
Evolution of open access publishing in Chinese scientific journals

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ABSTRACT. *Based on the 1,608 journals covered by the Chinese Science & Technology Journal Citation Reports (2005 edition), we analyzed the open access (OA) publishing situation of Chinese scientific journals. From this database we identified 91 journals offering full OA; a further 139 journals offered delayed OA. Data collected at three different time points (January 2006, July 2006, and January 2007) showed that the OA status of these journals is not stable; some OA journals subsequently became non-OA. Most of the Chinese OA journals are not part of a larger aggregation, but are published independently. Relatively more OA journals are published in the fields of medicine and biology. Citation indicators of OA journals were found to be higher than those of non-OA journals.*



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Introduction

Open access (OA) literature is digital, online, free of charge, and usually free of most copyright and licensing restrictions.¹ Although some free online journals were established as early as the mid-1990s,² OA publishing has really taken off as an international phenomenon since the Budapest Open Access Initiative (BOAI) in 2001.³ Some OA publishers such as BioMed Central (BMC, <http://www.biomedcentral.com>) and Public Library of Science (PLOS, <http://www.plos.org>) have gained international prestige, and several of their journals are covered by Thomson Scientific's *Web of Science: Genome Biology*, published by BMC, has a 2006 impact factor of 7.17 and is ranked 9th out of the 140 journals listed under 'Biotechnology & Applied Microbiology'; *PLoS Biology*, published by PLoS, has a 2006 impact factor of 14.10 and is ranked first among the 64 journals listed under 'Biology'.

Since early 2005, the Chinese government and local scientific publishers have been paying close attention to OA publishing.^{4–7} In May 2004 Prof. Lu Yong-xiang (President of the Chinese Academy of Sciences) and Prof. Chen Yi-yu (President of the National Natural Science Foundation of China) signed the Berlin Declaration on Open Access to Knowledge in the Science and Humanities, on behalf of the Chinese government and the Chinese scientific community.⁸ Over the same period, Chinese journals have published several papers covering the origins, background, economic feasibility, and development of OA publishing.^{2,9} Chinese scientists' knowledge of and response to OA publishing,^{10,11} the challenges and opportunities of OA publishing for Chinese scientific journals,^{2,12–14} etc. As early as 2004 we ourselves urged the editors of Chinese English language journals to join the OA

Table 1. Numbers of OA journals and delayed OA journals found in January 2006, July 2006, and January 2007

| | OA journals | Delayed OA journals |
|--------------|---|---|
| January 2006 | 59 | 108 |
| July 2006 | 76 50 remained OA from January 2006 8 converted to delayed OA since January 2006 1 ceased to be OA since January 2006 26 became OA since January 2006 | 122 97 remained delayed OA from January 2006 10 ceased to be delayed OA since January 2006 1 inaccessible online 8 converted from full OA since January 2006 17 became delayed OA since January 2006 |
| January 2007 | 91 67 remained OA from July 2006 7 ceased to be OA since July 2006 2 inaccessible online 24 became OA since July 2006 | 139 118 remained delayed OA from July 2006 1 ceased to be delayed OA since July 2006 3 inaccessible online 21 became delayed OA since July 2006 |

publishing movement.¹⁵ Now that the practice of OA publishing is better known, and more publishers have gained experience with it, a growing number of Chinese scientific journals are becoming OA journals.^{14,16}

In order to study the overall situation of Chinese OA journals, we searched all 1,608 journals covered by the *Chinese Science & Technology Journal Citation Reports* (CJCR, 2005 edition),¹⁷ which is issued by the Institute of Scientific and Technical Information of China (ISTIC). Full texts of all these journals can be read online or downloaded from Wanfang Data (<http://www.wanfangdata.com.cn>) on the basis of 'pay per view' (for more information about this database, see the article by Wu *et al.*¹⁸). The websites of all 1,608 journals were accessed three times, in January 2006, July 2006, and January 2007. This made it possible to determine if the OA status of the journals had changed over this period.

Chinese OA journals and their policies

Number and evolution of Chinese OA journals from January 2006 to January 2007

We took the 1,608 journals covered by the 2005 edition of CJCR as our study sample; we checked each journal's website via the

CJCR link to www.wanfangdata.com.cn on three separate occasions, in January 2006, July 2006 and January 2007. In the case of journals with no linked online version, we first checked the sponsoring institution's website to see whether the journal was hosted there; failing that, we searched for the journal's title through Google (www.google.cn).

During the first search (January 2006), we found 167 journals that provided free online access to full papers; 59 of these made papers freely available online immediately upon print publication, and the remaining 108 offered free online access after some time delay. In this article, we refer to the former as 'OA journals', and to the latter as 'delayed OA journals'.

The numbers of OA journals and delayed OA journals found in the first, second and third searches (January 2006, July 2006, and January 2007) are listed in Table 1.

Our search results indicate that the OA status of many of the Chinese journals is unstable (Table 1). Of the 167 journals that were OA or delayed OA in January 2006, 25 (14.97% of the 167 journals) either were no longer OA/delayed OA 12 months later or were inaccessible online. In addition, 40 (23.95%) appeared to be inactive (their content had not been updated in the 12 months between the first and third search). On the

the OA status of many Chinese journals is unstable

Table 2. Number and percentage of Chinese OA journals among different types of publishers (CJCR, January 2007)

| | Sponsoring Institution | No. of journals covered by CJCR | % | No. of OA journals | % | OA journals as % of total | No. of delayed OA journals | % | Delayed OA journals as % of total |
|---|---------------------------|---------------------------------|-------|--------------------|-------|---------------------------|----------------------------|-------|-----------------------------------|
| 1 | Association or society | 514 | 32.0 | 24 | 26.4 | 4.7 | 32 | 23.0 | 6.2 |
| 2 | Research institution | 487 | 30.3 | 38 | 41.8 | 7.8 | 33 | 23.8 | 6.8 |
| 3 | University | 471 | 29.3 | 21 | 23.1 | 4.5 | 55 | 39.6 | 11.7 |
| 4 | Government department | 61 | 3.8 | 6 | 6.5 | 9.8 | 7 | 5.0 | 11.5 |
| 5 | Commercial publisher | 7 | 0.4 | 0 | 0 | 0 | 2 | 1.4 | 28.6 |
| 6 | Hospital/national company | 68 | 4.2 | 2 | 2.2 | 2.9 | 10 | 7.2 | 14.7 |
| | Total | 1608 | 100.0 | 91 | 100.0 | 5.7 | 139 | 100.0 | 8.6 |

other hand, 43 additional journals had become OA or delayed OA by July 2006, and a further 47 by January 2007. We also note that all Chinese OA journals or delayed OA journals are parallel online versions of existing printed journals.

Chinese scientific journals

According to recent statistics, 4,758 scientific journals are published in mainland China (excluding Hong Kong, Macao, and Taiwan).¹⁹ The majority are published in Chinese; about 210 are published only in English, and another 20 in minority languages (Uyghur, Kazak, Mongolian, Tibetan, etc.).

Based on publication policy and contents, Guo *et al.*¹⁹ classify Chinese scientific journals into four classes: 51.8% are academic (basic research) journals; 36.9% are technical journals; 9.6% are popular science journals; and 1.7% are guides or directories published by information centres or government agencies.

Types of journal publishers in China

Unlike the Western situation – where 45% of journals are published by commercial publishers, including about 25% published by the four largest commercial publishers

(Elsevier, Springer, Taylor & Francis, Wiley–Blackwell)²⁰ – in China, universities, societies, and research institutes are the major sponsors of scientific journals. They are responsible for respectively 28.8%, 25.6% and 24.3% of all published scientific journals.¹⁹

As a science indexing institute, ISTIC evaluates all journals and selects only those of high quality for indexing in the CJCR; thus only one-third of the existing 4,758 Chinese journals are covered by the CJCR (this is very similar to the 29.28% of journals listed in *Ulrich's* that are indexed by ISI²⁰). Table 2 and Figure 1 show the types of publishers and the percentage of OA journals for each of them.

Except for commercial publishers, the ratios of OA journals among the different journal sponsoring institutions are similar (see Table 2). The percentage (5.7%) of OA journals in CJCR is much higher than that in *Ulrich's Periodicals Directory* issued by CSA²⁰ and even higher than that in JCR issued by Thomson ISI.²¹ Morris found that of the 56,963 active academic/scholarly journals listed in *Ulrich's* in early 2007, 2,302 (4.0%) were listed as being OA.²⁰ In October 2004, McVeigh surveyed OA journals indexed in ISI's citation databases, and found 239 titles

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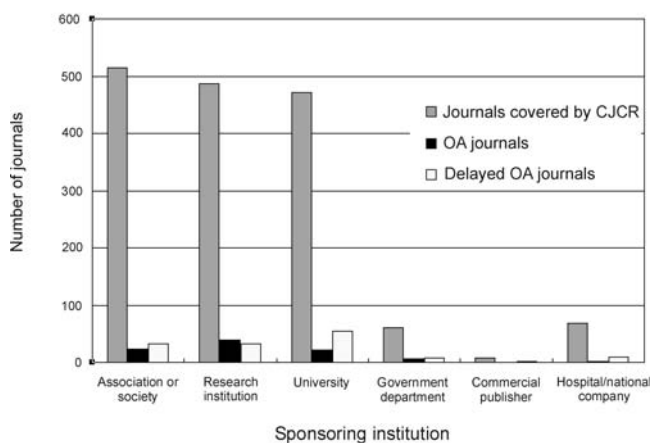


Figure 1. Number of Chinese OA journals among different types of publishers (CJCR, January 2007).

that could be classified as OA journals, which is approximately 1% of the 20,000 journals in ISI Web of Knowledge.²¹

In China, most scientific journals are subsidized by national or provincial governments, either directly or indirectly (e.g. via societies or national institutions). The main purpose of Chinese scientific journals is to make the results of scientific research, which is also often supported by governments, visible to the whole nation. Sponsoring journals is therefore seen as a means of promoting efficient communication. As journals are often largely or totally supported by subsidy, there is no commercial reason not to make the content freely available (and the objective of maximum visibility will also be achieved). Thus there is considerable scope

for OA and delayed OA in China, and many of the barriers that apply to publishers in the West are not applicable to journal publishers in China.

Online domain of OA journals in China

All the 91 OA journals and 139 delayed OA journals can be classified into four groups based on their first-level online domain names. As Table 3 shows, 62.5% of Chinese OA journals and 18.7% of delayed OA journals provide their online content independently (i.e. via an individual online domain only). Chinese non-OA scientific journals do not generally have their own websites; full text is only available on a 'pay per view' basis through a commercial

most scientific journals are subsidized by national or provincial governments, either directly or indirectly

Table 3. OA journals classified by first-level online domain names

| Type of online domain | Characteristics of online domain | No. of OA journals | % | No. of delayed OA journals | % |
|--|---|--------------------|-------|----------------------------|-------|
| Individual online domain | Journal has its own first-level domain name | 57 | 62.6 | 26 | 18.7 |
| Joint online domain | Two or more journals share the same first-level domain name | 15 | 16.5 | 64 ^a | 46.0 |
| Attached to an institutional online presence | Content accessible on main website of sponsoring institution | 7 | 7.7 | 14 | 10.1 |
| Other | Content accessible via other means, e.g. institutional library website, publisher's website, etc. | 12 | 13.2 | 35 | 25.2 |
| Total | | 91 | 100.0 | 139 | 100.0 |

^aTwenty-three of these offer content via both a joint online domain and an individual domain.

*an individual
online domain
is not the
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increasing a
journal's
impact*

journal database such as Wanfang Data (<http://www.wanfangdata.com.cn>) or China National Knowledge Infrastructure (<http://www.global.cnki.net/>). In the authors' opinion, an individual online domain is not the best way of increasing a journal's impact as an isolated (small, low impact) journal website is less likely to attract attention from the science community.

However, we found that some institutions are involved in the establishment of OA websites which offer access to a larger collection of related scientific journals. There are at least two OA websites of this kind. The first is 'Sciencepaper Online' (<http://www.paper.edu.cn/journal.php>), sponsored by the Center for Science and Technology Development, Ministry of Education, PR China; the other is 'Website of Principal Medicine in China' (<http://www.shouxi.net>), supported by Huaxia Investment Company. In January 2007, 'Sciencepaper Online' contained 73 journals, 9 of which were OA and 64 delayed OA; 49 of the journals (including 2 OA journals) were indexed by CJCR. At the same date, 'Website of Principal Medicine in China' included 295 medical journals; all were delayed OA journals, 25 of them indexed by CJCR. Both of these websites are loosely organized: journals can be added or removed by their publishers at will, and the journal contents of the two websites are not regularly updated. Twenty of the 64 delayed OA titles on 'Sciencepaper Online' and 15 of the 295 on 'Website of Principal Medicine in China' had not been updated during the whole of 2006.

Instability of OA status

As was shown in Table 1, Chinese journals' OA policies are not stable. For example, nine of the 59 OA journals identified in January 2006, and a further 9 of the 76 identified in July 2006, had become non-OA six months later. Some of these 18 journals are English-language journals with high academic quality and impact; the main reason why they abandoned their OA policy would appear to be their co-operation with international commercial publishers. (These titles of course remain accessible online, though in most cases not (full) OA.) For

example, the journal *Cell Research* is covered by Thomson Scientific's Science Citation Index (SCI), with a 2006 impact factor (IF) of 3.426, and is ranked 62nd out of the 156 journals listed under 'Cell Biology'. This is the highest 2006 impact factor for all the Chinese journals covered by SCI (the mean IF of the 75 Chinese journals indexed by SCI in 2006 is 0.633). *Cell Research* dropped its OA policy when it entered into co-operation with Nature Publishing Group in 2006. Other high-impact journals such as *Acta Mechanica Sinica*, *Journal of Integrative Plant Biology*, and *Journal of Genetics and Genomics* have also dropped their OA policies because of their co-operation with Springer, Wiley-Blackwell, and Elsevier, respectively.

Among the 91 OA journals identified in January 2007, 8 (8.8%) are published in English. These account for 21.6% of the 37 English-language journals covered by CJCR in 2005. On the other hand, of the 1,571 Chinese-language journals covered by CJCR only 83 (5.3%) are full OA. Most of the English-language scientific journals in China are directly sponsored by national institutions or governments, and they have far fewer subscriptions than do Chinese-language scientific journals. English-language journals are therefore more likely to be supported by a subsidy from their sponsoring institutions, rather than by income from subscriptions; as mentioned earlier, OA may be a logical step for a wholly or largely subsidized journal. This may explain why the ratio of OA to non-OA journals is higher among English-language than among Chinese-language journals.

Those journals that have abandoned an OA policy continue to be published in print and electronic form; the full text of these journals is available on a 'pay per view' basis through the database of their commercial publisher partner, or through a commercial journal database in China, such as Wanfang Data or China National Knowledge Infrastructure. Closing a journal is a step that is not taken lightly: in China, a new journal cannot be launched without obtaining a CN (China Number) or ISSN (International Standard Serial Number) from the General Administration of Press and Publication of the People's Republic of China (GAPP). In

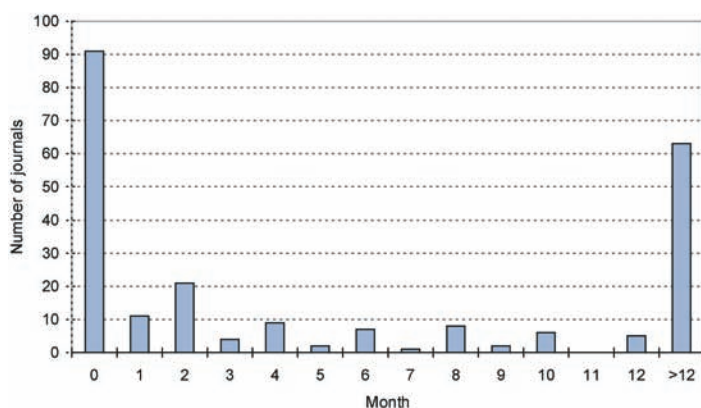


Figure 2. Delay in making papers OA.

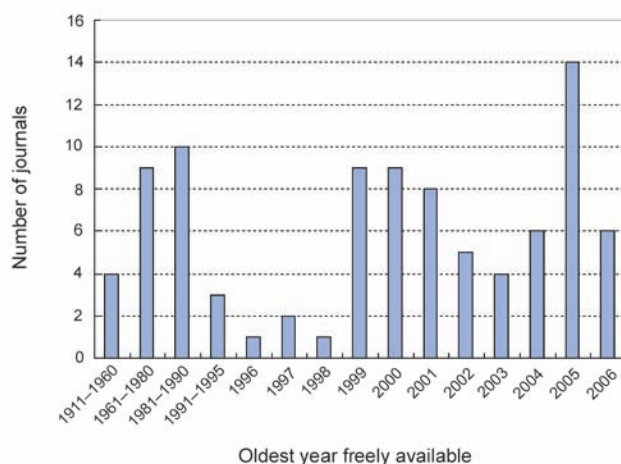


Figure 3. Year from which archival content is freely available for full OA journals.

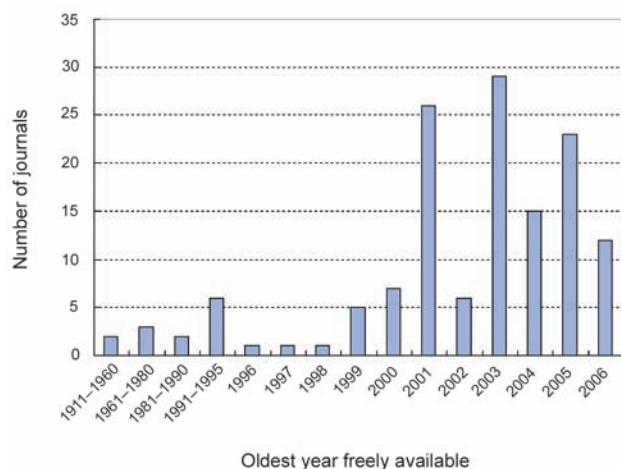


Figure 4. Year from which archival content is freely available for delayed OA journals.

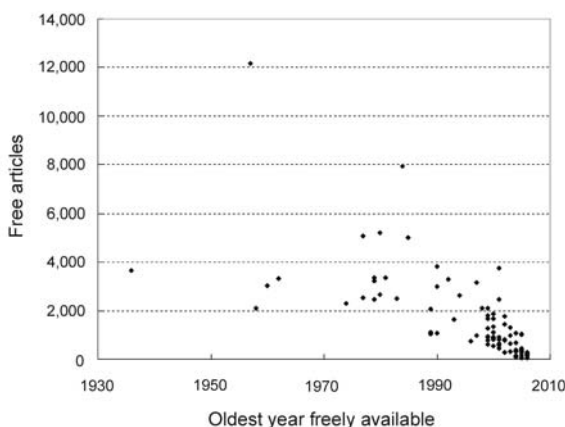
order to ‘control’ the number of journals, GAPP have only allocated about 20 such numbers per year for the past 15 years. Thus CN and ISSN are very precious in China; consequently very few (less than 10) journals cease publication each year.

Characteristics of Chinese OA and delayed OA journals

Timing of delayed OA journals

In our three surveys, we found that 90 OA journals have a free online version which is

Figure 5. Number of articles freely available from individual Chinese journals as of January 2007 (each dot represents one journal).



*the number of
free articles
varied widely*

made available more or less simultaneously with publication of the print version. Just one is made available online ahead of print: all papers accepted by *Acta Agronomica Sinica* are initially published in full text online; the print version is published about three months later. The 139 delayed OA journals offer free online versions some time after print publication. In terms of issues, 29 make the online version freely available after one issue, 14 after two issues, and 96 after three or more issues; in terms of months, 11 make the online version freely available after one month, 21 after two months, 44 after 3 to 12 months, and 63 after 12 months or more (see Figure 2).

Years of freely available content

As shown in Figure 3, about two-thirds of Chinese full OA journals (61 of 91) make their content freely available from 1999 or later. However, 16 journals make all their published papers (from the launch of the journal) free to their readers. In the case of the 139 delayed OA journals, 123 (88%) make their content freely available from 1999 or later (see Figure 4), and 9 journals make all their published papers (from the launch of the journal) free to their readers.

The data collected in January 2007 show that 25 (27.5%) of the 91 Chinese OA journals had fewer than 500 articles freely available; 48 journals (52.7%) had more than 1,000. The number of free articles varied widely, from 24 to 12,146 (see Figure 5). The mean number of free articles in the 91 Chinese OA journals is 1,573, which is much higher than that of the 1,150 journals

listed in the DOAJ (mean 287).²² The top five journals in terms of number of free articles are *Acta Physica Sinica* (12,146 articles), *Chinese Physics Letters* (7,896), *Chinese Journal of Semiconductors* (5,197), *Progress in Biochemistry and Biophysics* (5,080), and *Transactions of the Chinese Society of Agricultural Engineering* (4,988). Of these all except *Chinese Physics Letters* are published in Chinese; *Chinese Physics Letters* is published in English.

In the case of the 139 delayed OA journals, 62 (44.6%) of them had fewer than 500 articles freely available; 46 journals (32.7%) had more than 1,000. The number of free articles varied from 19 to 8,333, with a mean of 1,090. The top five journals in terms of the number of free articles are *World Chinese Journal of Digestology* (8,333 articles), *Journal of Tsinghua University* (6,919), *Journal of the Fourth Military Medical University* (6,643), *World Journal of Gastroenterology* (4,642), and *Acta Pharmacologica Sinica* (3,810). The last two of these (*World Journal of Gastroenterology* and *Acta Pharmacologica Sinica*) are published in English.

Format

The PDF file format is widely used by Chinese OA and delayed OA journals. Of the 91 OA journals, 87 (95.6%) provide articles in PDF format; 6 of these also provide articles in other formats, such as HTML, CAJ (Chinese Academic Journal viewer, developed by China National Knowledge Infrastructure, <http://www.global.cnki.net/>), CEB (Chinese eBook, developed by Beijing Founder Electronics Co., Ltd. [LEARNED PUBLISHING VOL. 21 NO. 2 APRIL 2008](http://www.</p>
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Table 4. Disciplinary distribution of Chinese OA and delayed OA journals in CJCR (2005)

| Discipline | No. of journals in CJCR-A | OA journals-B (%) | B/A (%) | Delayed OA journals-C (%) | C/A (%) |
|--------------------|---------------------------|-------------------|---------|---------------------------|---------|
| Medicine | 442 | 17 (18.7) | 3.9 | 33 (23.7) | 7.5 |
| Biology | 56 | 13 (14.3) | 23.2 | 11 (7.9) | 19.6 |
| Multidisciplinary | 83 | 8 (8.8) | 9.6 | 10 (7.2) | 12.1 |
| University journal | 80 | 7 (7.7) | 8.8 | 10 (7.2) | 12.5 |
| Chemistry | 35 | 7 (7.7) | 20.0 | 4 (2.9) | 11.4 |
| Agriculture | 135 | 6 (6.6) | 4.4 | 14 (10.1) | 10.4 |
| Geosciences | 104 | 6 (6.6) | 5.8 | 6 (4.3) | 5.8 |
| Other disciplines | 673 | 27 (29.6) | 4.0 | 51 (36.7) | 7.6 |
| Total | 1608 | 91 (100.0) | 5.7 | 139 (100.0) | 8.6 |

founder.com.cn), etc. The remaining 4 journals only offer articles in HTML or WinWord format. Of the 139 delayed OA journals, 135 (97.1%) provide articles in PDF format (5 of them also provide articles in HTML or CAJ format). The remaining 4 journals only offer articles in HTML format. For non-OA Chinese scientific journals, their commercial database publisher partner (such as Wanfang Data or China National Knowledge Infrastructure) provides full text in PDF format only.

The international OA journals published by BioMed Central and Public Library of Science are offered in both PDF and a searchable file format (HTML in the case of BMC, XML in the case of PLoS). The 1,079 journals hosted by HighWire Press, most of which are delayed OA, are almost all available in HTML as well as PDF format. Many international journals, both OA and non-OA, have a hyperlinked 'table of contents' at the beginning of every paper, linking directly to each section of the article, and references are often linked to their full-text sources. Thus the full paper is 'active' and allows for convenient searching and linking. However, most Chinese OA journals only provide full text in PDF format, which means that the articles are effectively isolated from related information.

Disciplinary distribution and scientific impact of Chinese OA journals

Disciplinary distribution

For journals covered by CJCR, the percent-

age of OA journals is relatively high in the fields of biology and chemistry, while the absolute numbers of OA journals are relatively high in medicine and biology (see Table 4). We found that the absolute number and percentage pattern of OA journals in CJCR is similar to those in journals covered by the JCR: according to a statistical report based on the JCR-2003,²¹ the disciplines with the highest numbers of OA journals were Medicine and Health with 86 OA journals (36.0% of the 239 OA journals covered by the JCR); Biology and Life Sciences with 40 (16.7%), and Chemistry, Chemical Engineering and Material Sciences with 30 (12.6%).

Impact of Chinese OA journals

There are different views on whether the OA publishing model increases the number of citations per publication,²³⁻²⁵ and if so, why.^{26,27} Bearing in mind the inevitable time-lag in the occurrence of citations and thus the measurement of impact, we selected those 167 journals that had adopted an OA or delayed OA policy prior to 2006, and compared the average number of citations, impact and immediacy measures with those of the non-OA journals in the same database.

Based on the 2006 edition of the CJCR,²⁸ we calculated the mean total citations, mean IFs and mean immediacy indexes for the top five fields by number of full OA journals and delayed OA journals (Table 5); the numbers in the remaining fields were too small to derive reliable conclusions. For each field,

the pattern of OA journals in CJCR is similar to those in journals covered by the JCR

Table 5. Comparison of mean citation indicators between non-OA, OA, and delayed OA journals^a

| Field | Non-OA journals | | | | OA journals | | | | Delayed OA journals | | | |
|-------------------------------|-----------------|--------------------------------|---------|----------------------|-----------------|--------------------------------|---------|----------------------|---------------------|--------------------------------|---------|----------------------|
| | No. of journals | Average no. of total citations | Mean IF | Mean immediacy index | No. of journals | Average no. of total citations | Mean IF | Mean immediacy index | No. of journals | Average no. of total citations | Mean IF | Mean immediacy index |
| Medicine | 397 | 665 | 0.427 | 0.047 | 7 | 689 | 0.517 | 0.078 | 33 | 909 | 0.515 | 0.068 |
| Biology | 41 | 832 | 0.524 | 0.064 | 9 | 1320 | 0.726 | 0.086 | 6 | 617 | 0.643 | 0.096 |
| Agriculture | 120 | 521 | 0.438 | 0.055 | 4 | 1726 | 0.869 | 0.102 | 9 | 699 | 0.583 | 0.604 |
| Chemistry | 26 | 704 | 0.484 | 0.043 | 6 | 1806 | 0.733 | 0.074 | 3 | 559 | 0.557 | 0.133 |
| University journals | 61 | 246 | 0.241 | 0.031 | 4 | 433 | 0.424 | 0.041 | 7 | 325 | 0.343 | 0.066 |
| Others ^b | 774 | | | | 29 | | | | 50 | | | |
| Total or average ^c | 1419 | 511 | 0.396 | 0.050 | 59 | 1022 | 0.653 | 0.088 | 108 | 722 | 0.509 | 0.070 |

^aOA journals are restricted to those operating an OA policy before January 2006.

^bFigures in other disciplines are too small to be meaningful.

^cThe total number of non-OA journals, OA journals, and delayed OA journals is 1,586 (i.e. 1,419 + 59 + 108), because 22 of the 1608 OA journals in CJCR-2005 are not included in the 2006 edition.

the mean IF and mean immediacy index of both OA and delayed OA journals are clearly higher than those of non-OA journals. Given the time lag for citations, it is too early fully to evaluate the effect of OA publishing; however, we tentatively conclude that the OA publishing model may be helpful in enhancing the journal's visibility and accessibility, and thus increasing citations.

Discussion and conclusions

Using the CJCR 2005 database we selected the most important OA and delayed OA journals in China. Their OA-related characteristics, such as the number of articles freely available, the earliest year of archival content that is freely available, their disciplinary distribution, and their citation impact, were analyzed. The findings may well also be relevant for those journals not covered in the CJCR, especially for those English-language journals that have low subscriptions and low visibility.

In China, a number of academic journals (particularly those published in English) are subsidized by their sponsoring institutions and thus do not rely on revenues from subscriptions. This means that the journals are primarily published to disseminate information, and are not run to make profits as such. In addition, in order to enhance their visibility and accessibility, many Chinese scientific journals give away a large percentage of their circulation – sometimes as much as 50% – as presentation or exchange copies; libraries, and even editorial board members and some well-known researchers, may obtain a significant percentage of their journals collection in this way. Many institutionally sponsored journals are also facing challenges as they attempt to publish papers from a wider author-base, and not just from within their own institution.²⁹ Consequently a number of the commercial obstacles to OA publication do not exist for many Chinese academic journals; adopting an OA or delayed OA publishing model may be beneficial, by increasing their visibility and accessibility.

On the other hand, since 2005 more than 100 Chinese scientific journals have been incorporated into the portfolios of Elsevier,

Springer, and other leading Western publishing companies. As more and more Chinese scientific journals start co-operating with international publishers, it is naturally difficult or impossible for them to adopt, or maintain, OA policies unless a charge is made to authors (which Chinese researchers will find it difficult or impossible to pay); an increasing number of Western commercial publishers do now offer authors an OA option for a fee, such as Springer's 'Open Access Choice'. However, co-operation with big commercial companies undoubtedly increases the visibility of Chinese journals, especially those published in English, in other ways. It is too early to evaluate the effects of Chinese journals' co-operation with international commercial publishers on such measures as citations and impact, contributions from researchers outside China, etc.; it would be worth while to carry out some research on this in a few years' time. Thus the choice of whether to go OA or to partner with a commercial publisher is partly an economic decision (what will produce the greatest visibility and the largest profit?) and partly a political one (should the results of Chinese research be free to all researchers in China or the whole world?).

Our data indicate that most Chinese OA journals publish online independently of each other, without any form of collaboration; 47.3% (43 of 91) of full OA journals and 67.3% (93 of 139) of delayed OA journals also offer free access to relatively little content – fewer than 1,000 articles. These two factors may lead to an inefficient system, as small and/or isolated collections of information may have difficulty in attracting the attention of the science community. By contrast, Chinese non-OA journals are generally available only through the major Chinese databases.

We propose that a national website platform be created which brings together as many Chinese OA journals as possible, in a single digital library. This could enable China's OA journals to attract more attention from researchers and thus increase their impact on the science community. In some developing and non-English speaking countries, well-established OA websites already exist, such as SciELO (<http://www.scielo.org>),

a number of the commercial obstacles to OA publication do not exist for many Chinese academic journals

supported by the FAPESP/BIREME/CNPq Project, in Brazil and J-STAGE (<http://www.jstage.jst.go.jp>), sponsored by the Japan Science and Technology Agency (JST), in Japan, both of which are measurably increasing the visibility, accessibility and impact of the journals they serve.^{30,31} We believe that there is much in their methods from which China can learn.

Acknowledgements

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