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Sustainability of open access citation advantage: the case of Elsevier's author-pays hybrid open access journals

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Abstract The present study tended to investigate the sustainability of citation advantage of author-pays hybrid open access journals. Applying a comparative citation analysis method, it explored a sample consisted of 160,168 articles in 47 Elsevier APC-funded hybrid open access journals published in the periods 2007–2011 and 2012–2015. Two citation windows were selected in the study: one ranging from the journals' publication years until 2013 (obtained from Sotudeh et al. in Scientometrics 104(2):581–608, 2015), and another ranging from the journals' publication years until 2016 (data collection date in the present study). The comparative citation analysis of the older articles (published in 2007–2011) in the two mentioned citation windows indicated that they sustained their citation advantage in comparison with the toll-access ones. The citation advantage was also confirmed for more recent APC-funded OA articles (published in 2012–2015). Therefore, the passage of time did not seem to affect the citation gap between APC-funded OA and toll-access articles, and the citation advantage of the APC-funded OA articles was apparently a sustainable phenomenon. Moreover, the number of the APC-funded OA articles increased in comparison with that of the toll-gated articles. In addition, the APC-funded OA articles exhibited citation advantages in almost all fields.

Keywords APC · Article processing charges · Author-pays model · Sustainability · Hybrid open access journals · Open access citation advantage

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Introduction

Open access (OA) to scientific publications has been devised to break publishers' monopoly on academic productions and liberalize the public access to science in order to bring the academia back to its authentic scholarly traditions. Publishing Gold journal was the earlier OA model admitted by publishers. It was followed by the Green model and hybrid Gold OA or the Author-pays model with Article-processing-charges (APC) paid by volunteer authors. The latter was proposed by publishers in order to reduce the threats of OA repositories to their revenues from the subscription model (Björk 2004; Björk et al. 2014).

The validation of the OA publications in comparison with that of subscription-based articles has been one of the most important challenges to establish the OA demands (Åström 2008; McVeigh 2004; Sotudeh and Horri 2007). Citation advantage has been used as a metric to claim the validation and recognition of the OA articles by their citing scholars. Widespread research evidence confirmed the OA citation advantage (OACA) of different OA models (Lawrence 2001; Antelman 2004; Norris et al. 2008; Kousha and Abdoli 2010; Hajjem et al. 2006), including the APC-funded one (Eysenbach 2006; Chaudhuri and Thohira 2010; Sotudeh et al. 2015). In a detailed investigation of the citation advantage of APC-funded OA papers, Sotudeh et al. (2015) studied the articles published in 47 Elsevier and 576 Springer hybrid journals between 2007 and 2011. They advocated a significant growth of the OA articles and their citation advantage in comparison to the subscription model. In fact, Social Sciences and Humanities ranked the lowest and Natural Sciences had the highest rank in terms of OA citation advantage.

The OACA-oriented studies focused on different collections and different citation and publication windows. Given the temporal fluctuation and dynamism of citation, it is not clear whether the collections reported to experience OACA sustain their superiority over time or this is rather a temporary imbalanced fading with the passage of time. To answer the question, this follow-up research investigated the APC-funded OA (hereafter OA in brief) and toll-access or non-open access (TA) articles published in 47 Elsevier APC-funded journals identified by Sotudeh et al. (2015). It examined the sustainability of the OACA from two perspectives: the citation advantage of older OA articles in a newer citation window, and the citation advantage of more recent OA articles published in the same journals. Sotudeh et al. (2015) used a citation window from 2007 to 2013, including a time span from three to 7 years depending on the publication date of the article. In the present study, the articles published by the 47 Elsevier journals would be examined in a wider citation window from 2007 to 2016 (i.e. the data collection date) and the findings would be compared with those of Sotudeh et al. (2015). Moreover, the citation advantage of newer OA articles published in the same journals (between 2012 and 2015) in a 2–5 year citation window would be investigated.

Literature review

Open Access movement tried to provide quick, free and fair access to research studies, and thereby to facilitate the advancement of science and knowledge (Björk 2004; Chi Chang 2006). To achieve these ambitious goals, it required review and publication costs. Open access system has devised various models to cover theses costs, the most important of which are:

- Green OA model (free publication of articles for authors, and free access to the author-archived version for readers through the authors' personal websites or subject or institutional repositories);
- Subsidized Gold OA (free publication of articles for authors and free access to the entire journal content for readers);
- Mandatory Gold OA or pure Gold OA (paid publication for authors and free access to the entire journal content for readers), and
- Hybrid Gold OA model or author-pays (paid publication of articles for authors and free access for readers, just to the author-paid section of the journal).

Some adherents of the OA movement consider the Green OA model as short-term prospect, which should be gradually oriented to long-term prospect by supporting authors and research institutes to finance the publication of the articles. The long-term prospect is depicted in the pure and hybrid gold OA models based on paying the publication charges by authors. What makes the hybrid model different from the pure golden one is the authority of the authors or research sponsors to pay for the publication of articles (Abad 2009; Aguzzi 2015; Björk et al. 2009; Harnad et al. 2008; Hunter et al. 2012).

The OA models are widely confirmed to show a citation advantage over their toll-gated peers (Sotudeh and Horri 2008, 2009; Swan 2010; Gargouri et al. 2010; Wagner 2016; Ottaviani 2016). Although all fields are not advantageous to the same degree, the OA citation advantage is supported for computer science (Lawrence 2001), philosophy, political science, electrical engineering and mathematics (Antelman 2004), ecology, mathematics, applications, sociology and economics (Norris et al. 2008), agriculture (Kousha and Abdoli 2010) and many other fields (Hajjem et al. 2006).

Since the growth of OA repositories is considered as a threat to the publishers' earnings from the web subscription model (Björk 2004; Björk et al. 2014), hybrid OA model provided the authors or sponsors with an open choice to pay for publishing their articles. Many of the great publishers such as Elsevier, Springer, Oxford, Wiley, Sage, and Cambridge supported the hybrid model (Dallmeier-Tiessen et al. 2010; Pinfield 2006; Moskovkin 2008; Solomon and Björk 2012a). Researchers' motivation to increase their citation and visibility, the provision of discounts or exemptions especially for authors in low-income countries, and the access to international research grants are among the factors playing a role in the development of the hybrid OA model (Mounce 2013; Bernius and Hanauske 2009; Pinfield 2010; Björk 2012).

Although the number of papers in the Author-pays or APC-funded model has significantly increased in recent years (Laakso and Björk 2016; Sotudeh et al. 2015), publishers and researchers' tendency to the model is still unstable (Björk and Solomon 2012b; Vogel 2011). Basically, the number of articles in this model, especially compared to the green model, is estimated to be minimal (Björk and Paetau 2012; Carr et al. 2006; Gargouri et al. 2012; Harnad 2006; Harnad et al. 2008). The reluctance to APC-funded model is believed to have roots in various factors, including its unaffordability for authors or research sponsors. The high publication fee ranges from $300 to 3000 for the majority of publishers; it sometimes rises to $5000. On the other hand, to publish their works, the authors prioritize the journal's quality, validity, impact factor, lifetime, citation advantage, editorial quality and reviewing process over OA and the publication fees (Björk and Solomon 2015; Björk et al. 2011; Coonin 2011; Doty 2013). However, the existence of predatory publishers, who usually publish non-qualitative articles through author-pays, has shaken the confidence of scientific community in the model (Akhtar 2015; Beall 2013; Frandsen 2009; Papin-Ramcharan and Dawe 2006). It is, therefore, likely that poor quality articles are published

due to the financial ability of wealthy authors. Another threatening aspect is the double dipping problem, which serves the profitability of both subscription and publication fees for publishers (Bernius et al. 2009; Ho 2011; Jeon and Rochet 2010; Solomon and Björk 2012b; Mittermaier 2015; Weber 2009). Thus, it endangers the library and research budgets.

Although the tendency to APC-funded model, in comparison with other OA as well as TA models, is estimated to be negligible, citation analyses show that they are more advantageous than toll-gated articles and even articles in other OA models (Björk and Solomon 2012a; Chaudhuri and Thohira 2010; Solomon et al. 2013), including the green model (Davis 2009; Eysenbach 2006; Harnad and Brody 2004; Lin 2007; Mueller-Langer and Watt 2014; Koler Povh et al. 2013). Moreover, Van Dorp (2012) and Koler Povh et al. (2013) showed that there was a positive association between the APC-funded model and the journals' impact factors. By investigating ten journals on medicine and science through traditional, subsidized gold, and pure gold models, Chaudhuri and Thohira (2010) concluded that despite their limited number, articles in both OA models were more cited than the traditional ones. Furthermore, their study showed that hybrid OA journals were more advantageous than pure gold ones. Moreover, according to Gaule and Maystre (2011) and Koler Povh et al. (2013), researchers choose their high-quality articles to be published in hybrid APC-funded journals.

According to Wang et al. (2015), APC-funded OA articles in the Nature Communications e-journal not only have citation advantage, but also unlike the subscription model, have sustained and increased the journal downloading over a long period of time. Since 2014, the journal has become a pure gold model demonstrating the possibility of shifting from the hybrid to the pure gold model through the authors and sponsors' supports.

Recently, Piwowar et al. (2017) showed that 28% of the papers were OA. They found that the OA papers experienced citation advantage over their TA peers. On the contrary, Dorta-González and Santana-Jiménez (2017) and Dorta-González et al. (2017) found no OA citation advantages, neither at journal level, nor at article level.

In a detailed investigation of OA citation advantage of 90,380 articles published in 47 Elsevier APC-funded hybrid journals, and 306,380 articles published in 576 Springer APC-funded hybrid journals between 2007 and 2011, Sotudeh et al. (2015) advocated a significant growth of OA articles. The OA articles had citation advantage in comparison with the subscription model in each field, including Social Sciences and Humanities, Life Sciences, Health Sciences and Natural Sciences.

As the searches in a wide number of OA-oriented publications revealed, the studies mostly supported the OACA for the APC-funded model. As a rare instance, one may name Sabharwal et al. (2014) reporting no significant difference between the APC-funded and subscription-based papers in terms of their citation and impact factor. As a result, the literature on the OA in general and on the APC-funded model in specific seems to be consistent; studies generally confirmed the OACA for a wide range of journals. However, more evidence through longitudinal studies is needed to confirm the OACA sustainability for the same collections (including the same articles and journals) with the passage of time. To do so, the present study tried to test the OACA sustainability of a group of journals by comparing its past and present citation performances.

Objectives

The main purpose of the present study was to investigate the sustainability of the citation advantage of OA articles published in the APC-funded journals. Hence, it aimed to achieve the following three specific objectives:

1. Investigating the growth trend of OA and TA articles published in 2007–2016;
2. Comparing the OA and TA articles published in 2007–2011 in terms of their citation changes from the past (in a 3–7 year citation window from 2007 to 2013) to the present (in a 6–10 year citation window from 2007 to 2016);
3. Examining the OACA of more recent OA articles published in 2012–2015 (through a 2–5 citation window of 2012–2016).

Methodology

Using a comparative citation analysis, the present study analyzed and compared citations of OA and TA articles published in 47 Elsevier hybrid journals identified by Sotudeh et al. (2015).

Data collection procedures

The research sample selected purposively consisted of the articles published in 47 Elsevier journals indexed in Scopus in the two publication time spans of 2007–2011 and 2012–2015. The rationale for focusing on Elsevier journals was that the publisher was known as the largest publisher of OA journals with 511 pure gold journals and 2149 hybrid journals in 2016 (Morrison 2017). Moreover, the reason for using the 47 journals is that Sotudeh et al. (2015) advocated that the journals had consistently followed the hybrid OA model between 2007 and 2011. Moreover, they had at least one OA article in 2007 and showed an OACA for the OA papers.

The identification of the OA articles

First of all, the papers published between 2007 and 2011 in 47 Elsevier journals were re-examined to double-check their OA model. To do so, the characteristics of these journals were examined by searching their ISSN in the Science Direct database which categorized journals through color labels in different OA models.

After ensuring the continuous adherence of the 47 journals to the hybrid OA model, their articles published between 2007 and 2015 were compiled from Scopus. This included 160,168 articles consisting of 90,380 titles published between 2007 and 2011, and 69,788 titles published between 2012 and 2015. Then, in order to identify the OA articles published in the APC-hybrid journals, the researchers referred to Science Direct database, where the type of OA articles was marked by a red label and also by the term "open access". Furthermore, in order to ensure open accessibility of the articles, the researchers attempted to download the full texts from an off-campus space. While downloading the articles, their URL was also controlled for the term "open archives", which indicated a delayed OA. Moreover, following Laakso and Björk (2016), the existence of the phrase "creative commons" was also controlled in each article. Finally, of the 160,168 articles in

this database, 5135 ones were identified as OA, including 982 titles published between 2007 and 2011, and 4153 titles published between 2012 and 2015.

In order to analyze the subjects, the content of the "subject" field of the journals was classified into four broader fields i.e. Natural, Life, Health, Humanities and Social Sciences. The number of citations was derived from the "cited by" field in the data collected from Scopus.

Data analysis procedures

The data were analyzed through the following procedures.

The growth trend of the articles

After examining the mathematical models provided in SPSS, an exponential model was found to best fit the growth trend of both OA and TA articles, in terms of its higher coefficient of determination and non-significant correlation between its predicted and residual values.

The citation growth

To investigate the citation growth of the articles, the percent of citation growth (PCG) was calculated for each article through the following formula:

$$\text{PCG} = [(\text{CIT2016-CIT2013})/\text{CIT2013}] \times 100$$

where CIT2016 is the number of citations of a given article since its publication year until 2016 (i.e. the data collection date of the present study) and CIT2013 is the number of citations of the same article since its publication date until 2013 (i.e. the data collection date of Sotudeh et al. 2015). Then, through an independent samples *t* test, the PCG values of the OA and TA articles were compared in terms of the year and the field.

It should be mentioned that there were 7495 and 73 uncited papers, accounting for 6.44 and 4.78% of the total NOA and OA papers, respectively. The uncited papers did not enter the analyses conducted on citation performance.

The OA citation advantage

The OACA for each year or field was calculated by comparing the citation means of the OA and TA articles via the following formula:

$$[(\text{OACP-TACP})/\text{TACP}] \times 100$$

where OACP is the OA citation per paper, and TACP is the toll-access citation per paper. Obviously, if the result of this formula were positive, it would indicate OA citation advantage, and if negative, it would indicate the TA citation advantage.

Results

The growth trend of OA articles versus TA articles between 2007 and 2015

As mentioned, from among the 69,788 articles published between 2012 and 2015, the total number of the OA articles reached to 4153 articles (accounting for 4.6%), whereas in Sotudeh et al.'s (2015) study 982 articles were OA, accounting for 1.1% of the total 90,380 articles published in the 47 Elsevier journals between 2007 and 2011. The comparison of these two time spans indicates that OA articles had dramatically been rising between 2012 and 2015.

Figure 1 shows the growth trend of the OA, TA and total papers published in the hybrid journals on an exponential basis. As it is evident from the exponents of the equations, the number of the TA articles had been decreasing very slightly. According to the exponent of the related curve ($n = -0.02$), the number of TA papers had been decreasing about 2% annually.[1] However, the number of the OA articles had been growing with a steeper slope. Based on the exponent of the exponential curve ($n = 0.3308$), the model had been experiencing an increase of about 33% a year in its quantity. The increase in the size of the OA model cannot be attributed to a probable growth of the total size of the journals, as the total number of the papers published in the journals were found to show a trivial, though significant, decrease of about 0.9% annually ($n = -0.009$) ($R^2 = 0.73$, $N = 8$, Sig.0.002) (Fig. 1).

Subject areas' approaches to the APC-funded model in 2012–2015

Table 1 depicts the frequency of the articles in the four subject areas. It is worth noting that the total number of the articles (108,447) was greater than their absolute number (69,778), given the classification of some journals in more than one subject area.

Based on the data summarized in Table 1, Life Sciences ranked higher than the other subject areas in terms of the absolute number of its OA articles. Health Sciences was ranked second and Social Sciences and Humanities, and Natural Sciences were located in the last ranks, respectively. However, when the percent of the OA articles was taken into consideration, Social Sciences and Humanities was the first (11.89), followed by Health Sciences (7.08) and Life Sciences (6.16). Natural Sciences (2.18%) ranked the last regarding the percent of the OA papers.

The comparison of the PCG values of OA and TA articles published between 2007 and 2011

In order to investigate the effect of time lapse on the citation gap between OA and TA articles, their PCG values in different years were compared using independent samples *t* tests.

The results illustrated in Table 2 shows that there was not a significant difference between the PCG means of the two access models for the publication span of 2007–2011. Hence, it could be concluded that the OACA of the OA articles, previously confirmed by Sotudeh et al. (2015) regarding the citation span of 2007–2013, was sustained during the following years, i.e. 2013–2016.

[1] The data point related to year 2008 was found to act as an outlier and was therefore omitted from the analysis.

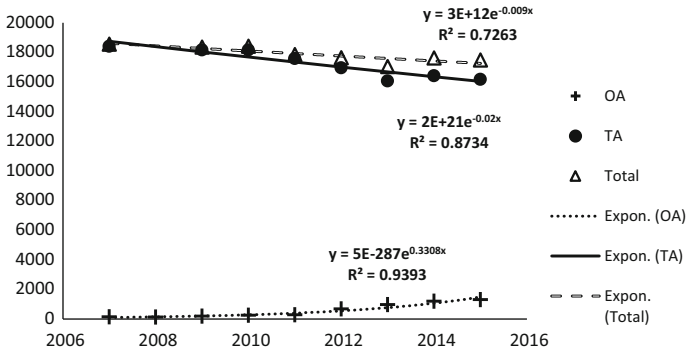

Fig. 1 The growth trend of OA, TA and total papers

Table 1 The number of OA and TA articles in different fields between 2012 and 2015

Model	Natural sciences		Life sciences		Health sciences		Social sciences and humanities		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
OA	96	2.18	3653	6.16	2486	7.08	1132	11.89	7367	6.8
TA	4327	97.82	55,700	93.54	32,664	92.92	8389	88.11	1,01,080	93.2
Total	4423	100	59,353	100	35,150	100	9521	100	1,08,447	100

Table 2 Independent samples *t* test comparing PCG of OA and TA articles

Year	Mean PCG		*t* value	*df*	Sig.
	OA	TA			
2007	0.67	0.65	0.728	18,555	0.467
2008	0.93	0.86	1.215	17,200	0.224
2009	1.22	1.16	0.397	18,354	0.691
2010	1.9	1.92	0.257	18,411	0.797
2011	4.35	3.94	1.789	17,850	0.074

The PCG values of the OA articles published in 2007–2011 in different fields

Table 3 shows the citations per paper (CPP) and PCG values of the OA and TA articles published between 2007 and 2011 in different fields. As evident, the percentage of OACA was very remarkable for all fields. Besides, all of the subject areas were revealed to have a higher PCG mean in the OA articles compared to TA group. It is worth noting that Natural Sciences included just four OA articles in Material Sciences during 2007–2011 and was not investigated in this section.

As evident from the results of the *t* tests comparing PCG means of OA and TA articles, in two fields of Health Sciences and Life Sciences the OA and TA articles differed significantly in terms of their PCG means. The PCG means of the OA group was higher than those of TA one; it can be implied that the citation gap between the two models in

Table 3 Citation performance of OA and TA articles in terms of fields

Field	Citation performance (up to 2013)			Citation performance (up to 2016)			Mean PCG			
	CPP		OACA %	CPP		OACA %	OA	TA	*t*	Sig.
	OA	TA		OA	TA					
Health sciences	13.48	11.29	19.40	32.31	24	34.63	2.38	1.74	3.13	0.001
Life sciences	13.3	11.86	12.14	30.53	24.36	25.33	1.91	1.56	4.24	0.000
Social sciences and humanities	15.39	11.49	33.94	38.54	28.15	36.91	2.71	2.39	1.07	0.286

Health and Life-related articles had increased over time. In other words, the OA articles not only sustained their citation advantage over time, but also kept increasing their citation distances from the TA publications. Further investigations taking the publication year into account showed that the increase in the citation gap did not occur every year. In Health Sciences, the citation gap between OA and TA articles had been increasing for papers published in 2008 and 2010, while in Life Sciences, it had been widening during the whole interval except 2010.

In Social Sciences and Humanities, investigating OACA in the both citation spans showed no significant differences between the two models regarding their PCG means. Consequently, although the field was found to experience a remarkable sustained OACA, it did not exhibit an increasing citation gap over time.

The citation advantage of OA articles published between 2012 and 2015

Table 4 shows that the OA articles published between 2012 and 2015, like the ones previously published in the same journals, had citation advantage over their TA peers. The citation advantage ranged from 25.71% in 2012 to 46.31% in 2015.

The citation advantage of OA articles published between 2012 and 2015 in different fields

As Table 5 shows, the OACA of the OA articles exhibited the highest (14.78%) in Life Sciences, and the lowest in Social Sciences and Humanities (1.36%). In Health Sciences, the citation advantage was 8.68. Furthermore, Natural Sciences with 96 OA articles could not be investigated since it contained just the journals on one subject area of Material Sciences.

Table 4 OA citation advantage for publications in 2012–2015

Year	OACP	TACP	OACA %
2012	16.3	12.96	25.71
2013	11.22	8.78	27.68
2014	6.25	4.69	33.09
2015	1.88	1.29	46.13

Table 5 Citation performance of OA and TA articles across fields

Field	OACP	TACP	OACA %
Health sciences	8.26	7.6	8.68
Life sciences	8	6.97	14.78
Social sciences and humanities	6.72	6.63	1.36

Discussion and conclusion

The results of previous studies showed that OA models (either Green, pure Gold or hybrid Gold) have citation advantage. However, no study was found to have examined the sustainability of the citation advantage over time for the same data collection. The present study, which was a follow-up study of Sotudeh et al. (2015), investigated the sustainability of citation advantage of the OA papers published in 47 Elsevier APC-funded hybrid journals. To do so, it compared the past and present citation performances of articles published in 2007–2011 using two citation spans: one starting from the papers' publication dates up to 2013 and another starting from the publication dates up to 2016. It also compared the citation performance of OA and TA articles published between 2012 and 2015 in a citation window of 2012–2016.

The results showed that the APC-funded model had been attracting a considerably larger number of articles in 2012–2015 compared to those in 2007–2011, although it was still in a minority considering the TA model. They also had been growing exponentially. The APC-funded model showed a high citation advantage, which was not only sustainable but also widening over time in some fields. Consequently, the OACA seemed to be positively time dependent, as it kept growing over time. It was not, indeed, ever-growing, but probably growing until it would get to its peak. For instance, in Life Sciences, it reached from 12.14% (for the older and shorter citation time span) to 25.33% (for the longer and newer citation window). In Health Sciences, the OACA increased from 19.40% in 2007–2013 citation span to 34.63 in the 2007–2016 citation window.

Social Sciences and Humanities had improved, though not significantly, its OACA from 33.94 in the past to 36.91 in the present. As seen, the OACA seemed to be a field-dependent characteristic, as it differed in its quantity and behavior among fields. Again Social Sciences and Humanities was the lowest in terms of its OACA value. However, the field was found to sustain its OA superiority over time (Table 3).

The amount of the OACA in Social Sciences and Humanities appeared to be considerably higher (33.94%) compared to the previous findings (3.14%) reported for the same citation window (from the publication date up to 2013) for a broader collection (Sotudeh et al. 2015). The study had focused on a huge group of journals consisted of 47 and 576 journals (co) published by Elsevier and Springer, respectively. As a result, the OACA seemed to vary among journals with different prestige levels, leading to the counteraction of higher by lower OACA values when being analyzed collectively. Besides, the verification of the subject categories covered by Elsevier journals on the Social Sciences and Humanities revealed that they were just limited to Social Sciences and Psychology subject areas. This may blur the role of subject and journal prestige. Because, unlike the Elsevier journals, Springer covers a wider range of Social Sciences and Humanities-related areas such as Business, Management, Accounting, Economics, Econometrics, Finance, Social Sciences, Arts and Humanities, Psychology, etc. in its APC-funded hybrid journals

(Sotudeh et al. 2015). Therefore, the difference might, also, be attributed to subject coverage divergences. To clarify this, we referred to the previous data collection and filtered Springer journals on Social Sciences and Psychology. The collection revealed CPP = 7.01 for its OA and CPP = 6.80 for its TA articles resulting in OACA = 3.95, which was far lower than the value yielded for Elsevier journals on the same subjects and in the same publication and citation time window (33.94).

This may provide an answer to Wray (2016a, b) who challenged Sotudeh et al. (2015) regarding their findings on Social Sciences and Humanities. In his study, Wray (2016a) reasonably argued that the OACA reported for the field might be caused by one article getting the maximum of the citations. To test the effect of the highly cited papers, the outliers with Citations ≥ 90 were identified and removed from the collection using Grubbs' test (Mean = 34.18, SD = 13.18, $N = 1949$, $Z = 4.199$, Sig. > 0.05). The recalculation of the OACA resulted in OACA = 1.72% which was still positive, though lower than the initial value reported in Sotudeh et al. (2015). Consequently, the field seemed to benefit from the OACA. However, as mentioned before, given the field-dependency of the phenomena, it was not highly affected by the OA model. Besides, the results of the present study confirmed that not all of the subject areas and journals in Social Sciences and Humanities might be expected to be equally benefitted from the OACA.

The citation advantage may serve as a leverage to drive writers and add survival motivations to their sense of altruism and commitment to science, which is not per se adequate to guarantee their support for the movement. However, that is not what OACA-oriented research seeks for. Ensuring higher visibility, effective and worldwide channel for disseminating research outputs and thereby progressing knowledge are the ultimate goals of OA, which can be partially traced via the OACA. As a result, even a low level of OACA, which can make researchers "reticent" in their support of OA for their individual goals, may be an early indicator of turning the academia back to its authentic traditions, though slightly and slowly. Besides, as Wray (2016a) correctly mentioned, "the research practices, publication practices, and citation practices in the Social Sciences and Humanities are different from those in the Natural Sciences, Life Sciences, and Health Sciences". Thus, OA is not meant to—and cannot—change the nature of a field's scholarly communication, but to help it realize its own potentialities, otherwise it is not flourished behind the access barriers. Consequently, for a field like Social Sciences and Humanities which is low in its citation potential in general, the very amount of variation cannot be negligible. As citation is just the visible tip of the "impact, importance, quality and usage" iceberg. For instance, referring to societal dimension of impact, Polonioli (2016) argued that "whilst citations allow a determination as to whether research is being pursued at the highest level on average or not, they might not be informative of its impact at a societal level."

With regard to this study's results, it supports the sustainability of the APC model; the OA articles have been keeping growing exponentially in quantity, with a higher citation performance leading to a citation advantage not only being sustained over time but also widening in some fields. The findings are in line with those of previous studies which testified the citation superiority of the OA articles, over not only TA model but also other OA models (Chaudhuri and Thohira 2010; Davis 2009; Eysenbach 2006; Gaule and Maystre 2011; Harnad and Brody 2004; Laakso and Björk 2016; Lin 2007; Mueller-Langer and Watt 2014; Sabharwal et al. 2014; Sotudeh et al. 2015; Wang et al. 2015). The sustainability of the OACA is in line with Archambault et al. (2016) who rejected the early publication advantage of OA articles. It is not, however, in agreement with Davis's (2009) findings reporting a decline in OACA over time for the biological and biomedical

literature. Given the temporal nature of citation and OACA, as well as its field and journal dependency, further research is needed to clarify the behavior of OACA over time.

It seems that the success of the APC model in attracting more articles and citations may lead to the appearance of citation core articles within hybrid journals. Discussions on the cause-effect relations of OACA and the OA articles' quality or visibility are continuing. If it is more decisively supported that higher recognition is due to higher quality, it would be possible to claim that high quality articles can be identified within hybrid journals based on their higher level of citedness. Therefore, further research is suggested to investigate the topic differences in the OA and TA articles, and their roles in the OA citation advantage.

The results also highlighted the OACA dependency on fields, time and journals. As the OACA was reported to be also dependent on multiple open access availability (Xia et al. 2011), more studies are required to examine the role and interaction of multi open access models in creating the OACA.

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