The motivations and criteria behind China's list of questionable journals

Lin Zhang[1,2,3*], Yahui Wei[1,2], Gunnar Sivertsen[4], Ying Huang[1,2,3]

[1] Center for Science, Technology & Education Assessment (CSTEA), School of Information Management, Wuhan University, Wuhan, Hubei Province, China

[2] Center for Studies of Information Resources, School of Information Management, Wuhan University, Wuhan, Hubei Province, China

[3] Centre for R&D Monitoring (ECOOM) and Dept. MSI, KU Leuven, Belgium

[4] Nordic Institute for Studies in Innovation, Research and Education, Toyen, Oslo, Norway

ORCID:
Lin Zhang: 0000-0003-0526-9677

***Corresponding author:** Lin Zhang, Center for Science, Technology & Education Assessment (CSTEA), School of Information Management, Wuhan University, Wuhan, Hubei Province, China.
Email: linzhang1117@whu.edu.cn

Abstract

On December 31, 2020, The National Science Library of the Chinese Academy of Sciences (CAS) released a list of 65 international scientific journals, all of them indexed by the Web of Science, that were said to be potentially in conflict with academic rigour. The list immediately influenced the publication patterns of Chinese researchers. A year later, on December 31, 2021, CAS released a revised and reduced list of 35 questionable journals and said the publishers in the meantime had reacted constructively and improved the procedures of their journals. This study aims to provide an understanding of the motivations and criteria behind the list, partly by reviewing Chinese policy documents and public debates, partly with a quantitative analysis to detect the relative importance of the criteria used to select the journals for the list.

Keywords: Questionable journals; research integrity; research evaluation; article processing charges; retractions; China

Key points:

- Retraction rates influence the selection of journals for the Chinese list, particularly when they are high for Chinese papers and associated with a 'paper mill' producing fraudulent articles.
- Journals dominated by contributions from Chinese researchers and with rapidly increasing annual volumes of papers tend to be listed.
- Journals representing rapidly growing total APC expenses for China tend to be listed.
- Impact factors, names of publishers, or business models are not influential.
- The list is clearly motivated by a recent change in research policy in China with more focus on research integrity and quality.
- The list immediately influenced the publication patterns of Chinese researchers.
- A revised and reduced list was published one year later with a claim that publishers had improved the procedures of their journals in the meantime.

Introduction

On December 31, 2020, The National Science Library of the Chinese Academy of Sciences released a list of 65 international scientific journals, all of them indexed by the Web of Science (WoS), that were said to be potentially in conflict with academic rigour. As we shall see, the list immediately influenced the publication patterns of Chinese researchers and created a debate among them. Outside China, one of the publishers of the journals reacted with a public statement only a week after the release (MDPI, 2021). Three months later, an analysis of the possible consequences for publishers was presented in a post by Christos Petrou for *Scholarly Kitchen*. Petrou (2021) observed that "*IEEE Access* has had its worst quarter since early 2019 and MDPI's listed journals are getting less content from China". Concluding his analysis, Petros warned:

> *In any event, the warning list shows that the Chinese market can be risky. Seemingly healthy revenue streams can come under threat with little warning and unclear justification. Over-reliance on the Chinese market is not a healthy long-term strategy, and scholarly publishers and information providers that are overly exposed to the Chinese market should plan to diversify their revenue streams.*

Given that China now contributes to almost one fourth of all scientific articles in international journals, these concerns on behalf of the publishers of the journals are understandable. However, there have been concerns on the side of China as well. By our estimates, the total processing charges paid by Chinese researchers to these few journals on the list had rapidly increased year by year, reaching more than $96 million in 2020. In that year, however, China's proportion of the total global revenues from Article processing charges (APC) in the same journals started to decline. Publishers of Open Access journals or journals in transition to Open Access had reasons to be concerned. The analysis published in *Scholarly Kitchen* was timely.

In China, policy documents are published in the native language and seldom translated to English. Outside of China, the Chinese list could easily be perceived as a sudden and unjustified initiative as it appeared a year ago. We find, however, that the Chinese list had been motivated long before its release in official policy documents and in publicly expressed concerns about research integrity and quality and increasing APC. These documents and debates are in Chinese, and we will summarize and interpret them here based on our translations.

A list of the criteria that were used to select the 65 journals was published in Chinese along with the list. After a year, the criteria were also published in English along with a revised and reduced list. We will return to this revised list in the discussion at the end. The same criteria are used in both versions of the list. They will be the starting point for our analysis, which aims to provide an understanding of the motivations and criteria behind the Chinese list. We present a quantitative analysis by which we can order explicit and non-explicit criteria according to their importance. We will show that the criteria are related to official concerns about research integrity in China. The list also reflects a changed focus from quantity to quality in Chinese research evaluation and funding. This policy change mirrors similar developments in other parts of the world.

Neither the criteria behind the Chinese list nor the related policy documents seem to be influenced by initiatives outside of China such as Beall's list (Beall, 2015) or *Cabells' Predatory Reports*, which is a product for the international library market. Other countries do not publish official lists of questionable journals. The most similar governmental initiative is "Level X" (indicating questionable journals) which has been introduced in relation to the Norwegian Register of Scientific Journals, Series and Publishers published by The Norwegian Directorate for Higher Education and Skills (https://kanalregister.hkdir.no/). The register has a comprehensive list of journals that are recommended by national expert panels representing the academic communities in each field of research. Level X was introduced in 2021 to take care of cases of doubt and make them discussed in the wider constituencies. Journals that are considered non-recommendable after this broader consultation, are not included in the register. Some of the journals on Level X in Norway also appear on the Chinese list.

Lists of questionable journals are controversial (Basken, 2017; Frandsen, 2019; Inouye & Mills, 2021). We therefore underline that our analysis is not an evaluation of the journals. We did not create the lists, and the criteria are not ours. We are independent scientists with competences in research policy studies and quantitative science studies, a combination that might be helpful to understand the interaction between countries' research policies and the global industrial trends in scientific publishing.

The first part of what follows is a review of Chinese policy documents and public debates that may explain the motivations for the list of questionable journals. The second part presents the official criteria for selecting and categorizing journals on the list and a quantitative analysis by which we find out how they have been interpreted and their relative importance. We conclude by summarizing and discussing our findings in a research policy perspective. The Chinese list of journals appears in the Appendix.

The motivations behind the list

The official name of the Chinese list is "*Early Warning List of International Journals (Trial)*". It is an experiment to test out possible solutions to research policy concerns that have been discussed for a long time. It is not intended as a definitive predatory list. Researchers are only asked to be aware of possible problems with publishing in the journals from the perspective of research quality and integrity. Along with its release, the Chinese Academy of Sciences took care to say that the list was not an evaluation of each paper published in the journals; its purpose was only *to remind researchers to choose their publishing venues carefully*.

The release of the list was clearly motivated by the increasing focus on research integrity in China in recent years. The two relevant Ministries, the Ministry of Science and Technology (MOST) and the Ministry of Education (MOE), had issued a series of policies with the aim of ensuring proper ethical behavior among researchers. In May 2018, the State Council of the People's Republic of China issued the document "*Several Opinions on Further Strengthening the Construction of Scientific Research Integrity*" to "further advance the institutionalization of scientific research integrity" (State Council of the People's Republic of China, 2018). The document mentioned the list among several possible means to achieve this goal:

> *The Ministry of Science and Technology should establish an early warning mechanism for academic journals to support relevant institutions. An early warning list of domestic and international academic journals should be published, and dynamic tracking and timely adjustment should be implemented. Academic journals that neglect academic quality, disorderly management, or put commercial interests first will be blacklisted.*

This was the first mentioning of an attempt to warn about questionable journals in the national research policies. In February 2020, the MOST issued the document "*Measures to Eliminate the Bad Orientation of 'Paper Only' in Scientific and Technological Evaluation (Trial)*" (Ministry of Science and Technology, 2020). Under the topic of "cultivating and building China's high-quality scientific journals", it mentioned again that a priority was:

> *Improving the early warning mechanism of academic journals, regularly publishing the early warning list of domestic and international academic journals and implementing dynamic tracking and timely adjustment.*

The same policy document from MOST more generally announced fundamental changes in the policies and practices of research evaluation and funding in China. This change of policy is the broader background for the Chinese list. Another policy document announcing the same change was titled "*Regarding the use of relevant indicators of SCI papers in colleges and universities to establish a correct evaluation orientation*" and issued by the MOE (2020) in early 2020.

This fundamental policy change for research evaluation and funding was announced with three main messages (Zhang & Sivertsen, 2020). The first message was a farewell to what has been called "SCI Worship" in China. It implied that indicators based on WoS would not anymore be applied directly in evaluation and funding at any level, and that WoS coverage was not a criterion in itself.

The second message was that research evaluation should move from metrics to peer review. A new focus on novelty, scientific value, research integrity, innovation potential and societal outcomes should replace the "paper only" orientation in panel evaluations. Publications presented for review in evaluation contexts should not be counted but constitute a limited set of "representative work" with explicit relevance for the evaluation. The numbers of publications and journal impact factors would not count anymore.

The third message was to give new priority to the local relevance of research. Publications in high-quality Chinese journals would be encouraged, and the development of such journals would be supported. It was even specified that "in principle, when researchers provide representative publication lists, papers from domestic journals should account for at least one third of all the publications". The policy recommends giving extra weight to "three types of high-quality papers, including those published in domestic scientific journals with international impact, internationally recognized top-level or important scientific journals, and papers reported at top academic conferences in China and abroad".

All three main messages represented a major change of policy because, until 2020, China's research evaluation and funding policies had a strong focus on quantitative indicators with incentives to publish rapidly in journals covered by the WoS (Zhang & Sivertsen, 2020). Although the change of policy had been discussed in Chinese research communities for almost a year as the list of questionable international journals was released by the end of 2020, the impact of the former incentives to publish rapidly in journals covered by the WoS was still

there. The list addressed this situation as well as the general agenda for research quality and integrity.

In addition, one of the policy documents had also addressed the need to manage the costs of APCs more tightly (Ministry of Science and Technology, 2020): “For a single paper whose publication expenditure exceeds RMB 20,000 (around $3128), the academic committee of the corresponding author or first author’s institution must review the necessity of the publishing the paper”. And: “Papers published in academic journals on a ‘blacklist’ or the Early Warning List shall not be included in the special funds for national science and technology plan projects.” Hence, journals demanding APC were already in focus as the list was released.

The reactions to the list within Chinese academic communities were immediately expressed on *Zhihu*, an influential community-driven Q&A site in China (Zhihu, 2021). Some discussions focused on possible selection criteria that had not been disclosed. Some researchers found the list reasonable, while others said journals with high impact factors should not have been included. Most commentators believed that the number of papers from China in the 65 journals would drastically decrease, arguing that articles in the journals would probably no longer be recognized in next year’s professional title evaluations, scholarship evaluations, and student graduation criteria.

How journals for the Chinese list were selected

The National Science Library of the Chinese Academy of Sciences only publishes the journal name, its discipline, and the level of risk. No other information was given about the individual journals, but seven criteria for their selection were published in Chinese with the first version of the list at the end of 2020:

- Number of articles in the journal
- Degree of internationalization
- Rejection rate
- Article processing charges (APC)
- Journal citation success index
- Self-citation rate
- Retraction information

The criteria were published both in Chinese and English with the latest version from the end of 2021 (National Science Library of the Chinese Academy of Sciences, 2022a). The criteria from 2020 were unchanged, but there are small differences between the original Chinese version and the English translation (in particular, the criteria of “degree of internationalization” only appears in the Chinese version, and “number of articles in the journal” in the Chinese version is described as “growth rate of productivity” in the English version; and “paper mill” is only specifically mentioned in the English version).

Rejection rates of journals are not publicly available in a comparable way. We analyzed how the six other criteria have been interpreted and applied, as well as their relative importance, with data obtained from InCites, Web of Science, the Directory of Open Access Journals, and Retraction Watch.

According to the official information, a panel of experts divided the journals in the Chinese list into three levels of risk. Among the 65 journals, 8 were deemed to be of high risk, 28 of medium risk, and the remaining 29 of low risk (see the Appendix). These distinctions are also helpful for detecting the relative importance of the criteria for selection of journals.

In addition to the six official criteria, our analysis included related factors such as the number and proportion of retracted papers by Chinese authors, the proportion of papers with authors' affiliations at institutions in China (Chinese papers), the publishers of the journals, the speed of publication, and the journal impact factor.

We present the criteria in descending order of influence, starting with the factor that seems to have had the most influence on the creation of the Chinese list. However, we should note that the list is a result of a combination of several different criterions, and the degree of influences of each factor may be just relative.

Retractions of papers published by Chinese authors

Retractions is one of the official criteria for the list. Our source of data to check its influence is *Retraction Watch*, a website specializing in collecting retraction information. We also consulted each journal's website. Combining this information with the total number of indexed research articles in WoS in the same period (2016-2020), we were able to calculate each journal's retraction rate using the following formula:

$$Retraction\ rate = \frac{Number\ of\ retracted\ papers}{Total\ number\ of\ papers} * 100\%$$

Only 11 of the 65 journals were without retractions during the period, indicating that retractions are an influential criterion. Dividing the remaining 54 journals by their level of risk, the retraction rates were as shown in Table 1.

Table 1. Retraction rates by risk group.

Level	Minimum (%)	Maximum (%)	Median (%)
High-risk	0.044	5.064	0.334
Medium-risk	0.011	8.609	0.454
Low-risk	0.006	1.222	0.037

In general, the values of the retraction rates are lower in the low risk groups. The strongest indication of influence is, however, that within the total of 1187 retracted papers in the 54 journals from 2016 to 2020, as many as 1085 (91.4 percent) have first authors from Chinese institutions, and 1056 (89.0 percent) with only-Chinese authors. Most of the journals on the list have a history of retracting Chinese papers. The criterion reflects that the Chinese government has paid great attention to the issue of retractions, especially after a scandal in which 107 Chinese papers were retracted as one package from the journal *Tumor Biology* (Retraction Watch, 2017). Furthermore, according to our recent communication with the publisher of the list, the retractions of a journal associated with a 'paper mill' producing fraudulent articles are treated as indications of "high risk". This information confirms our analysis and the impression that the list is directly connected to the concern about research integrity in Chinese research policy, as explained above.

The number and proportion of papers published by Chinese authors

High proportion of papers from China, or rapidly increasing number of papers from China, also seems to influence whether a journal is listed. Figure 1 shows the total number of papers published and the number and percentage of papers with a Chinese affiliation in different risk levels.

The annual number of papers in the high-risk journals is relatively stable at around 1100-1500 from 2016 to 2020, but the percentage of papers by Chinese authors is very high, exceeding 50 percent in 2016 and reaching a maximum over 75 percent in 2019. However, the average number of publications of journals in the high-risk group was only 690 in 2021, showing a big drop comparing to the average values during the previous years. In the medium-risk journals, the volume of papers rapidly increases per year. Here, the proportion of papers from China also increases to more than 70 percent after 2019. In the low-risk group, the volume of articles increases even more dramatically. Here, the proportion of Chinese papers is clearly lower, although higher than the general proportion of Chinese papers in WoS, which was 22.82 percent in 2020.

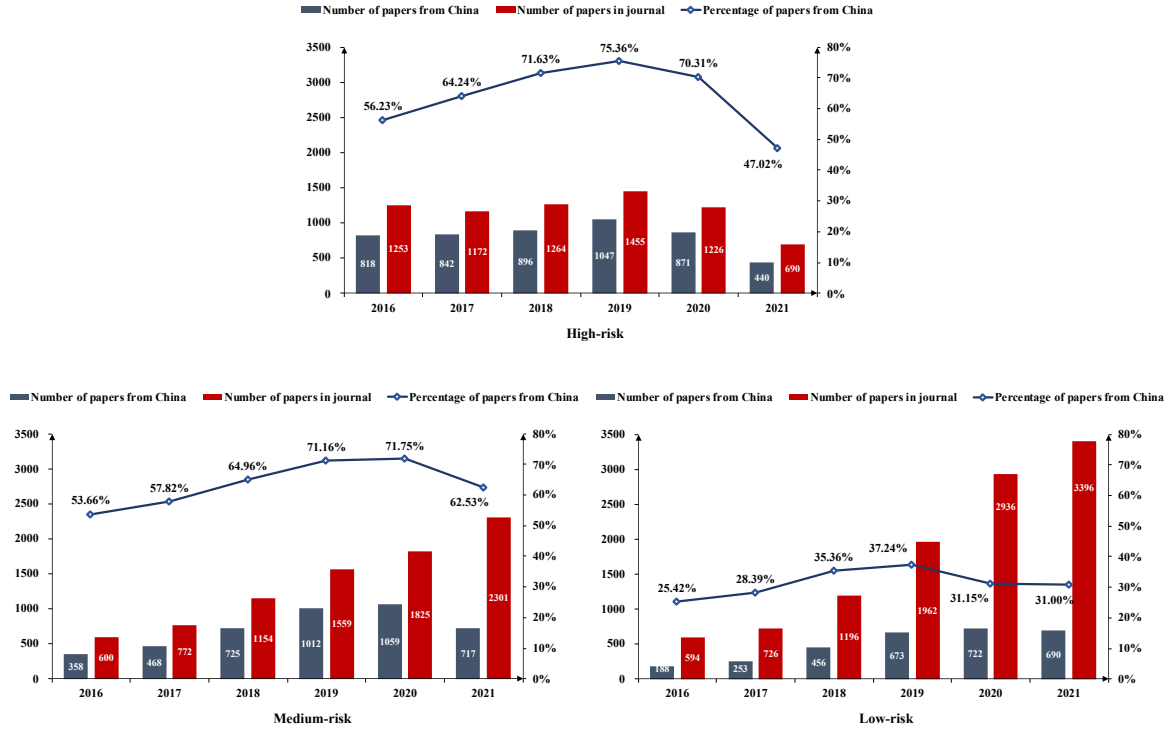

FIGURE 1. The number of papers and the number and percentage of papers from China for the three risk levels (2016-2021).

Generally, there is a stabilization or decrease in the proportions of Chinese papers after 2019. This change might be related to the change of research evaluation policy early in 2020, as described above, by which the government ceased its strong focus on publishing in journals indexed by WoS. The decreasing shares in the listed journals can be compared to the shares of China in all research articles indexed by WoS, which increased from 22.44 percent in 2019 to 22.82 percent in 2020. The rise of the percentage of the global output is different from the decline in most of the 65 listed journals. Furthermore, data from 2021 show that the release of

the list has a significant impact on the proportion of Chinese papers in these journals, and the proportion in high-risk journals has a dramatical decline. Note that the publication data of 2021 were retrieved on 5th, January, 2022, before the previous year could be expected to be completely indexed. Both the list and the new general policy seem to have had an observable effect on the publishing behaviors of Chinese researchers.

It seems that high proportions of Chinese papers in international journals is a factor that influences the selection of journals for the Chinese list. Rapidly increasing annual volumes of papers seem to be even more influential in the medium and low risk categories. The list thereby addressed the situation described above: While the former incentives to publish rapidly in journals covered by the WoS still had an impact, the new policy was concerned about research quality and integrity. This might explain why "Number of articles in the journal" is an official criterion for the list.

The degree of internationalization

"Degree of internationalization" is another official criterion. It assumes that a good international journal should have a diversity of international contributors and impact. Our analysis shows that this criteria is clearly related to the proportion of Chinese articles in international journals as analyzed above. Here, we use two indicators: the number of countries listed in the affiliations of articles within the journal and the number of countries citing the journal's articles. To avoid possible bias from a few outlier papers with authors of many different countries, we only counted countries appearing in more than 1% of the journal's articles. In addition, we further excluded a few papers (about 0.1%) which have "group authors" from a large number of different countries.

Figure 2 shows the two indicators for the journals in each risk category. Both indicators are high in the low-risk journals and low in the medium-risk and high-risk journals. We use a few examples to illustrate the variations seen in Figure 2: *Oncology Research* has the lowest degree of internationalization, publishing papers from only four countries, and receiving citations from only 16 countries. The authors of *Plants-Basel* are from most countries, while citations to *Sustainability* are mostly international diverse.

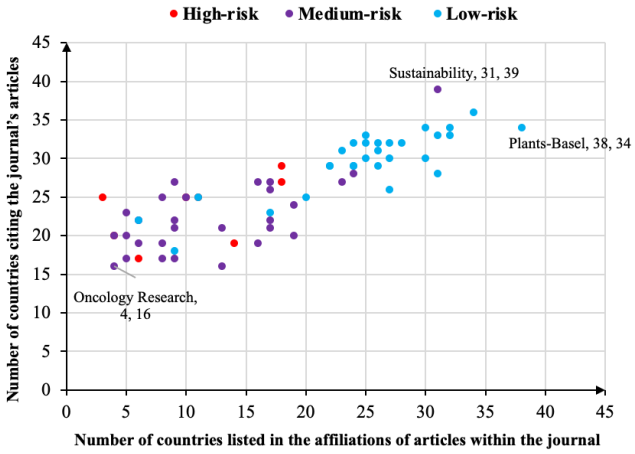

FIGURE 2. The number of countries listed in the affiliations of articles within the journal and the number of countries citing the journal's articles (2016-2020).

With only four exceptions, each journal publishes more papers from China than from any other country. In each of these journals, more than half of the citations come from papers from China. The official criterion "Degree of internationalization" may therefore be interpreted as the degree of Chinese dominance on the publications in and citations to the journal. Chinese dominance is regarded as risky in the Chinese list. This might be related to the new policy of prioritizing "internationally recognized top-level or important scientific journals" among international journals in general.

Article processing charges (APC)

Article processing charges is also an official criterion. Seven of the 65 journals on the list do not apply APC. To examine the influence of this criteria, we focused on the remaining 58 journals, where both gold and hybrid OA journals are represented. The APC of gold OA journals were retrieved from the Directory of Open Access Journals (DOAJ), which provides basic information about APC wherever it applies. The APC of hybrid journals were retrieved manually from the journal's official website. The date of data acquisition was May 26, 2021, and all prices were converted to US dollars. Since the exact price of APC for different years are not available, we estimated the total payment of APC based on the latest price. For hybrid journals, we only calculated the APC from OA publications. Table 2 shows the results. The price of APC alone does not seem to influence the risk level.

TABLE 2. The APC for each risk group.

Level	Minimum	Maximum	Average
High-risk	$1503	$4400	$2371
Medium-risk	$480	$4700	$2117
Low-risk	$610	$3,600	$2207

As a next step, using APC prices in combination with volumes of articles, we estimated the total annual revenue from APC per journal along with the proportion of these revenues derived from China. The total amount of APC paid by China was calculated according to the number of OA papers published by Chinese authors as the corresponding author or first author. Figure 3 shows the results. The increasing volume of Chinese articles in the low- and medium-risk categories, and thereby the rapidly increasing costs of APC, along with the high proportions of the revenues that are derived from China, seems to be the problem that influences the list. In 2020, the estimated total APCs derived from China in these few 58 journals reached almost $96 million. Notably, the proportion of APC revenues derived from China clearly declined after 2020, indicating the influences of the list and the new research policy on the publication behavior of Chinese researchers.

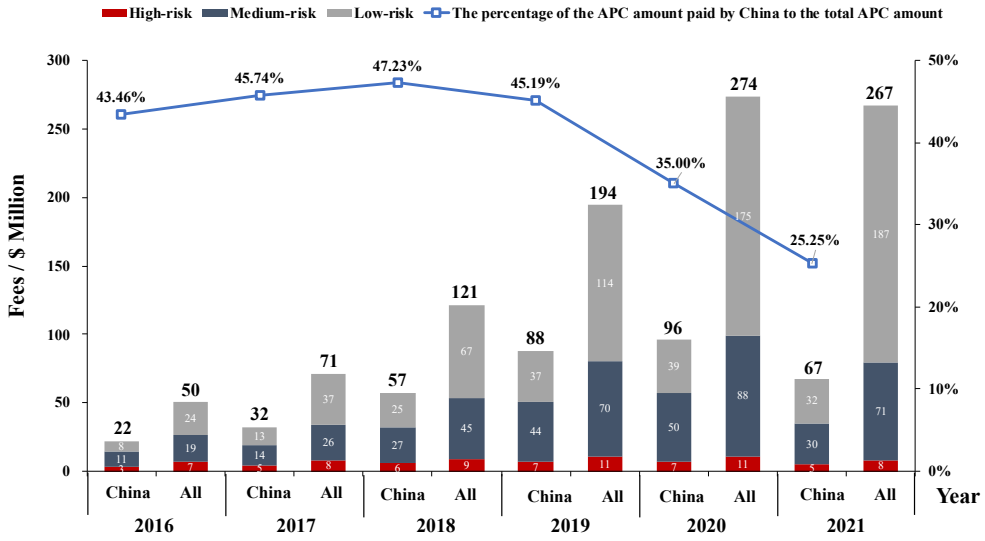

FIGURE 3. Total APC amounts (in million $) derived from the world from 2016 to 2021, and the percentage of these paid by China.

Not APC prices in themselves, but the rapid growth of Chinese APC expenditures, and the concentration of these expenditures in particular journals, seems to influence the selection of journals for the Chinese list. For example, the APC paid by China to *IEEE Access* in 2016 was only $0.6 million, while it grew rapidly to $17.5 million in 2020, and the total amount of APC reached $45.6 million during 2016 to 2020. Whether a journal is gold OA versus hybrid does not seem to be a factor. The proportion of gold OA journals versus hybrid journals is larger on the list than in WoS in general but the growth phenomenon is also clearly more found in gold OA journals. We conclude that rapid growth in APC expenditures from the perspective of China is the determining factor, not whether a journal is OA, gold, or hybrid, or applies APC.

Although the total amount of fees paid by China has increased year by year until 2020, China's proportion of the payments has declined during the past two years. We attribute the decline to the general influences of the list and the new research policy and to the more specific new restrictions on APC expenditures as described above. Again, we find a criterion that seems to be directly related to Chinese research policy.

Editorial practices

Editorial practices, and the relation of the journals to certain publishers, are not official criteria for the list, but we checked them because only 24 different publishers are represented in the Chinese list. They are presented in Table 3.

TABLE 3. The publishers of the early warning journals.

Publisher	Country	No. Journals	Publisher	Country	No. Journals
MDPI	Switzerland	22	Desalination Publ	Italy	1
Spandidos Publ Ltd	Greece	5	Dove Medical Press	UK	1
Wiley	USA	5	Cognizant Communication Corp	USA	1
E-Century Publishing Corp	USA	4	ESG	Serbia	1

Elsevier	Netherlands	3	IEEE-Inst of Electrical Electronics Engineers	USA	1
Hindawi	UK	3	Impact Journals LLC	USA	1
Springer	Germany	3	Int Scientific Information	USA	1
Amer Scientific Publishers	USA	2	IOS Press	Netherlands	1
Taylor & Francis	UK	2	Lippincott Williams & Wilkins	USA	1
Sage Publications	USA	2	Portland Press	UK	1
Assoc Bras Divulg Cientifica	Brazil	1	Verduci Publisher	Italy	1
Carbone Editore	Italy	1	Walter De Gruyter	Germany	1

One might ask why China is not among the nine different countries listed in Table 3. There are two major reasons. Firstly, publishers in the Netherlands, the UK and the USA dominate with journals among those indexed for Web of Science. Many of these international publishers have their branches in China. Domestic Chinese publishers are represented with very few journals in Web of Science, indicating very low chances to be listed. In particular, there are only 272 journals published in China which are indexed in WoS (SCIE, SSCI and AHCI), accounting for 1.98% of all journals indexed, according to the latest data report in Journal Citation Report. Among these 272 journals, 157 journals are published by international publishers (57.72%), 53 journals are published by Chinese non-commercial research organizations (19.49%), and only 62 journals are published by Chinese commercial publishers (22.79%). Secondly, the statement of the National Science Library of the Chinese Academy of Sciences (2022b) particularly explained that according to the calculation results of various indicators, no Chinese journals meet the criteria for inclusion in the list.

The publisher in Table 3 with the highest number of branches in China is Multidisciplinary Digital Publishing Institute (MDPI). It is listed with the largest number of journals, one third. Understandably, only a week after the release of the list, on 7th January 2021, MDPI China Marketing Department issued a "Statement on the release of the 'International Journal Early Warning List (Trial)' by the Chinese Academy of Sciences" (MDPI, 2021) in which the publisher emphasized its strict review standards and the high recognition of its journals in the academic community. Their statement also assured readers that they would continue to communicate with relevant personnel of the Chinese Academy of Sciences to have their journals removed from the list as soon as possible. As a possible effect, it is interesting to observe that all the 22 MDPI journals that were on the list for 2020 have been replaced by seven other MDPI journals in the list for 2021.

According to the analysis by Petrou (2020), MDPI's sustained and significant growth in the number of journals and their annual volumes is due to the combination of a consistent, long-term minimal lag between a paper's acceptance and its publication, a high acceptance rate, and an increasing citation rate. All of these factors are favorable for authors all over the world. However, from the Chinese perspective that we have explained above, in a policy situation where rapid publishing in journals indexed by WoS became questionable, the statements of editorial practices in MDPI journals' official website could appear in a different light (Table 4). An example for *Sustainability* (https://www.mdpi.com/journal/sustainability):

> *Rapid Publication: manuscripts are peer-reviewed and a first decision provided to authors approximately 15.4 days after submission; acceptance to publication is*

undertaken in 3.9 days (median values for papers published in this journal in the first half of 2021).

TABLE 4. Characteristics of MDPI's 22 early-warning journals.

Journal	Risk-level	Time from submission to first decision*	Time from acceptance to publication *	Number of papers from China / Number of papers in journal / Percentage of papers from China	Journal	Risk-level	Time from submission to first decision*	Time from acceptance to publication *	Number of papers from China / Number of papers in journal / Percentage of papers from China
Agronomy-Basel	Low	17.2	2.9		Mathematics	Low	17.6	3.7	
Applied Sciences-Basel	Low	13.8	3.5		Metals	Low	13	3.6	
Atmosphere	Low	14.3	3.6		Minerals	Low	14.8	3.4	
Catalysts	Low	11.4	2.7		Molecules	Low	13.3	3.4	
Cells	Low	15.3	2.9		Plants-Basel	Low	12.3	3.4	
Coatings	Low	11.4	3.4		Polymers	Low	10	3.4	
Electronics	Low	15	3.7		Processes	Low	11.6	3.4	
Energies	Low	15.9	3.7		Sensors	Low	15.1	3.6	
International Journal of Environmental Research and Public Health	Low	17.8	3.6		Symmetry-Basel	Low	13.3	3.7	
Journal Of Clinical Medicine	Low	19.3	3.6		Water	Low	16.9	3.5	
Materials	Low	16.3	3.6		Sustainability	Medium	15.4	3.9	

* Median values for papers published in this journal in the first half of 2021.

Declared editorial practices seem to have had some influence on the selection of journals for the list. MDPI journals would be a target according to all the other more influential criteria analyzed above. As seen in our analysis of their journals in Table 4 above, only one of their journals in the first list was in the medium-risk category. All the others are deemed to be of low risk. This is a clear indication that the focus has not been on specific publishers when

constructing the list. Instead, the general *decreases in the proportions* of papers from China within the *rapidly increasing volumes* of articles in MDPI journals, as seen in Table 4, might reflect local debates about the journals arising from the change of evaluation and funding policies at the beginning of 2020.

Impact factors and self-citations do not seem to influence the list

Two official criteria have not been discussed yet. One is the *journal citation success index*. This is a specific method for comparing journal citation impact (Milojevi et al., 2017; Shen et al., 2018). We have instead applied a more widespread methods, that is, dividing journals into quartiles after ranking them within their disciplines by journal impact factors. Quartile 1 will then include journals with the highest citation impact. It illustrates our general finding presented in Table 5: The citation impact of journals is a factor that does not influence the selection of journals for the Chinese list. Of the 65 journals, 28% belong to Q1, 38% belong to Q2, 19% belong to Q3, and only 15% belong to Q4. Table 5 shows that the citation impact of the listed journals is relatively high at all three levels of risk. There is no indication that impact factors influence the risk level.

TABLE 5. Impact factor quartiles by risk group.

Risk-level	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)
High-risk	25	37	12	25
Medium-risk	25	29	32	14
Low-risk	31	48	7	14

We also examined the official criterion of self-citations. Self-citation rates are generally low among the 65 journals, particularly among journals categorized as of high or medium risk. We conclude that this factor does not seem to have much influence on the Chinese list.

Summary and Discussion

Our research has mainly focused on criteria behind the selection of the 65 journals that were listed in the first version of the Chinese list that was published by the end of 2020. The criteria did not change much with the second version but the interpretation of them became clearer. According to the publisher, the new list is neither a supplement nor a negation of the former list. It is a new list based on the same criteria, but updated with 2021 data reflecting the latest results of indicator monitoring. The new list was reduced to 35 journals with most journals removed and some added compared to the first list. As an explanation, the CAS group stated that "over the past year, most publishers, whose journals were included in the early warning journal list, have taken efficient measures to improve" (National Science Library of the Chinese Academy of Sciences, 2022a).

To sum up our results, the six official criteria for the Chinese list (apart from rejection rates, which we could not study) are listed below in descending order of influence along with our summary of how they seem to have been interpreted and applied:

- *Retraction information*. Retraction rates clearly influence the selection of journals for the Chinese list, particularly when they are high for Chinese papers and related to a "paper

mill" source of fraudulent articles. This criterion seems directly connected to the concern about research integrity in Chinese research policy.

- *Number of articles in the journal*. High proportions of Chinese papers in international journals, particularly when combined with rapidly increasing annual volumes of papers in the journals, influences the selection of journals for the list. The list can thereby be interpreted as addressing a situation where the former incentives to publish rapidly in journals covered by the WoS still had an impact while the new policy was concerned about research quality and integrity.
- *Degree of internationalization*. This criterion should be interpreted as the degree of Chinese dominance on the research published in the journal, both by the proportion of articles and the citations. This criterion seems related to the new policy of prioritizing "internationally recognized top-level or important scientific journals" among international journals in general.
- *Article processing charges (APC)*. Not APC prices in themselves, but the rapid growth of Chinese APC expenditures, and the concentration of these expenditures in particular journals, seems to influence the selection of journals for the Chinese list. This criterion reflects that managing APC costs was officially addressed by Chinese research policy at the beginning of the year the first version of the Chinese list was released.
- *Journal citation success index*. The citation impact of journals does not seem to influence the list.
- *Self-citation rate*. This indicator does not seem to influence the list.

In addition to the four influencing criteria above we also investigated *editorial practices* as a possible factor. We found that declared editorial practices of rapid review and acceptance seems to have had some influence on the selection of journals for the list. However, this factor is clearly related to the other influencing factors above, particularly high proportions of Chinese articles and rapidly increasing volumes of articles in journals. Thereby, it is also connected to Chinese research policy concerns.

We did not find the publisher itself to be an influencing factor. Neither are the determining factors whether a journal is OA, gold or hybrid, or applies APC. In sum, our findings show that the list needs to be interpreted in both a research policy perspective and a business perspective. Representing both perspectives, Petrou (2021) commented on the Chinese list three months after its release:

> *As Europe doubles down on OA with initiatives such as Plan S, the Chinese administration, intentionally or not, seems to have chosen a different direction. The Warning List serves to remind that global cooperation among policy makers is just as likely as a policy rift. International publishers who try to accommodate conflicting regional policies may find themselves caught in the crossfire.*

Our analysis has shown that the list is not a sign China's departure from OA or other policies abroad. The list is instead related to a change in Chinese research evaluation and funding that mirrors similar developments in other countries. In a deeper analysis of the new research evaluation and funding policy in China (Zhang & Sivertsen, 2020), we found that the new policy has similarities with initiatives in other parts of the world, such as the DORA declaration on research assessment (DORA, 2013), the Leiden Manifesto for research metrics (Hicks et al.,

2015), and the EU policy for Responsible Research and Innovation (European Commission, 2020). These initiatives are directed towards holistic evaluations that go beyond publication and citation metrics, just as the new Chinese policy is. The concerns about research integrity and the societal value of research are also similar.

The Chinese list has its strengths and weaknesses. Its method is indicator-monitoring. It is mainly a desk top approach advised by groups of scientists. The value of using indicators is that they can be defended as objective and based on neutral information. But journal evaluation is provided with only partly available public information and statistics in an otherwise commercial market where for example rejection rates are not disclosed or comparable. Hence, results can become unpredictable and unfair, which is why journal evaluation is controversial. An alternative is to ask the academic communities more systematically for advice on questionable journals in their field. A different obstacle is then that it is about the reputation of journals that their colleagues publish in. Perhaps the solution in the end is to make the academic communities contribute to lists of recommendable journals rather than lists of questionable journals, as is done in Belgium (Flanders), Denmark, Finland, Italy, and Norway.

The Chinese list is still a sign of the increasing need for journal evaluation beyond impact factors. The list can be interpreted as an early 'market response' to increasing problems with research integrity and quality in the publishing industry. Our study shows that research funding organizations may respond differently from the authors behind rapidly increasing volumes of articles in questionable journals. Such responses may become recognizable among research funders in other parts of the world as well, e.g. in the countries collaborating within Coalition S, the group of national research funders, European and international organizations and charitable foundations who are promoting open access along with the European Commission.

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Appendix

Table A1 lists the name, ISSN, risk-level, discipline, and publisher of each of the 65 journals on Chinese list of questionable journals.

TABLE A1. Early Warning Journal List 2020 (Trial).

Journal	ISSN	Risk-level	Discipline	Publisher
International Journal of Clinical and Experimental Medicine	1940-5901	High	Medicine	E-Century Publishing Corp
International Journal of Clinical and Experimental Pathology	1936-2625	High	Medicine	E-Century Publishing Corp
Medicine	0025-7974	High	Medicine	Lippincott Williams & Wilkins
Advances in Difference Equations	1687-1847	High	Mathematics	Springer
Boundary Value Problems	1687-2770	High	Mathematics	Springer
Artificial Cells Nanomedicine and Biotechnology	2169-1401	High	Engineering Technology	Taylor & Francis
European Review for Medical and Pharmacological Sciences	1128-3602	High	Medicine	Verduci Publisher
Journal of Cellular Biochemistry	0730-2312	High	Biology	Wiley
Journal of Biomaterials and Tissue Engineering	2157-9083	Medium	Medicine	Amer Scientific Publishers
Brazilian Journal of Medical and Biological Research	0100-879X	Medium	Medicine	Assoc Bras Divulg Cientifica
Oncology Research	0965-0407	Medium	Medicine	Cognizant Communication Corp
Oncotargets and Therapy	1178-6930	Medium	Medicine	Dove Medical Press
American Journal of Cancer Research	2156-6976	Medium	Medicine	E-Century Publishing Corp
American Journal of Translational Research	1943-8141	Medium	Medicine	E-Century Publishing Corp
Experimental and Molecular Pathology	0014-4800	Medium	Medicine	Elsevier
Biomedicine & Pharmacotherapy	0753-3322	Medium	Medicine	Elsevier
International Journal of Electrochemical Science	1452-3981	Medium	Chemistry	ESG
Advances in Civil Engineering	1687-8086	Medium	Engineering Technology	Hindawi
Biomed Research International	2314-6133	Medium	Biology	Hindawi
Mathematical Problems in Engineering	1024-123X	Medium	Engineering Technology	Hindawi
IEEE Access	2169-3536	Medium	Computer Science	IEEE-Inst Electrical Electronics Engineers Inc
Aging-Us	1945-4589	Medium	Medicine	Impact Journals Llc
Medical Science Monitor	1643-3750	Medium	Medicine	Int Scientific Information
Cancer Biomarkers	1574-0153	Medium	Medicine	IOS Press
Sustainability	2071-1050	Medium	Environmental Science & Ecology	MDPI
Bioscience Reports	0144-8463	Medium	Biology	Portland Press
International Journal of Immunopathology and Pharmacology	0394-6320	Medium	Medicine	Sage Publications
Journal of International Medical Research	0300-0605	Medium	Medicine	Sage Publications
Experimental and Therapeutic Medicine	1792-0981	Medium	Medicine	Spandidos Publ Ltd
International Journal of Molecular Medicine	1107-3756	Medium	Medicine	Spandidos Publ Ltd

Molecular Medicine Reports	1791-2997	Medium	Medicine	Spandidos Publ Ltd
Oncology Letters	1792-1074	Medium	Medicine	Spandidos Publ Ltd
Oncology Reports	1021-335X	Medium	Medicine	Spandidos Publ Ltd
Journal of Inequalities and Applications	1029-242X	Medium	Mathematics	Springer
International Journal of Energy Research	0363-907X	Medium	Engineering Technology	Wiley
Journal of Cellular Physiology	0021-9541	Medium	Biology	Wiley
Journal of Nanoscience and Nanotechnology	1533-4880	Low	Materials Science	Amer Scientific Publishers
Acta Medica Mediterranea	0393-6384	Low	Medicine	Carbone Editore
Desalination and Water Treatment	1944-3994	Low	Engineering Technology	Desalination Publ
Life Sciences	0024-3205	Low	Medicine	Elsevier
Agronomy-Basel	2073-4395	Low	Agriculture & Forestry Science	MDPI
Applied Sciences-Basel	2076-3417	Low	Engineering Technology	MDPI
Atmosphere	2073-4433	Low	Earth Science	MDPI
Catalysts	2073-4344	Low	Chemistry	MDPI
Cells	2073-4409	Low	Biology	MDPI
Coatings	2079-6412	Low	Materials Science	MDPI
Electronics	2079-9292	Low	Engineering Technology	MDPI
Energies	1996-1073	Low	Engineering Technology	MDPI
International Journal of Environmental Research and Public Health	1661-7827	Low	Medicine	MDPI
Journal of Clinical Medicine	2077-0383	Low	Medicine	MDPI
Materials	1996-1944	Low	Materials Science	MDPI
Mathematics	2227-7390	Low	Mathematics	MDPI
Metals	2075-4701	Low	Materials Science	MDPI
Minerals	2075-163X	Low	Earth Science	MDPI
Molecules	1420-3049	Low	Chemistry	MDPI
Plants-Basel	2223-7747	Low	Biology	MDPI
Polymers	2073-4360	Low	Engineering Technology	MDPI
Processes	2227-9717	Low	Engineering Technology	MDPI
Sensors	1424-8220	Low	Engineering Technology	MDPI
Symmetry-Basel	2073-8994	Low	Comprehensive Journals	MDPI
Water	2073-4441	Low	Environmental Science & Ecology	MDPI
Natural Product Research	1478-6419	Low	Chemistry	Taylor & Francis
Zeitschrift Fur Kristallographie-New Crystal Structures	1433-7266	Low	Chemistry	Walter De Gruyter
Biofactors	0951-6433	Low	Biology	Wiley
Complexity	1076-2787	Low	Engineering Technology	Wiley

Source: The National Science Library of the Chinese Academy of Sciences. https://earlywarning.fenqubiao.com/#/en/early-warning-journal-list-2020