessed by anyone for free. If a journal is not OA, prospective readers will need to purchase access rights to obtain it. In order to publish papers to an OA journal, two different methods, Gold and Green OA, are employed. In Gold OA, a paper is made available to the public free of charge by having the author(s) of the paper pay the Article Processing Charges (APCs). In Green OA, a paper is posted on an institutional repository (Wang et al. 2015). The OA definition includes the concept of free use. The Budapest Open Access Initiative recommends a CC-BY or equivalent license for the publication, use, and reuse of work (Budapest Open Access Initiative 2012). The definition of OA in this study is free access and it is not limited to a specific creative commons license.

Many previous studies have examined the performance of OA journals. These include a number of studies that analyzed associations between a journal’s OA characteristics and number of citations (e.g., Björk and Solomon 2012; Davis 2009; Davis et al. 2008; James and Reimer 2009; Lawrence 2001; Miguel et al. 2011; Solomon et al. 2013; Sotudeh et al. 2015; Wang et al. 2015a, b; Xia et al. 2011). Xia et al. (2011) note that although certain analyses have indicated that OA journals have a higher citation count owing to their wider

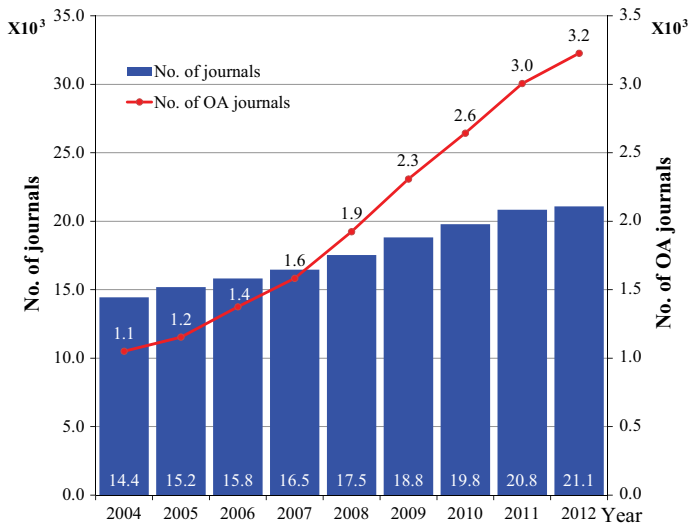


Fig. 1 The number of academic journals. (Note) The author used Elsevier Scopus XML Data (extracted on February 19,2015). For year, the publication year of the paper is used. Type of sources used is journal

accessibility, others have produced contradicting results (e.g., Björk and Solomon 2012; Davis 2009; Davis et al. 2008; Solomon et al. 2013).

However, few studies have focused on how journals' country of publication affects their citation count. Björk and Solomon (2012) showed that papers of the four largest publishing countries (United States, United Kingdom, the Netherlands, and Germany) have higher impact factors compared with those of other publishing countries. Meneghini's (1992) pioneering study focused on the affiliation of an author to a journal's country of publication, particularly whether the author's paper was published in a domestic or international journal. Meneghini (1992) targeted 487 staff members from 19 Brazilian institutions and calculated their number of citations of domestic journals. The study showed that papers published in domestic journals have low citation counts. Meneghini et al. (2006) analyzed the international visibility of Brazilian journals. They showed that the 13 Brazilian journal visibility was higher than international journal one.

This study explores the effect on citation count of a journal's OA status and its publication geography, either international or domestic, including representation from 77 different countries. This analysis focuses on whether the publishing country of a journal is the same as the author's country of affiliation (i.e., if it is an overseas publication).

Identifying the type of journal access and distinguishing domestic from international journals is an important exercise and research subject, as publication language is a critical issue for researchers in non-English speaking communities. The greatest variance in publication language occurs within domestic journals and these are preferred by researchers from non-English speaking communities.

As Salager-Meyer (2014) pointed out, journals fall into two categories: "mainstream" and "small/peripheral" journals. The former are problematic for non-English-speaking scientists because even if they are able to read scientific articles written in English, they must still translate this knowledge so that it can be understood with their national context, whereas the latter are mostly written in the researchers' native language. According Salager-Meyer (2014), "in spite of the generalized pressure to publish research outcomes in English-medium journals (p. 79)," non-native English speaking scientists often opt to publish their research results in domestic journals, owing to their difficulties in writing in English. Meneghini and Packer (2007) also discuss non-English journals and non-English speaking communities. They pointed out that any scientist must master English to obtain international recognition and to access relevant publications. Gamba et al. (2015) describes the increase in English-language publication in the journals of Brazil.

Building on the exploration of these issues in the existing literature, this study, first, determines the number of papers published in OA journals. Next, it studies the paper-publishing behavior in countries where English is not a native language, such as Japan, and whether it is different from that in English-speaking locations. As many studies in the fields of humanities and social sciences have regional characteristics, they tend to have a high rate of native language usage, demonstrating a relationship between the publication language and the state of paper publication in non-English speaking countries.

Moreover, this study aims to identify any differences in the manner by which papers are cited that might stem from a journal's OA status and whether it is an international or domestic publication. This study is based on two assumptions. First, OA journals, which are accessible online for free, are likely browsed from a wider range of countries, resulting in higher rates of citation. Second, papers published in international journals are more likely to be cited by researchers, compared with those published in domestic ones, because of their global orientation.

The analysis begins with Japan, Germany, France, China, and South Korea as non-English speaking countries that publish a large number of scholarly papers. Trends are identified by comparing and analyzing the state of paper publication in these countries and observing their respective characteristics. After examining the state of paper publication in these five countries, this study further analyzes the characteristics of papers published in journals in 77 countries for a more macroscopic perspective.

Hypotheses

In contrast to non-OA journals, researchers attempting to access previous research can search for, acquire, and examine contents of papers published in OA journals without any barriers as these journals are accessible online free of charge. For this reason, papers published in OA journals have more opportunities to gain citations, making them more likely to be cited. Xia et al. (2011) used the terms “availability,” “easy,” and “wide” to characterize OA journals.

The prospective market for international journals is global, meaning that they face stronger competition compared to the market for domestic journals. For this reason, papers published in international journals are likely to have prevailed against fierce competition. In this sense, the value of these papers is more likely to be high, and thus they are likely to be highly cited. Consequently, when researchers around the world search for published papers, they are more likely to investigate the most prestigious and internationally prominent journals first; domestic journals have a relatively low level of recognition.

The effect of publishing a paper in an OA journal may also differ depending on whether the journal is international or domestic. There may also be differences among international journals in how they are cited. International journals are accessed by researchers around the world, whereas domestic ones are accessed more frequently by researchers in the journal’s home country. Moreover, the publication of a paper in a reputable journal may lead to more citations than would be achieved through the expanded accessibility from OA journal publication.

Thus, the following three hypotheses are verified in this study:

H1 Papers published in OA journals are cited from more countries than those published in non-OA journals. They are cited by many foreign countries other than their own, leading to their high citation count.

H2 Papers published in international journals are cited from more countries than those published in domestic journals. They are cited by many foreign countries other than their own, leading to their high citation count.

H3 The effect of OA on citation count is different for international and domestic journals.

Data

A database for analysis was built based on Elsevier Scopus XML Data (extracted on February 19, 2015). Scopus was selected because the number of journals it includes is more extensive than Web of Science and includes publications in an extensive number of languages. Scopus and Web of Science listed journals in 54 and 49 languages, respectively.

When analyzing a wide range of journals, from world-renowned resources to those at the periphery, the use of Scopus offers an advantage in terms of coverage.

The source types covered by Scopus include Book, Trade Journal, Journal, Book Series, Multi-volume Reference Works, Conference Proceeding, and Report. Of these source types, only journals were selected for this study. Within Scopus, every journal is given an ID, and is tagged with its country of publication and research field. These journal IDs contained in the Elsevier Scopus XML Data were used when counting the number of journals. However, when journals are considered over time, aside from the journal title, there is no comprehensive list of journals that can be used for tracing certain changes, such as the cessation of publication, integration, and split.

Within the document type, Article, Conference Paper, and Review listings were used in the study. Although Scopus only records papers that include English-language abstracts, Scopus XML data lists information on the language used in the main text of each paper; this information was employed in the analysis.

The identification of a journal as OA is based on each journal's listing in the Scopus Journal Title List (May 2016 edition). This identification was determined by the target journal's OA status as of May 2016. For example, in the case of a journal that was not OA in 2004 but had become OA by May 2016, it was counted as an OA journal even in 2004. As a result, when viewed as a time series, the number of past OA journals may be overstated. To account for this, the study covered papers published over a three-year period, from 2010 to 2012, and the average number of citations was used to offset annual fluctuations.

In Scopus, OA journals were identified through the Directory of Open Access Journals (DOAJ)¹ and the Directory of Open Access Scholarly Resources (ROAD).² DOAJ, an online directory of OA journals launched in 2003, provides a whitelist of OA journals in all fields, allowing access to high-quality peer-reviewed OA journals. Its purpose is to expand the accessibility of OA journals by including all such publications for which measures have been taken to ensure quality. ROAD, provided by the ISSN International Center, is a service launched in 2013 that offers information on OA journals registered with ISSN.

In this study, the journals counted as OA are those listed in either DOAJ or ROAD and also identified as OA within Scopus. Scopus OA list includes Gold OA. It does not include Green OA, hybrid OA, or delayed hybrid OA. Thus, this study is subject to the constraint that it uses only journals listed in Scopus rather than all existing journals around the world.

Methods

Analytical viewpoint and counting method

Journals were divided into four categories based on whether they are OA and whether their country of publication is domestic or international. The Scopus XML data contains information on the author's country of affiliation and the journal's publication country for each paper. In this study, "international" means that an author's country of affiliation differs from the journal's publication country. If an author's country of affiliation (e.g., Japan) is the same as the journal's country of publication (e.g., Japanese Journal of Applied Physics published in Japan), then this paper is classified as "domestic." If an author's

¹ <https://doaj.org/>.

² <http://road.issn.org/en>.

country of affiliation (e.g., Japan) is different from the journal’s country of publication (e.g., PLoS ONE published in the USA), then this paper is classified as “international.” Since the former journal example is non-OA and the latter journal is OA, the former is classified as domestic non-OA and the latter as international OA. Japanese examples of these four journal categories and the abbreviations used in this analysis are shown in Fig. 2.

There were a number of cases of papers written by two authors, for example, one where the authors’ countries of affiliation were Japan and Germany, respectively, and the paper was included in Springer Nature’s OA journal, published in Germany. This paper was counted as international OA for Japan and domestic OA for Germany.

Categorizing a journal as OA was objective in all instances in contrast to the question of whether it is domestic or international, which is relative, as a journal may be domestic in a given affiliation country but international in another. As such, researcher decides to publish domestically or internationally at the time of a paper’s publication.

This study counted the number of papers published by each journal in each country. The whole counting method was used to consider each journal’s degree of involvement in paper production for each country.

The Scopus’ Journal Title List (May 2016 edition) was used as the basis for the classification of research fields. This study employed 27 field classifications found in Scopus. Papers corresponding to multiple fields were counted once for each field. Papers in the top 10% for their respective citation counts in each of these 27 fields in each publication year were extracted.

In this study, the following data was analyzed in each paper to verify the hypotheses identified above:

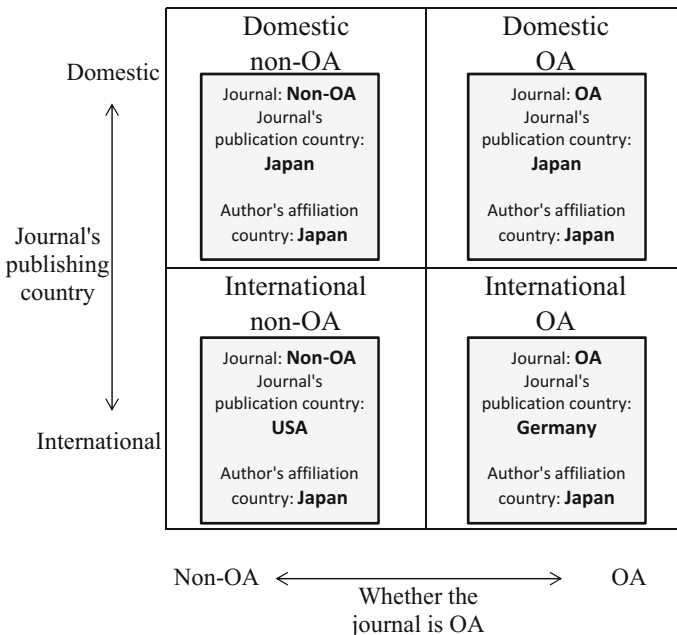


Fig. 2 Four journal categories

1. Language used in the main text of the paper
2. Countries citing the paper
3. Papers share of the top 10% most cited papers

The analyses were carried out in two stages. As this study focused on whether the journal's country of publication is domestic or international for the author's affiliation country, the countries that accounted for an overwhelming percentage of journals' country of publication, namely the USA (28.3%) and the UK (20.4%),³ were necessarily excluded from the discussion. (See “Appendix” for the top 20 list of countries with the highest percentage of journal publications in Scopus.) It is because their large share of publications will skew the results as many of them will publish in major publications that are also domestic (e.g., Physical Review Letters for the USA). Therefore, Stage 1 of this analysis concerns the characteristics of Japan, Germany, France, China, and South Korea (hereinafter referred to as “the five countries”) as examples of countries publishing a large number of papers.⁴

In Stage 2, the number of target countries was expanded to broaden the discussion. Using the average annual values from 2010 to 2012, the countries included in the analyses are those with at least one paper published in domestic non-OA and domestic OA journals outside of the USA and the UK. Through this process, a total of 77 countries were included in the final counting of results for average values and testing. The analysis included 19,530 journals and 3,215,742 papers without duplication.

Results

This section contains the results obtained from the analysis.

Characteristics of the language used in published papers

First, to examine whether the publication language differed by country, Table 1 shows the percentage of languages used in papers for each journal category using the five countries as examples (upper: all papers; lower: top 10% papers). This analysis uses the main text language of each paper listed in the Scopus XML data. If the database assigned more than one language for a paper (e.g., a paper written in Japanese and English), each language is counted.

The results indicate that most papers use English in both international OA and non-OA journals. In comparison, the percentage of English usage (from 20 to 50%) in papers published in domestic non-OA journals was lower, except in South Korea where most papers were published in English in domestic non-OA journals. Conversely, in domestic OA journals, a higher rate of English usage was observed even in domestic journals in non-English speaking countries.

³ Although the USA and the UK are excluded from the discussion, articles published in journals for which the USA or the UK is the country of publication are subject to analysis. In addition, the USA and the UK are included in the analysis in terms extracting articles in the top 10% and identifying countries from which citations originate.

⁴ Country identification is based on the country in which the institution that the author is affiliated with is located.

Table 1 Percentage of publication language in each journal category for the five countries (average values for 2010–2012)

All papers	Non-OA		OA									
	English		Native language			English			Native language			
	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)		
Japan	97,382	99.4	53.2	0.0	46.5	99.3	89.6	0.0	10.2			
Germany	108,607	98.6	49.7	0.8	50.2	96.9	90.1	1.0	9.8			
France	79,551	97.9	22.0	1.5	77.6	95.6	25.4	1.0	73.9			
China	256,394	99.7	13.2	0.1	86.8	99.4	57.1	0.2	42.3			
South Korea	51,355	99.7	70.7	0.1	29.3	99.4	92.3	0.1	7.7			
Top10% most cited papers	No. of papers	Non-OA		OA								
		English		Native language			English			Native language		
		International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	International journals (%)	Domestic journals (%)	
Japan	9549	100.0	99.1	0.0	0.9	99.8	100.0	0.0	0.0			
Germany	19,601	99.9	96.0	0.0	4.0	99.8	95.2	0.0	4.8			
France	12,854	99.9	91.8	0.0	8.1	99.7	52.4	0.2	47.6			
China	21,532	100.0	35.1	0.0	64.9	99.8	96.2	0.0	3.8			
South Korea	5563	100.0	90.9	0.0	9.1	99.9	100.0	0.0	0.0			

Percentages were calculated by language used for the main text. In terms of native languages, these were tabulated as Japanese for Japan, German for Germany, French for France, Chinese for China, and Korean for South Korea. In cases where papers were published in languages other than English or a country's native language, the total of percentages does not equal 100%

In France, the percentage of French usage in domestic non-OA and OA journals is high. Similarly, in China, a high percentage of Chinese usage in domestic non-OA journals was observed.

According to the results, papers in the top 10% of citations largely used English, except for the high percentage of Chinese usage in domestic non-OA journals. This shows that native language use is low among the top 10% most cited papers, suggesting that papers published in domestic journals in a country’s native language did not obtain many citations. However, this argument may not apply in France, given that the number of papers published in domestic journals was comparatively small.

In conclusion, English usage is high in papers published in OA journals, even in non-English-speaking countries, and there exists a strong relationship between publication language and citation count. Hence, an analysis of publication language is necessary. In light of this consideration, subsequent analyses include only the papers that employed the English language.

Number and percentage of papers using English

After this section analyzes only the papers that used English, examining the average number of papers and relative ratio of papers in each journal category for 77 countries from 2010 to 2012 (see “Appendix”). The average percentage of papers published in international non-OA journals was 75.1%, indicating that the publication of papers in international non-OA journals was a major priority for each country. Papers published in international OA journals accounted for 14.1%, domestic non-OA journals for 6.8%, and domestic OA journals for 4.1%.

Percentage of publications cited by foreign countries

To investigate whether the number of citations of a paper was affected by the category of the journal in which it was published, the percentage of publications cited by foreign countries in each journal category was determined. In other words, this study looked into whether the increased ability of other countries to access publications through OA leads to being cited by these other countries.

In Table 2, the percentage of publications cited by foreign countries (i.e., by countries other than that of the paper itself; hereinafter referred to as “foreign citation”) has been calculated for papers published in each country. The calculation method is as follows.

First, using the cited paper and citing paper as units, non-overlapping pairs are identified as the author’s country of affiliation of the cited and citing paper. The affiliation country of the cited paper is $i = (1, \dots, L)$, the affiliation country of the citing paper is $j = (1, \dots, M)$, and the year of publication is $n = (1, \dots, N)$.

If the number of occurrences of pairs i and j in a given year n was denoted as a_{ij} , the annual average percentage at which country i is cited by country j , R_{ij} , was calculated by the following formula:

$$R_{ij} = \frac{\frac{1}{n} \sum a_{ij}}{\sum_i \left(\frac{1}{n} \sum a_{ij} \right)}$$

The results for the five countries indicated that the percentage of foreign citations tends to be relatively higher for papers published in international rather than in domestic journals and in OA rather than non-OA journals.

Table 2 Percentage of publications cited by foreign countries in each journal category for the five countries (average values for 2010–2012)

Countries	International non-OA (%)	International OA (%)	Domestic non-OA (%)	Domestic OA (%)
Japan	81.2	83.4	60.6	68.1
Germany	83.4	83.6	76.2	84.3
France	85.6	87.7	85.0	80.3
China	58.7	68.7	37.9	57.3
South Korea	83.9	87.6	64.7	69.1

A nonparametric test was performed to determine whether any difference exists in terms of the median percentage of foreign citations between non-OA and OA journals when 77 countries were considered. A Wilcoxon matched-pairs signed-ranks test was carried out to determine any difference in median value. The null hypothesis that no such difference in the median existed for data pairs was tested. Considering the possibility that trends may differ between countries with a large number of papers and those without, a test was also conducted for a case in which the total number of papers is larger than the median number of papers and one conducted for a case with a smaller number of papers than the median. The results are shown in Table 3.

The results of these tests showed that the median value for the percentage of foreign citations was higher for international OA journals; the null hypothesis, which states that there was no difference in median, was statistically rejected. The null hypothesis was not rejected for domestic journals. Thus, international journals using OA expand their accessibility more broadly and increase a paper's number of foreign citations.

Number of countries that papers are cited in

For each journal category, the number of countries citing a paper was determined. For the calculation method, non-overlapping affiliation country pairs were created for each cited and citing paper. For each country affiliated with the author(s) of the paper being cited, an average annual value was calculated for the number of countries citing the paper.

Table 4 shows the results of Wilcoxon matched-pairs signed-ranks test of 77 countries. The results of this study showed that papers published in international journals and those published in OA journals tended to be cited in a greater number of countries. In terms of

Table 3 Wilcoxon matched-pairs signed-ranks test for foreign citations in the 77 countries

Journal	Non-OA or OA	All countries		Above the median countries		Bellow the median countries	
		Median (%)	<i>p</i> value	Median (%)	<i>p</i> value	Median (%)	<i>p</i> value
International	Non-OA	90.1	0.000***	87.7	0.000***	92.4	0.749
	OA	91.5		90.8		93.4	
Domestic	Non-OA	68.3	0.171	69.8	0.256	66.3	0.522
	OA	70.3		69.7		55.5	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

the number of citations, this figure was higher for OA rather than non-OA journals, particularly in domestic journals.

Percentage of citations from countries with large numbers of papers

Although the characteristics of foreign citations were clarified in Table 3, a more detailed breakdown was determined to establish whether these foreign citations were from countries that publish a large number of papers. By dividing countries into those publishing a large number of papers and those publishing a lower number, the author identified from which the citations came from. The results are shown in Table 5.

The results indicated that papers published in international non-OA journals were more heavily cited by countries with many papers than those published in international OA journals. Thus, although the percentage of foreign citations was higher for international OA journals than international non-OA journals, these foreign citations were from countries with small numbers of papers, whereas international non-OA journals attracted attention from countries with large numbers of papers. In other words, the OA has an effect on countries with lower numbers of papers.

Percentage of the top 10% most cited papers

To verify if the citation count differs depending on whether a journal is OA or not, the differences are present in the percentage of the papers with the top 10% of citations (i.e., in terms of quality value). As an example, the figures for the five countries are shown in Table 6.

In international journals, when OA are compared with non-OA journals, the quality value tends to be higher among non-OA journals. For domestic journals, the quality value tends to be higher among OA journals, except in the case of France. Based on these findings, it can be concluded that while gaining wider accessibility does not have any major effect on citation count for international journals, for domestic journals in these five countries from the non-English speaking world, OA journals are more likely to be cited than non-OA journals that have few opportunities to be widely viewed.

Here, a nonparametric Wilcoxon matched-pairs signed-ranks test was performed to determine whether any difference exists between non-OA and OA journals in terms of the median quality value when 77 countries are assessed in the same way as in the above sections. The results are shown in Table 7.

The result of these tests indicated that the null hypothesis was statistically rejected for international journals as there was no difference between non-OA and OA journals’

Table 4 Wilcoxon matched-pairs signed-ranks test for the number of countries in the 77 countries

Journal	Non-OA or OA	All countries		Above the median countries		Bellow the median countries	
		Median	<i>p</i> value	Median	<i>p</i> value	Median	<i>p</i> value
International	Non-OA	7.2	0.000***	7.4	0.000***	7.2	0.108
	OA	8.1		8.4		7.8	
Domestic	Non-OA	2.6	0.040*	3.3	0.418	2.3	0.053
	OA	2.9		3.3		2.6	

*** *p* < 0.001; ** *p* < 0.01; * *p* < 0.05

Table 5 Wilcoxon matched-pairs signed-ranks test for foreign citations from countries with large numbers of papers in the 77 countries

Journal	Non-OA or OA	All countries		Above the median countries		Bellow the median countries	
		Median (%)	<i>p</i> value	Median (%)	<i>p</i> value	Median (%)	<i>p</i> value
International	Non-OA	79.8	0.000***	79.6	0.000***	80.0	0.000***
	OA	76.9		77.1		76.2	
Domestic	Non-OA	58.3	0.171	64.8	0.627	55.8	0.200
	OA	58.9		60.9		57.5	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

median quality value, whereas the null hypothesis was not rejected for domestic journals at 5% statistical significance level. This suggests that among international journals, papers published in non-OA journals had a higher quality value, and that no quality value difference existed among domestic journals. There was also no difference observed in terms of the total number of papers. This result suggests that the higher quality value of international non-OA journals was due to foreign citations from countries with large numbers of papers.

Discussion and conclusion

This study compiled journal characteristics such as OA status and publication geography to analyze their characteristics in terms of publication language and the way they are cited. In previous studies, journals have been subjected to analysis en masse, with no full consideration given to their country of publication. In this analysis, the author has considered the fact that while papers published in international journals are highly likely to attract attention from multiple countries, those carried in domestic journals are more domestically oriented and, thus, less prominent and accessed less frequently. In addition, the publication language of domestic journals in non-English speaking countries had an effect on the number of citations.

As a result, the conclusions for this study's hypotheses are as follows:

Table 6 Quality value of papers in each journal category in the five countries

	International non-OA (%)	International OA (%)	Domestic non-OA (%)	Domestic OA (%)
Japan	13.5	11.6	2.9	4.2
Germany	22.2	16.8	12.8	19.2
France	20.1	18.0	8.4	3.1
China	14.6	10.3	1.7	2.1
South Korea	13.7	11.4	1.6	2.4

In each journal category, the quality value was obtained by dividing the number of Top 10% most cited papers by the total number of papers

Table 7 Wilcoxon matched-pairs signed-ranks test for quality value in the 77 countries

Journal	Non-OA or OA	All countries		Above the median countries		Bellow the median countries	
		Median (%)	<i>p</i> value	Median (%)	<i>p</i> value	Median (%)	<i>p</i> value
International	Non-OA	13.2	0.000***	16.2	0.000***	10.7	0.000***
	OA	11.6		14.8		8.5	
Domestic	Non-OA	0.4	0.063	1.7	0.405	0.0	0.078
	OA	0.9		2.2		0.0	

*** *p* < 0.001; ** *p* < 0.01; * *p* < 0.05

H1 Papers published in international OA journals are cited in more countries than those published in international non-OA journals. They are cited by many foreign countries other than their own, leading to their high citation count.

H2 Papers published in international journals are cited from more countries than those published in domestic journals. They are cited by many foreign countries other than their own, leading to many papers with a high citation count.

H3 The effect of OA on citation count differs for international and domestic journals, respectively. Among international journals, quality value is higher among papers published in non-OA journals than among those published in OA journals. Conversely, among domestic journals, no difference was observed statistically in quality value.

From this analysis, the author found that papers published in OA journals were cited by more countries and achieved more foreign citations. Although the focus of the study was on the country of publication (i.e., domestic or international) and the wider accessibility resulting from being OA, the results of the study showed that publishing in a competitive environment and in world renowned journals are key when it comes to citations. In particular, international non-OA journals attracted more attention from researchers from countries that publish a significant number of papers than international OA journals did, and could have contributed to the higher citation counts of the former.

The global research landscape is changing and the number of OA journals is increasing and expected to continue to do so into the future. An opportunity for future research efforts will be to monitor this shift and note any effects on the dissemination of research in different countries.

However, this study has limitations. First, it used journal identification that only indicated whether journals are OA at the present time. Hence, as the number of OA journals is increasing, future trends will likely change depending on which journals become OA. It is precisely because of this point of transition to OA that it is beneficial to discuss what kinds of differences can be derived. Even among OA journals, there may be a perceived hierarchy of journal quality (i.e., quality of peer-review), as pointed out by Bohannon (2013). Although the analysis involved journals listed in the Scopus database (based on DOAJ that provides a whitelist of OA journals), it did not consider such a quality hierarchy, and incorporating this into OA research will remain a future challenge.

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Appendix

See Tables 8 and 9.

Table 8 The top 20 list of percentage of journals' countries of publication in Scopus

Countries of publication	Percentage
United States	28.3
United Kingdom	20.4
Netherlands	9.3
Germany	7.0
France	2.8
China	2.4
Switzerland	2.1
Italy	2.1
Japan	2.1
Spain	1.8
India	1.5
Canada	1.4
Poland	1.3
Australia	1.3
Russian Federation	1.2
Brazil	1.1
South Korea	0.8
Czech Republic	0.7
Egypt	0.6
Romania	0.6

Table 9 Number of papers and ratio of foreign non-OA, domestic non-OA, foreign OA and domestic OA in each journal category for the 77 countries (average values for 2010–2012)

Countries	Total number of papers	International non-OA (%)	Domestic non-OA (%)	International OA (%)	Domestic OA (%)
United Arab Emirates	1589	86.7	0.0	13.0	0.3
Argentina	7854	86.9	0.8	11.7	0.6
Australia	52,618	80.8	9.8	8.6	0.8
Austria	13,367	86.4	2.6	10.7	0.3
Azerbaijan	552	82.6	0.8	16.1	0.5
Belgium	19,815	87.3	2.8	9.7	0.2
Bangladesh	1854	64.8	7.2	21.0	7.0
Bulgaria	2701	63.0	17.8	13.4	5.8
Bosnia and Herzegovina	426	51.1	13.5	27.2	8.2

Table 9 continued

Countries	Total number of papers	International non-OA (%)	Domestic non-OA (%)	International OA (%)	Domestic OA (%)
Brazil	31,104	73.5	1.4	10.6	14.5
Canada	65,826	83.9	6.1	8.9	1.1
Switzerland	26,054	84.2	2.1	11.8	1.8
Chile	4676	86.5	0.2	9.9	3.4
China	163,142	80.3	8.5	9.7	1.5
Colombia	2626	76.9	0.7	17.6	4.8
Cuba	855	74.6	8.6	16.3	0.5
Czech Republic	10,517	75.5	6.8	11.2	6.5
Germany	95,329	76.2	12.2	10.0	1.6
Denmark	14,679	86.1	1.6	11.7	0.6
Egypt	8411	78.9	4.2	16.4	0.5
Spain	48,872	87.7	1.3	9.8	1.2
Estonia	1546	79.5	0.3	14.7	5.5
Ethiopia	882	65.8	7.1	26.5	0.7
Finland	11,813	86.8	0.8	11.5	0.9
France	66,479	85.0	4.8	10.1	0.2
Georgia	600	72.9	8.1	18.9	0.1
Greece	12,658	83.8	2.4	11.7	2.1
Hong Kong	9801	91.5	1.4	5.8	1.3
Croatia	3420	63.3	6.0	13.0	17.7
Hungary	6558	78.2	9.1	11.1	1.6
Indonesia	1854	73.7	4.8	17.7	3.9
India	70,598	59.7	17.2	9.7	13.4
Iran	25,636	71.9	5.6	14.3	8.1
Iraq	689	63.5	3.9	29.5	3.0
Israel	13,512	88.7	0.7	9.2	1.3
Italy	61,106	83.1	5.3	9.9	1.7
Jamaica	283	60.0	1.1	12.0	26.9
Jordan	1692	78.6	3.2	16.4	1.9
Japan	84,765	71.4	15.8	8.4	4.3
Kenya	1537	71.5	2.5	25.9	0.1
South Korea	48,628	75.1	11.6	7.2	6.1
Libyan Arab Jamahiriya	230	63.2	8.6	25.5	2.8
Sri Lanka	703	67.7	11.2	20.1	1.0
Lithuania	1891	59.0	23.0	12.7	5.2
Latvia	690	76.5	3.3	13.9	6.2
Morocco	1758	70.1	1.9	26.2	1.8
Moldova	285	88.8	0.4	8.4	2.5
Mexico	10,185	81.6	0.9	13.6	3.9
Malta	248	78.6	0.5	11.7	9.1
Malaysia	10,824	62.3	7.7	25.5	4.5
Nigeria	4498	59.5	12.8	26.5	1.2

Table 9 continued

Countries	Total number of papers	International non-OA (%)	Domestic non-OA (%)	International OA (%)	Domestic OA (%)
Netherlands	36,728	77.6	11.8	10.2	0.5
Norway	11,812	86.2	0.9	12.3	0.6
Nepal	645	53.3	16.0	20.7	10.0
New Zealand	9772	82.9	8.6	7.6	0.9
Oman	710	76.8	0.9	16.5	5.7
Pakistan	6989	50.7	20.4	15.2	13.7
Philippines	1151	72.6	14.8	11.6	1.0
Poland	21,145	65.4	12.0	8.0	14.5
Puerto Rico	730	82.2	4.0	10.8	3.0
Portugal	11,504	87.8	1.0	11.0	0.2
Romania	8208	47.2	37.6	7.3	7.9
Russian Federation	32,359	55.1	38.6	5.8	0.5
Saudi Arabia	7085	75.3	1.0	21.7	1.9
Singapore	10,953	87.5	3.0	9.4	0.2
Slovakia	3441	68.6	12.3	17.3	1.9
Slovenia	3604	76.7	5.5	14.0	3.8
Sweden	23,685	86.3	0.8	12.3	0.6
Thailand	7661	69.7	12.8	15.3	2.2
Turkey	23,236	77.8	5.7	13.2	3.4
Taiwan	28,923	85.0	4.9	9.5	0.6
Tanzania	807	62.6	1.1	30.8	5.6
Ukraine	5829	80.2	4.8	7.9	7.1
Venezuela	910	81.5	1.8	15.4	1.4
South Africa	10,691	71.4	7.7	12.4	8.5
Average of 77 countries	17,011	75.1	6.8	14.1	4.1

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