

The emergence of China in international academic management research: A nuanced analysis following the new f^2 -methodology

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ABSTRACT

In a few decades, China has made a huge rise in science, exemplified with an impressive expansion of academic publications. The management field has traditionally been dominated by the US universities and Anglo-Saxon researchers. The objective of the present study is to analyze through the application of a new bibliometric methodology whether the progress of Chinese universities in academic management research is in line with China's overall progress in science. The classic analysis of volume productivity and citation count is complemented with the recent f^2 -methodology. It is based on a more fine-grained classification of publications into categories of citations, focusing on the 10%-percentile and the h-core. The methodology is applied here at a country level and at the level of the university, for all publications and for those of the last 5 years. The results confirm the rise of academic publications by Chinese management scholars, but the analysis of publication outlets and the international collaborations nuance this progress. The US dominance in academic management research is maintained; despite a decline in relative terms, the US publication volume and the higher citations remain in absolute terms. This application of the f^2 -methodology with weighted factors in function of impact brings nuances to first level bibliometric analyses based on volume productivity or on total citations. This nuanced analysis results in fairer assessments and more equitable rankings. The application of the compound F^2 -index illustrates the dynamics in bibliometrics.

Keywords: Bibliometrics; Academic management research; Research performance; Publication productivity; China

INTRODUCTION

China's imposing economic development over the past decades has impressed the international community (Zhou 2015). With its two-digits growth ratios, China has gradually caught up with the most important economic powers, to become the second country in the world behind the USA. Following this growth of the economy, China also has recently moved towards own technological innovation. The Chinese government has strategically put a focus on scientific research (Zhou and Leydesdorff 2006). With huge investments in laboratories and universities, and in manpower, China has overtaken the R&D budget of the European Union (Zhang, Rollins and Lipitakis 2018). This effort is also substantiated by the number of scientists China has trained. This strategy has led to a rapid

rise of China as a research nation (Zhou 2015). The growing prominence of China in science is illustrated by a fantastic increase of the publication volume in international scientific journals, especially in the last 15 or 20 years (Zhou and Leydesdorff 2008; Zhou 2013).

The objective of the paper is to analyze this phenomenon applying a recent bibliometric methodology, the f^2 -methodology (Fassin 2018), within the scope of a specific social sciences research area, namely academic management research. The structure of the paper is as follows. Following a brief literature review on bibliometric studies on the emergence of Chinese research, the study more specifically analyzes academic management research. First, a volume productivity and citation analysis are undertaken for China and US, embedded in a broader country comparison, and complemented with an analysis at the university level. Then, the recent f^2 -methodology is introduced and applied to reveal a more fine-grained classification of publications into categories of citations, focusing on the 10%-percentile and the h-core. This method is applied at a country level and at the level of the university. This study is one of the first papers to present an analysis and findings based on this new f^2 -methodology. A special attention is devoted to an analysis of the recent 5 years, and complemented with an analysis of the publication outlets and the international collaborations. Then follows the discussion and conclusion.

SITUATIONAL ANALYSIS

Chinese universities have been progressing as well as their scientific publications output (Rui 2015). The exponential growth in scientific publications had already been signaled by Jin and Rousseau (2004) on the basis of scientific and technological indicators. Zhou and Leydesdorff (2008) confirmed the second rank of China second in number of scientific publications since 2006. Recent reforms are realized to further raise the country's profile in scientific research (Kennedy 2019).

China has focused with success on education in STEM fields: science, technology, engineering and mathematics. In their comparative study of perception of career choice, Rezayat and Sheyu (2020) found out that Chinese students adopt a more positive attitude and readiness for pursuing STEM studies careers than their US colleagues, who consider other career choices more rewarding. The progress of Chinese research resulted from a focus on promising fields of economic growth and innovation such as information and communication technology (Jin, Latif and Shen 2018). A scientometric analysis on the basis of OECD statistics and publications shows how China has become a major player in critical technologies like nanotechnology (Zhou and Leydesdorff 2008)

Zhou, Thijs and Glänzel (2009) noticed that the development of research in social sciences in China is slower than that in natural sciences. They also mentioned a few possible reasons, especially the more national character and more local impact of the social sciences. Liu et al (2015) confirmed that the development of social sciences research in China has been less explored. While Chinese business schools have also made huge progress in the world rankings, a bibliometric study on their contribution to management research has not been performed yet.

Zhang et al. (2018) analyzed the contemporary international scientific collaboration using new concepts as the centrality in the international collaborative network. While Zhang et al. (2018) performed their analysis at the global level of all scientific disciplines, one of their suggestions is followed to go into more details to some specific fields. Several authors have

pointed to the importance of international collaboration (Glänzel 2001; Lee and Bozeman 2005; Ribeiro et al. 2018), also applied to China (He 2009; Zhou and Glänzel 2010; Niu and Qiu 2014).

OBJECTIVE

A constant critique on most of those bibliometric studies is that an international comparison is realized on the basis of number of publications or citations without much nuances or differentiation. The objective of the present study is to perform a more in-depth analysis of the bibliometric data through a more advanced methodology. The sample chosen to perform this analysis is Chinese academic research in management.

The management field has traditionally been dominated by the US and Anglo-Saxon researchers, and the objective of the present study is to analyze whether the progress of China in academic management research is in line with its overall progress in science. The search was performed on data of the Web of Science (WoS), selected on ‘management’ as topic for the WoS categories ‘Management’ or ‘Business’ or ‘Economics’ or ‘Business Finance’ from 1955 to 2018 (last complete year). Further selections were analyzed by countries. The analysis is realized through bibliometric data, using the recent f²-methodology (Fassin 2018).

RESULTS OF FIRST LEVEL BIBLIOMETRIC ANALYSIS

As in all scientific fields, China has increased its share in academic publications in the management field during the last decades (Zhou and Leydesdorff 2008). With 83923 articles, China ranks second to the USA that participated in 132837 of the 441966 academic articles on management. Limiting the count to the last 5 years, China has equalized its publication volume with a share of 20 percent nearly equivalent to the USA. Table 1 illustrates this phenomenon with figures of cumulated publication volumes for each decade, and for the last 5 years, for the world, and for China and the USA.

Table 1: Total Number of Publications

All years	World	USA	China	Recent 5 yrs	World	USA	China
	441965	132835	83923		152252	31640	30569
Before 1980	23084	10520	3	2014	21391	4917	4426
1981-1990	25339	15002	25	2015	31718	6440	5412
1991-2000	49169	25657	837	2016	34928	6636	8035
2001-2010	130723	35699	38799	2017	35283	6734	8046
2011-2018	213650	45957	44259	2018	28932	6913	4650

Figure 1 shows the evolution of articles selected in the Web of Science for the last 20 years per year, for China and for the USA. China has started to increase its productivity from around 2003 and has overpassed the USA in volume from 2006 onwards.

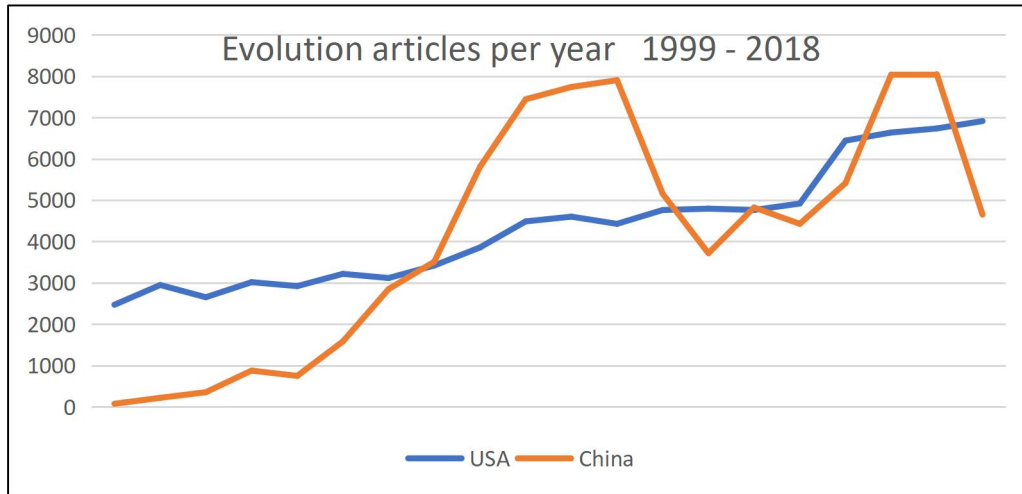


Figure 1: The Evolution of Scholarly Publications in China versus USA

A Country Comparison

The country comparison in Table 2 illustrates how China’s share has improved dramatically. By 2000, China did not attain 1 percent of all publications in management; at the country level, China was positioned on the 8th place. By 2010 this amount has climbed until 17.4 percent and 19 percent by 2018. In total amount, China has reached the level of the USA in a quasi shared 1st position, with each around 20 percent, more than double of England, 3rd, and more than 4 times more publications than the following countries: Canada, Australia, Germany, the Netherlands, France and Italy.

Table 2: Publications on Management per Country

	All years	2010	2000	5 years	2000	2010	2018	5 years	rec/total	proc %
World	441965	228315	97592	152250	100	100	100	100	34%	-
USA	132837	86879	51179	31640	52.4	38.1	30.1	20.8	24%	-31%
China	83923	39664	865	30569	0.9	17.4	19.0	20.1	36%	6%
England	38873	19896	9295	13970	9.5	8.7	8.8	9.2	36%	4%
Canada	18210	9833	4744	5934	4.9	4.3	4.1	3.9	33%	-5%
Australia	16493	6355	1702	7570	1.7	2.8	3.7	5.0	46%	33%
Germany	14001	4992	726	7151	0.7	2.2	3.2	4.7	51%	48%
Netherlands	11424	4288	1302	4465	1.3	1.9	2.6	2.9	39%	13%
France	10567	3701	1071	5277	1.1	1.6	2.4	3.5	50%	45%
Italy	9344	2558	485	5628	0.5	1.1	2.1	3.7	60%	75%

When comparing the last 5 years percentual contribution to the overall contribution until 2018, the USA present a decline of 31 percent and Canada 5 percent. In a relative comparison, all other countries have increased their productivity in the last 5 years: the proportion of the 5 recent years contribution is superior to their cumulated share until 2018, 2010 and 2000. The recent contribution of China is still 6 percent superior to its overall cumulated contribution.

Universities

Additional information is provided by an analysis at the level of the universities. How do Chinese university perform in management research? The overall data bring Wuhan University of Technology as the most productive institution by 2018, before Massachusetts Institute of Technology (MIT), Northwestern University, the University of Pennsylvania and Cornell University. Harbin Institute of Technology comes 6th before Harvard, the University of Minnesota and Erasmus University, the first European institution. Six other Chinese universities (in 3rd series of columns of Table 3a) join the top 50 of productivity.

Table 3a: Publications on Management: The Leading Universities

University	Publications	Rank	University	Publications	Rank	University	Publications	Rank
Wuhan Univ Tech	3845	1	Erasmus Univ	2566	9	HK Polytech Univ	1915	25
Mass Inst Tech	3699	2	Univ Michigan	2426	10	Beijing Jiaotong	1868	29
Northwestern Univ	3346	3	Univ Illinois	2348	11	Wuhan Univ	1673	34
Univ Penn	2686	4	Penn State Univ	2310	12	City Univ HK	1624	35
Cornell Univ	2677	5	Michigan State	2177	13	Zhejiang Univ	1554	38
Harbin Inst Technol	2661	6	Univ Toronto	2130	14	Huazhong Univ ST	1323	48
Harvard Univ	2625	7	Stanford Univ	2099	15	Tsinghua Univ	1265	60
Univ Minnesota	2605	8	Univ Maryland	2084	16	Chinese Univ HK	1260	61

Table 3b: Recent publications on Management: The Leading Universities

University	Publications	Rank	University	Publications	Rank
Wuhan Univ Technol	1115	1	Tsinghua Univ	639	12
Bucharest Univ Econ Studies	1005	2	City Univ HK	591	19
Erasmus Univ	997	3	Harbin Inst Tech	581	22
Hong Kong Polytech Univ	809	4	Zhejiang Univ	550	25
Beijing Jiaotong Univ	806	5	Peking Univ	542	26
Univ Lancaster	774	6	Shanghai Jiao Tong Univ	511	32
Copenhagen Business Sch	773	7	North China Elect Power	504	34
Cornell Univ	736	8	Sichuan Univ	460	43
Natl Univ Singapore	675	9	Chinese Univ HK	436	55
Mass Int Tech	658	10	Xiamen Univ	422	63

The progress in productivity of the Chinese universities in management research in the last 5 years, is confirmed, with Wuhan University of Technology in the first place, and two other Chinese universities in the top 5, Hong Kong Polytechnic (4th) and Beijing Jiaotong University (5th); further Tsinghua University comes in 12th position. 10 Chinese universities join the top 50, whereof 7 in top 25 (Table 3b).

Citation Analysis

In two decades, China has gradually taken the lead in productivity in management research but this statement needs further analysis. Besides the number of publications, a classic bibliometric analysis studies the amount of citations (Rousseau, Egghe and Guns 2018). The WoS provides the total number of citations for a limited number of 10000 articles, presented in Table 4. Applied to the first 10000 of the selected samples, the US presents more the 3 million of citations, 10 times more than the Chinese sample. Applied to the recent selection of the last 5 years, the US sample gathers 177250 citations, more than 2.5 that of the Chinese sample.

Table 4: Publications in USA versus China

All years *	All	USA	China	5 years	USA	China
Number articles	441965	132837	83923	152250	31640	30569
Total citations **	3486391	3083314	322633	274524	177250	68151
Average citation per article	348.64	308.3	32.3	27.45	17.7	6.8
h-index	741	701	193	114	100	64
* retrieved WoS 12 February 2019			** limited to first 10000 articles			

The number of citations for the overall US dataset reaches 88 percent of all citations; that of the overall Chinese dataset only 9 percent. Restricted to the last 5 years, the US participation in citations is reduced to 65 percent, compared to an increase towards 25 percent of all citations for the Chinese dataset. It should be noted that in this WoS search, each co-author is assigned full credit, as well as their institution and their country, which explains that the total overpass 100 percent.

The average number of citations for the US top 10000 dataset is 308 per article compared to 32 for the Chinese; and 18 versus 7 for the recent dataset. The USA benefits from an important number of seminal articles with more than 20 years citations: 3 articles (Podsakoff et al. from 2003, Barney in 1991 and Eisenhardt in 1989) have gathered more than 10000 citations; 16 articles have more than 5000 citations and 334 articles reached the 1000 limit. From those 334 articles, 217 were published before 2000. For the Chinese dataset 6 articles got more than 1000 citations by 2018 (the maximum is 1588 citations), while 108 articles obtained more than 250 citations. Only 7 of those Chinese articles were written before 2000. It should also be noticed that the top 5 articles have been written in collaboration with non-Chinese first authors.

This higher amount of US citations is also reflected by the h-index, calculated at the country level. The overall US-dataset has a h-index of 701 versus 193 for the Chinese set; the recent US-dataset reaches an h-index of 100 versus 64 for the Chinese dataset. The h-index of the complete dataset reaches 741 by mid February 2019, the h-index for the recent set reaches 114.

By the begin of 2019, there are 2087 Highly Cited papers (HCP) in management research in the Web of Science selection (written within 2009 and 2018); 1162 with a US author and 305 with a Chinese scholar. In the last 5 years, the US got 514 HCP and China 194. From the 39 hot papers (published in the last 2 years 2017/2018) in management research, 20 have a US participant and 9 a Chinese scholar.

METHODOLOGY: A CLASSIFICATION OF PUBLICATIONS INTO CATEGORIES OF CITATIONS: THE *gh*-RATING AND THE f^2 -METHODOLOGY

Impactful articles are awarded more citations. In order to analyze into more details, the recent f^2 -methodology is applied, based on the *ghent*-rating, a classification of publications into categories defined by thresholds on number of citations (Fassin 2018). Besides the total number of publications, that determine productivity, the distribution of the top 10% is defined and the h-core; in a more advanced analysis, also the 10%, 5%, 1%, and the g- and h^2 -core can be defined.

The fame-index or f^2 -index is founded on a specific rating system that takes into account the relative influence of the most important publications of the unit under study (country or university in the present study). The categories are defined on a mix of standard and h-type percentiles. This rating system is comparable to the ratings in the financial sector such as Moody's and S&P ratings, designated by the symbols, AAA, AA, A, BA, BBB, etc. The principles behind those ratings rest upon an exponential increase of impact in function of the higher grades. In the present application, a simplified version is used with the field division into percentiles with three basic categories (A, B and C) and 2 sub-categories (AAA and BA). The field percentiles categories comprise the field's h-core (category A), the 10%-percentile defining category B and category C from the 10 to 25% percentiles, and the remaining category R; in addition, there is the h^2 -core (AAA) and the g-core (BA). The f^2 -index is calculated based on the most important publications of the unit under study: the number of articles taken into account are limited to the $h^{(2)}$ -core of the unit under study. The successive categories are a, b, c and r. Very highly cited articles (aaa) within the category 'AAA' are included under 'a', articles in the g-core 'ba' are included under 'b'.

The respective weighted factors follow a geometric sequence: 4, 2, 1, 0.5 and 0.25 for the successive categories aaa, a, b, c and r; the intermediate category ba is awarded 1.5. In its simplified version, the f^2 -index is thus defined as

$$f^2 = 2a + b + r/4 + 2aaa$$

The classification following the f^2 -index mitigates between the classical rankings based on productivity (number of papers) or on the total number of citations of those papers (Fassin 2018).

The f^2 -indicator is static. Bibliometric data evolve over time: citations are further accumulated over the years. In order to gain an overview on the recent evolution, bibliometric indicators can be calculated on the basis of the publications in the last five years. Applied to the f^2 -index, the 'recent' $f^{2'}$ -index is defined, different from the overall f^2 -classification. In a next step, a compound F^2 -index can be calculated as the sum of the overall f^2 -index and the five-year $f^{2'}$ -index, plus (for individual authors) the number of highly cited papers (HCP in the Web of Science), those papers of the last 10 years that are within the 1% of their field (Fassin 2020). This compound F^2 -index offers a complementary and more dynamic view.

RESULTS OF IN-DEPTH ANALYSIS

Country Analysis

A first analysis of the evolution of management publications in China versus USA is presented in Table 5 for the 2000 and overall 2018 data. It also calculates the percentages

in both countries for the total number of publications, for the publications in the top 10% (B-category) and for the h-core (A-category).

Table 5: The Evolution of Publications in China versus USA

	2000	2018	2000	2018	2000	2018
	all publications	all publications	10%	10%	h-core	h-core
World	97592	441965	9759	44197	628	741
USA	51179	132837	7726	27576	552	642
China	865	83923	94	2228	3	9
USA	52.4	30.1	79.2	62.4	87.9	86.6
China	0.9	19.0	1.0	5.0	0.5	1.2

Whereas China participated to 19 percent of the cumulated publication volume compared to the 30 percent of the USA, the share of the Chinese publication in the top 10% drops to 5 percent and to 1.2 percent in the h-core of management research. The US share dominates with 62 percent of the top 10% and 87 percent of the h-core.

The data elucidate a substantial increase of the Chinese share between 2000 and 2018: from 1 to 19 percent overall, from 1 to 5 percent of the top 10% publications and from 0.5 to 1.2 percent of the h-core. But the US domination in citations and thus their impact remains obvious.

Chinese publications approach the US publications in publication volume in the last 5 years, collecting each around 20 percent of all publications. However, it is interesting to analyze the evolution in a more global perspective and also in comparison with other countries.

Table 6 presents the data for various categories 10%, 1%, g- h- and h²-core for 2018; the key figures for the recent 5-year sample, and in order to assess the evolution also some data with categories for the data until 2000 are included.

This allows to notice the expansion of the academic publication phenomenon. Indeed, only one quarter of the publications have been published in the XXth century, half of all articles in academic management research included in the WoS have been written since 2010, and one third in the last 5 years. China has started its major efforts in academic management research in the early 2000s.

Looking into more details, at the country level over the years, and in relative terms, as presented in Table 7, one can compare the evolution of the publications in number and in category (all, 10% and h-core) between 2000 and 2018, and for the recent 5 years.

The dominance of the Anglo-Saxon world in the early years, in the last decades of the XXth century is obvious. The USA with the UK, Canada and Australia group 70 percent of all publications, leaving continental Europe with 7.4 percent. China has only a participation of 0.9 percent somewhat more than Japan 0.7 percent, India, 0.8 percent, and double as Taiwan, Singapore and South-Korea. All these countries progress. Most of these countries doubled or tripled their share by 2018, but rather gradually in both the first and second decades. Also, continental Europe improved gradually from 7.4 percent in 2000, to 13.3 percent by 2010, and 21.1 percent by 2018. China did a huge catch up action in the first decade to reach 17 percent by 2010 and consolidated this effort around 20 percent in the

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last 5 years. Japan, on the contrary, did hardly increase from 0.8 to 1 percent, India and Taiwan towards 2 percent.

Table 6: The Citation Distribution of Publications per Country

	2018						2013-2018			2000					
	100	10	1	g	h	h ²	100	10	h	100	10	g	h	h ²	
	441965	44197	4420	1132	741	53	152250	15225	114	97592	9759	1014	628	50	
USA	132837	27576	3518	965	642	49	31640	5852	63	51179	7726	883	552	45	
China	83923	2228	108	18	9	-	30569	1940	7	865	94	3	3	-	
Europe	139477	16829	1052	186	102	5	62843	10873	100	17882	1725	106	62	2	
Cont Europe	93115	10615	699	120	67	2	46059	7801	64	7190	934	68	39	1	
UK	46362	6214	353	66	35	3	16784	3072	36	10692	791	38	23	1	
Canada	18210	3475	368	90	59	4	5934	1061	8	4744	715	83	54	5	
Japan	4356	331	17	6	4	1	1456	143	1	648	45	6	4	1	
Australia	16493	1918	101	23	16	2	7570	1198	5	1702	201	14	6	2	
Russia	3456	40	4	-	-	-	2959	55	-	74	4	1	-	-	
Israel	3988	635	55	16	7	-	1028	124	2	1462	185	14	9	-	
India	7950	292	15	1	1	-	5382	316	-	802	33	-	-	-	
New Zealand	3900	472	20	4	3	-	1685	226	4	498	61	3	1	-	
Taiwan	9528	931	38	5	2	-	3471	417	2	384	38	1	-	-	
Singapore	4252	687	37	10	9	-	1853	373	1	346	51	6	2	-	
South Korea	5377	562	41	7	7	1	2684	297	1	341	56	1	1	-	
South Africa	3551	91	4	-	-	-	1860	103	1	205	9	-	-	-	
Turkey	4011	262	12	1	-	-	1976	178	1	157	21	-	-	-	
Brazil	3958	99	6	1	1	-	2774	141	2	144	9	-	-	-	
Malaysia	5628	100	2	-	-	-	3421	162	2	55	2	-	-	-	
Germany	14001	1388	85	12	5	-	7151	1229	8	726	77	4	3	-	
Netherlands	11424	1981	141	29	15	-	4465	975	15	1302	194	18	10	-	
France	10567	1149	111	20	12	2	5277	778	6	1071	182	14	9	1	
Italy	9344	792	34	3	1	-	5628	862	4	485	63	2	1	-	
Spain	9318	958	55	9	7	-	4962	792	4	287	39	2	1	-	
Sweden	5929	701	63	8	4	-	2855	480	2	614	87	8	4	-	
Finland	5059	547	27	2	2	-	2529	428	3	372	48	4	1	-	
Switzerland	4521	604	43	14	7	-	2108	454	3	427	36	6	4	-	
Denmark	4405	555	39	6	4	-	2228	442	6	327	43	2	2	-	
Belgium	4074	644	33	8	4	-	1646	350	2	585	82	6	3	-	
Norway	3870	417	17	3	2	-	1828	303	3	370	31	1	-	-	

When analyzing further in categories, a different picture emerges: Europe reaches 38 percent of the publications in the top 10% (24% for continental Europe and 14% for the UK), more than double of the 2000 data. In comparison the USA take 62 percent of the top 10% and 87 percent of the h-core. The European part in the h-core drops to 9 percent, while 6 percent in 2000. China's part in the top 10% increased from 1 to 5 percent, and doubled in the h-core from 0.5 to 1.2 percent. This is behind Australia (2.2%), the

Netherlands (2%) and France (1.6%), equal to Singapore and before South-Korea and Spain, Israel and Switzerland (0.9%).

In the last 5 years, the gradual improvement in impact is pursued with 12, 7 percent of the top 10% publications, and 6 percent of the h-core. These improvements in impact of the Chinese publications are the results of the tremendous effort of the early 2000s.

Table 7: The Evolution of the Citation Distribution of Publications per Country

	2000	2010	2018	2000	2010	2018	2000	2018	2000	2018	2013-2018		5y
	100	100	100	100	100	100	10	10	h	h	100	10	h
World	97592	228315	441965	-	-	-	-	-	-	-	-	-	-
USA	51179	86879	132837	52.4	38.1	30.1	79.2	62.4	87.9	86.6	20.8	38.4	55.3
China	865	39664	83923	0.9	17.4	19.0	1.0	5.0	0.5	1.2	20.1	12.7	6.1
Europe	17882	52599	139477	18.3	23.0	31.6	17.7	38.1	9.9	13.8	41.3	71.4	87.7
Cont Europe	7190	30271	93115	7.4	13.3	21.1	9.6	24.0	6.2	9.0	30.3	51.2	56.1
UK	10692	22328	46362	11.0	9.8	10.5	8.1	14.1	3.7	4.7	11.0	20.2	31.6
Canada	4744	9833	18210	4.9	4.3	4.1	7.3	7.9	8.6	8.0	3.9	7.0	7.0
Japan	648	1564	4356	0.7	0.7	1.0	0.5	0.7	0.6	0.5	1.0	0.9	0.9
Australia	1702	6355	16493	1.7	2.8	3.7	2.1	4.3	1.0	2.2	5.0	7.9	4.4
Russia	74	788	3456	0.1	0.3	0.8	0.0	0.1	-	-	1.9	0.4	-
Israel	1462	1108	3988	1.5	0.5	0.9	1.9	1.4	1.4	0.9	0.7	0.8	1.8
India	802	2278	7950	0.8	1.0	1.8	0.3	0.7	-	0.1	3.5	2.1	-
New Zealand	498	1031	3900	0.5	0.5	0.9	0.6	1.1	0.2	0.4	1.1	1.5	3.5
Taiwan	384	3638	9528	0.4	1.6	2.2	0.4	2.1	-	0.3	2.3	2.7	1.8
Singapore	346	1438	4252	0.4	0.6	1.0	0.5	1.6	0.3	1.2	1.2	2.4	0.9
South Korea	341	1851	5377	0.3	0.8	1.2	0.6	1.3	0.2	0.9	1.8	2.0	0.9
South Africa	205	957	3551	0.2	0.4	0.8	0.1	0.2	-	-	1.2	0.7	0.9
Turkey	157	1108	4011	0.2	0.5	0.9	0.2	0.6	-	-	1.3	1.2	0.9
Brazil	144	1054	3958	0.1	0.5	0.9	0.1	0.2	-	0.1	1.8	0.9	1.8
Malaysia	55	2121	5628	0.1	0.9	1.3	0.0	0.2	-	-	2.2	1.1	1.8
Germany	726	4992	14001	0.7	2.2	3.2	0.8	3.1	0.5	0.7	4.7	8.1	7.0
Netherlands	1302	4288	11424	1.3	1.9	2.6	2.0	4.5	1.6	2.0	2.9	6.4	13.2
France	1071	3701	10567	1.1	1.6	2.4	1.9	2.6	1.4	1.6	3.5	5.1	5.3
Italy	485	2558	9344	0.5	1.1	2.1	0.6	1.8	0.2	0.1	3.7	5.7	3.5
Spain	287	2496	9318	0.3	1.1	2.1	0.4	2.2	0.2	0.9	3.3	5.2	3.5
Sweden	614	2129	5929	0.6	0.9	1.3	0.9	1.6	0.6	0.5	1.9	3.2	1.8
Finland	372	1741	5059	0.4	0.8	1.1	0.5	1.2	0.2	0.3	1.7	2.8	2.6
Switzerland	427	1694	4521	0.4	0.7	1.0	0.4	1.4	0.6	0.9	1.4	3.0	2.6
Denmark	327	1612	4405	0.3	0.7	1.0	0.4	1.3	0.3	0.5	1.5	2.9	5.3
Belgium	585	1434	4074	0.6	0.6	0.9	0.8	1.5	0.5	0.5	1.1	2.3	1.8
Norway	370	1025	3870	0.4	0.4	0.9	0.3	0.9	-	0.3	1.2	2.0	2.6

Table 8 shows the distribution of the publications in categories following the f^2 -methodology for 2018 (in reduced form (100, 10 and h), the h, h2 and h3-indexes of each country in this dataset, and the (simplified) f^2 -index, calculated as the weighted sum of the articles in the countries' $h^{(2)}$ -core; and similar data for the recent 5 years, the $f^{2'}$ -index and the compound F^2 -index, sum of f^2 and $f^{2'}$.

Table 8: h-index and h-related Indexes (h1, h2, h3, f²) per Country, Cumulated and Recent

	10	h	h ²	2018 h1	h2	h3	f ²	10	h	h ²	5 yrs h1'	h2'	h3'	f ² '	F ²
World	44197	741	53	741	53	16	212	15225	114	7	114	16	7	46	258
USA	27576	642	49	706	52	16	202	5852	63	2	103	14	6	32	234
China	2228	9		195	22	9	31	1940	7	-	65	10	5	17	48
Europe	16829	102	5	382	32	12	74	8247	81	6	100	14	6	40	114
Cont Europe	10615	67	2	337	30	11	64	6384	64	4	91	13	6	34	98
UK	6214	35	3	282	28	11	62	3072	36	2	82	13	6	30	92
Canada	3475	59	4	293	32	12	72	1061	8	-	63	10	5	18	90
Australia	1918	16	2	184	24	9	44	1198	5	1	59	10	5	15	59
Japan	331	4	1	93	16	7	22	143	1	-	28	7	4	8	30
India	292	1	-	90	15	6	16	316	-	-	35	8	4	8	24
Turkey	262	-	-	88	11	6	11	178	1	-	28	7	4	8	19
Brazil	99	1	-	54	12	6	13	141	2	-	28	7	3	9	22
Malaysia	100	-	-	57	11	5	11	162	2	-	28	7	4	9	20
Russia	40	-	-	39	10	5	10	55	-	-	18	5	3	5	15
Netherlands	1981	15	-	205	25	9	40	975	15	1	60	11	5	24	64
France	1149	12	2	178	22	9	38	778	6	1	54	10	5	18	56
Germany	1388	5	-	171	21	8	26	1229	8	3	60	10	5	24	50
Spain	958	7	-	147	20	8	27	792	4	-	51	9	4	13	40
Belgium	644	4	-	126	19	8	23	350	2	1	39	9	4	13	36
Italy	792	1	-	133	19	7	20	862	4	-	50	9	4	13	33

The results of the f²-index elucidate the immense historical advance of the US, that are followed by Canada, continental Europe and the United Kingdom. By 2018, China leaps behind Australia, the Netherlands and France, somewhat approaching Japan, but precedes Switzerland, Israel, Singapore, Spain, Germany. For the recent year f²'-index, Europe has overpassed the USA. The UK and the Netherlands, Germany, Denmark, Canada, France, are still before China. The compound F²-index is in line with the f²-index, but underlines the progress of some countries, especially China that narrows the gap with the preceding countries.

A ranking established on the basis of this f²-index displays significant differences with the ranking based on the number of publications. While China is second in volume productivity, and approaches Continental Europe; China appears only 8th in the f² and F²-ranking, just behind France and Germany, before Japan, Spain, Switzerland and Denmark. In recent years, where the number of Chinese publications reach the US number, China's f²'-index stays in the regions of Canada, France and Denmark. This more fine-grained analysis based on the f²-methodology nuances the progress of Chinese management scholars that volume productivity tends to forecast.

The Type of Publications

The type of publication sheds a complementary light on the results of the analysis, presented in Table 9. About 90 percent of all publications worldwide are constituted of articles (58%) or proceeding papers (32%); the remaining 10 percent include review articles

(less than 2%), book reviews (5%), editorials (3.4%), and book chapters, meeting abstracts, various letters and notes. In the last 5 years, the part of proceeding papers dropped somewhat to 29 percent for 66 percent articles. The distribution among types of publication differs when taking the top 10% of most cited publications: in this selection, 90 percent of the publications are articles, 7 percent review articles and 5 percent proceedings; within the h-core, 80 percent of the publications are articles, 18 percent reviews and 4 percent proceedings.

Table 9: Type of Publications China versus USA

All years	n	World	USA	China	10% World	USA	China	h-core World	USA	China
		441195	132837	83923	44197	27520	935	741	638	10
Article		253124	103715	17730	39888	24775	858	587	510	7
Proceedings Paper		142219	10699	65651	2364	1302	32	32	25	-
Book review		22166	7269	82	1	1	-	-	-	-
Editorial material		14783	6025	358	628	382	14	13	1	-
Review		8089	3510	382	3169	1973	62	131	108	3
Meeting Abstract		3159	1302	112	1	-	-	-	-	-
Note		2767	2016	3	402	344	-	10	9	-
Letter		2172	1362	10	9	7	-	-	-	-
Correction		706	156	49	-	-	-	-	-	-
Book Chapter		490	373	17	40	33	-	-	-	-
Recent 5 years	n	World	USA	China	10% World	USA	China	h-core World	USA	China
		152250	31640	30570	15225	5878	1967	114	62	7
Article		99690	27833	11026	14084	5409	1888	94	53	7
Proceedings Paper		43636	1056	19144	290	52	38	1	1	-
Book review		1623	414	31	-	-	-	-	-	-
Editorial material		4134	1492	203	237	142	13	2	2	-
Review		2970	774	204	748	262	47	18	7	-
Meeting Abstract		865	229	70	-	-	-	-	-	-
Book Chapter		299	236	14	61	52	3	1	1	-

Those distribution strongly differ between the US and Chinese publications. The US counted 78 percent articles and 8 percent proceeding papers, while China got 21 percent articles and 78 percent proceeding papers. In the recent 5 years, the part of the proceeding papers dropped to 3 percent in the US and towards 63 percent in China. The part of articles in China increased from 21 percent to 36 percent. The higher portion of proceedings papers that do not get as many citations as articles explains the lower percentage of Chinese publications within the top 10% or h-core, despite equal numbers of total publications in the last 5 years.

The Universities

How do Chinese universities perform in management research? Additional information at the level of the universities is provided by an analysis within each of the major categories, overall total, top 10%, and h-core. The results are displayed in Table 10a.

Table 10a: Publication Volume per University, Total, Top 10%, and h-core

University	Total	University	10%	University	h 741
Wuhan Univ Technol	3845	Mass Int Tech	1197	Mass Int Tech	53
Mass Int Tech	3699	Northwestern Univ	1055	Harvard Univ	45
Northwestern Univ	3346	Univ Penn	966	Univ Penn	40
Univ Penn	2686	Harvard Univ	903	Northwestern Univ	34
Cornell Univ	2677	Univ Minnesota	888	Stanford Univ	34
Harbin Inst Technol	2661	Michigan State Univ	769	Univ Minnesota	30
Harvard Univ	2625	Univ Texas	758	Univ Michigan	23
Univ Minnesota	2605	Univ Michigan	745	Univ Texas	21
Erasmus Univ	2566	Cornell Univ	730	Texas A M Univ	20
Univ Michigan	2426	Stanford Univ	729	Univ Chicago	19
Univ Illinois	2348	Univ Maryland	690	Ohio State Univ	18
Penn State Univ	2310	Univ Illinois	678	Univ Calif Berkeley	18
Michigan State Univ	2177	Indiana Univ	621	Univ Maryland	18
Univ Toronto	2130	Penn State Univ	617	Penn State Univ	17
Stanford Univ	2099	Texas A M Univ	599	Columbia Univ	16
Univ Maryland	2084	New York Univ	594	New York Univ	16
Univ Lancaster	2033	Univ N Carolina	586	Univ Illinois	16
Univ Wisconsin	2021	Arizona State Univ	583	Indiana Univ	15
Univ Manchester	2018	Univ Calif Los Angeles	575	Arizona State Univ	14
Arizona State Univ	1982	Columbia Univ	557	Carnegie Mellon Univ	14
Indiana Univ	1960	Erasmus Univ	536	Cornell Univ	14
Purdue Univ	1958	Purdue Univ	520	Univ Calif Los Angeles	14
New York Univ	1957	Ohio State Univ	515	Florida State Univ	13
Texas A M Univ	1957	Univ Wisconsin	497	Michigan State Univ	13
Hong Kong Polytech Univ	1915	Univ Calif Berkeley	469	Purdue Univ	12

The overall data bring Wuhan University of Technology as the most productive institution by 2018, overpassing MIT and Northwestern University. Harbin Institute of Technology comes in the 6th position. However, they have only a few papers within the top 10% (3 for Wuhan and 15 for Harbin), and none in the h-core; the same phenomenon applies for Beijing Jiaotong, Zhejiang and Huazhong Universities. By 2018, no Chinese university gets into the overall top 25 in the top 10% and the h-core, dominated by the American universities MIT, Harvard, the University of Pennsylvania Northwestern, Stanford and Minnesota. In the h²-core, 5 of the 53 articles are co-authored by Stanford researchers, 4 by Harvard, Chicago and Maryland University.

The situation in the recent 5 years (Table 10b) acknowledges the trend of the improvement of the Chinese universities: Wuhan University of Technology ends as the most productive institution before two European institutions, Bucharest University of Economic Studies and Erasmus University. Then follow two Chinese institutions, the Hong Kong Polytechnic University and Beijing Jiaotong University; also two universities from Singapore join the top 10%. The Hong Kong Polytechnic University comes also in 6th position in the top 10% and City University Hong Kong on 13th position, while the National University of Singapore joins the top 10¹.

¹ The figures for the detailed analysis at the university level are somewhat different than in the first part of the study, as they were extracted from the WoS on 1st April 2019, some 6 weeks later than the original search.

Table 10b: Recent Publication Volume per University, Total, Top 10%, h-core and h²--core

University	5 years	Total	University	5 years	10%	University	5 years	h 114
Wuhan Univ Technol		1102	Erasmus Univ		247	Harvard Univ		5
Bucharest Univ Econ Studies		1006	Univ Penn		177	Univ Groningen		5
Erasmus Univ		994	Univ Lancaster		173	Univ Penn		5
Hong Kong Polytech Univ		811	Copenhagen Business Sch		172	Boston Coll		4
Beijing Jiaotong Univ		805	Mass Int Tech		167	Erasmus Univ		4
Univ Lancaster		773	Hong Kong Polytech Univ		164	Mass Int Tech		4
Copenhagen Business Sch		770	Arizona State Univ		163	Univ Calif Berkeley		4
Cornell Univ		734	Harvard Univ		155	Univ London Imperial Coll		4
Natl Univ Singapore		671	Cornell Univ		154	Arizona State Univ		3
Mass Int Tech		655	Natl Univ Singapore		150	Univ Magdeburg		3
Univ Toronto		646	Indiana Univ		148	Univ Newcastle		3
Tsinghua Univ		636	Northwestern Univ		147	Univ Nova Lisboa		3
Monash Univ		633	City Univ Hong Kong		146	Univ Washington		3
Univ Manchester		610	Univ Michigan		146	York Univ		3
Singapore Management Univ		609	Univ Toronto		140	35 Institutions		2

Table 11 presents some more details on the distribution of the publications of the top universities, and the major Chinese institutions. They include the total number of publications, the number of publications in the top 10%, in the h-core and h²-core of the dataset; and the total, top 10% and h-core of the recent dataset of the last 5 years. Table 11 also includes some recent indexes following the f²-methodology (Fassin 2018): the f²-index calculated on the most cited publications, within the h⁽²⁾-core of each institution, with different weights for different categories; the f^{2'}-index for the recent last 5 years dataset, and the F² compound f²-index, sum of the f² and f^{2'}.

The analysis provides clear information: the US top universities largely dominate in terms of impact, thanks to a larger partition of articles in the top 10%, and in the h-core, which results in a higher h⁽²⁾-index for the university and consequently a higher f²-index. Harvard, MIT, Stanford, Northwestern and the University of Pennsylvania are leading in impact of academic management research. Toronto and Erasmus University are the leading Canadian and European universities but far behind the US. The Hong Kong universities follow, with double of the f²-index of the major Chinese universities. The explanation lies of course in the longer tradition of publication of US universities and business schools, and in the presence of a larger number of seminal works situated in the top cited articles written by American professors.

The f^{2'}-index applied to the recent publications, during the last 5 years, offers a complementary view on the situation. It shows who now counts in management research. The data show that Harvard, MIT and Stanford still dominate academic management research, but Canadian and European universities follow, and are situated in the group of the top US institutions. In the recent years, the Chinese universities approach the sub-top and the major Chinese universities Tsinghua and Zhejiang equalize with the Hong-Kong universities.

Table 11: Citation Distribution and h-related Indexes per University, Cumulated and Recent

University	100	10	h	h ²	h	h2	h3	f ²	5 yrs 100	10	h	h'	h2'	h3'	f ² '	F ²
Harvard Univ	2626	910	45	4	212	30	11	94.5	428	34	4	40	9	5	22	116.5
Mass Int Tech	3702	1194	53	3	246	31	11	88.0	658	25	4	36	9	4	18.5	106.5
Stanford Univ	2095	726	34	5	186	28	11	86.5	431	13	2	30	8	4	18.5	105.0
Northwestern Univ	3350	1050	34	3	202	28	11	83.5	599	19	2	31	7	4	13.5	97.0
Univ Penn	2688	969	40	2	213	29	11	82.0	540	30	5	32	7	4	10.8	92.8
Univ Michigan	2426	750	23	2	184	26	10	74.3	540	14	0	32	7	4	12.5	86.8
Univ Minnesota	2606	887	30	1	191	27	10	72.5	583	17	1	30	8	4	14	86.5
Univ Maryland	2086	686	18	4	175	25	9	69.3	415	13	1	39	7	3	14	83.3
Penn State Univ	2311	623	17	0	166	23	9	55.8	606	22	0	34	8	4	12.3	68.0
Univ Illinois	2345	679	16	0	172	23	9	53.8	572	21	1	31	8	4	14.8	68.5
Cornell Univ	2678	732	14	0	169	23	9	53.5	736	20	1	31	7	3	14.5	68.0
Michigan State Univ	2177	763	13	0	173	23	9	51.5	515	20	2	31	8	4	16.3	67.8
Univ Toronto	2130	467	8	0	126	20	8	40.5	646	18	1	32	8	4	15	55.5
Erasmus Univ	2569	546	3	0	128	18	7	30.5	997	28	3	36	8	4	16.8	47.3
Hong Kong Univ Sci Tech	1127	369	4	0	119	18	7	33.3	318	11	1	25	7	4	11.3	44.5
Chinese Univ Hong Kong	1262	294	4	0	104	18	7	31.3	436	11	0	24	7	3	10.5	41.8
City Univ Hong Kong	1624	306	2	0	99	17	7	27.8	591	17	1	30	7	4	12.5	40.3
Hong Kong Polytech Univ	1914	347	3	0	103	16	7	27.3	809	15	0	34	6	4	9.5	36.8
Shanghai Jiao Tong Univ	1105	69	0	0	50	10	5	13.4	511	7	0	24	6	4	9	22.4
Tsinghua Univ	1268	86	0	0	53	10	5	13.2	639	9	0	31	7	3	13	26.2
Dalian Univ Technol	1129	26	1	0	32	8	4	12.1	356	3	0	18	5	3	7.2	19.2
Zhejiang Univ	1552	40	0	0	39	9	5	11.8	550	11	0	23	7	4	10.5	22.3
Fudan Univ	718	45	0	0	39	9	5	11.8	351	6	0	24	6	3	9	20.8
Huazhong Univ Sci Tech	1324	34	0	0	36	9	4	11.4	368	8	0	23	6	3	9.3	20.7
Harbin Inst Technol	2663	15	0	0	27	8	4	9.8	581	3	0	16	5	3	7.2	16.9
Beijing Jiaotong Univ	1869	17	0	0	25	8	4	9.3	806	3	0	17	6	3	8.5	17.8
Wuhan Univ	1673	20	0	0	31	7	4	8.3	354	3	0	16	5	3	7.2	15.4
Wuhan Univ Tech	3858	3	0	0	14	5	3	3.3	1115	1	0	6	3	2	4	7.3

The compound F²-index confirms the leadership of the US universities, that benefit from their longevity and historic advance. But this compound index allows to inform on the dynamics in this citation phenomenon. Ranking the institution on the overall f²-index and on the compound F²-index allows to identify the improvers. Dynamic universities gradually progress and can overtake the universities that have not sustained in their research. This analysis clearly demonstrates that Chinese universities that dominate in productivity gradually also progress in quality and impact. An exception that merits some more attention is the strange evolution of Wuhan University of Technology that is leader in productivity based on WoS publications, but that remains outside the top 1000 in impact.

The Publications Outlets in Management Research

A further analysis investigates the publication outlets of US and Chinese management scholars. Table 12a and 12b display important differences in publications outlet between both, listing

Table 12a lists the major journals and for each the number of total articles for all years and the number of articles in the last 5 years, then the articles for the USA and China; each of these sets are completed with the number within the top 10% of citations, and those within the h-core. That list includes a majority of FT-listed journals, especially those that achieve higher 10% and h-core status, also for the Chinese authors. *Management Science* has the largest number of contributions in the US, the *European Journal of Operational Research* (EJOR) in China; in the top 10% selection, the *Academy of Management Journal* (AMJ) leads in the US, in China EJOR also before *Energy Policy*; in the h-core, the *Academy of Management Journal*, the *Academy of Management Review* and the *Strategic Management Journal* lead in the US; AMJ and EJOR lead in China.

A few other management journals attract most publications but with low amount in the 10% and none in the h-core yet: the *Journal of Political Analysis and Management* and the *Journal of Portfolio Management*; other journals, *Energy Policy*, the *International Journal of Human Resources*, the *Journal of Business Research*, and the *Journal of Business Ethics* present a higher percentage of top 10% articles of Chinese authors (due to the lower h-index of the Chinese publications).

Table 12b shows the most important outlets of China’s publications: 9 of the top 10 title sources are proceedings, with only one journal in 9th position, the *European Journal of Operational Research*.; hardly 2 per mille reach the top 10% in citations; US authors do not publish 1% of those mainly Chinese conference proceedings. The low f²-index of the most productive institution, Wuhan University of Technology and Harbin Institute of Technology can be explained by a high proportion of non-cited proceedings articles.

Table 12b: The Citation Distribution of China’s Publication Outlets in Academic Management Research

<i>Journal/Proceedings</i>	China 100	10%	USA 100
Lecture Notes in Management Science	2804	1	4
Advances in Social Science Education and Humanities Research	2672	5	21
Advances in Intelligent Systems Research	2484	7	5
AEBMR Advances in Economics Business and Management Research	2227	6	10
International Conference on Industrial Engineering and Engineering Management IEEM	1361	8	12
EBM 2010 International Conference on Engineering and Business Management	1350	2	-
International Conference on Management Science and Engineering Annual Conference Proceedings	1273	2	6
ACSR Advances in Computer Science Research	1065	2	1
Proceedings of the 2012 International Conference on Management Innovation and Public Policy ICMIPP	821	1	-
International Conference on Engineering and Business Management EBM 2011	789	-	-

Table 12a: The Citation Distribution of Publication Outlets in Academic Management Research

All years	100	10	h	h ²	5 years 100	10	h	USA			China		
								100	10%	h	100	10%	h
Journal Title	441965	44197	741	53	152250	15225	114	100	10%	h	100	10%	h
Management Science	7107	2265	51	5	567	259	2	5113	912	42	228	131	-
Academy of Management Journal	3552	1862	73	2	337	233	2	2855	1048	76	117	94	20
Journal of Policy Analysis And Management	2932	202	-	-	101	49	-	2258	54	-	15	2	-
European Journal of Operational Research	6649	1403	3	-	1060	503	9	2150	158	1	847	579	10
Strategic Management Journal	2771	1551	85	7	484	306	3	2114	816	73	111	82	4
Academy of Management Review	2342	1035	99	15	144	93	3	1752	623	96	19	14	6
Journal of Applied Psychology	2052	1220	26	1	260	174	1	1751	633	28	135	103	6
Journal of Business Ethics	3650	780	1	-	628	291	-	1642	126	-	276	170	-
Journal of Portfolio Management	2059	78	-	-	45	7	-	1614	26	-	18	4	-
Journal of Management	1897	888	24	2	353	223	2	1588	461	26	71	56	-
California Management Review	2308	405	6	-	78	45	1	1555	159	6	10	7	-
Energy Policy	2146	407	1	-	545	287	2	434	24	-	490	343	-
Tourism Management	3584	976	5	-	735	451	6	652	92	3	357	242	7
International Journal of Human Resource Management	2530	308	-	-	363	131	-	399	19	-	292	179	-
Journal of Business Research	2664	489	-	-	706	333	5	1167	76	-	248	138	-
Omega International Journal of Management Science	3322	494	3	-	373	210	6	1156	62	3	246	176	7
Information Management	2111	489	4	-	254	134	1	1166	94	1	228	148	9
Journal of International Business Studies	910	457	7	-	148	97	1	571	165	7	131	112	10
MIS Quarterly	875	492	27	3	121	69	2	735	251	23	56	40	4
Journal of Operations Management	818	451	4	-	138	90	2	666	209	4	49	43	8
Organization Science	1149	618	21	1	176	95	1	903	323	20	40	35	6
Journal of Marketing	943	428	33	3	87	58	1	724	257	38	34	29	5
Journal of Finance	1153	483	19	1	96	71	-	1006	300	19	26	24	3
Administrative Science Quarterly	981	319	26	2	66	46	-	812	228	27	11	7	-

International Collaboration

An additional analysis sheds some interesting insights in the publication process. Zhang et al. (2018) demonstrated the increasing impact of international collaboration in research, that is signaled by the publications by joint researchers of both countries. They showed how this increased co-authorship helped to raise the Chinese scientific contribution. The analysis in Table 13 based on the publication achievements in the 10%-percentile and h-core confirms this finding. The top 1% data are added, as this has comparable datasets, each defined with 310 articles, whereas the sets for the h-core strongly differ.

Table 13: The Collaboration of Chinese and US in Academic Management Research

	ch 100	10	1%	h		ch 100	10	1%	h
China	30688	3100	310	64	USA	31740	3100	310	101
USA	3402	1029	134	34	China	3402	381	38	9
England	999	308	32	10	England	2182	317	50	15
Australia	863	241	31	7	Australia	1044	148	24	6
Canada	620	186	27	8	Canada	1813	229	30	7
Europe M5*	856	269	28	8	Europe M5*	3887	596	74	17
USA	11.1%	33.2%	43.2%	53.1%	China	10.7%	12.3%	12.3%	8.9%
England	3.3%	9.9%	10.3%	15.6%	England	6.9%	10.2%	16.1%	14.9%
Australia	2.8%	7.8%	10.0%	10.9%	Australia	3.3%	4.8%	7.7%	5.9%
Canada	2.0%	6.0%	8.7%	12.5%	Canada	5.7%	7.4%	9.7%	6.9%
Europe M5*	2.8%	8.7%	9.0%	12.5%	Europe M5*	12.2%	19.2%	23.9%	16.8%

* Germany, Italy, France, Spain, Netherlands

In the 5 most recent years, China reached the productivity of the USA, both around 30000 publication, which represents for each 20 percent of the world publication. Around 11 percent of those publications have a joint publication involving authors of US and Chinese institutions. Besides this, Chinese authors have more cooperation with other English-speaking countries as England, Australia or Canada, together for about 16 percent, compared to the USA with only 8 percent. Also, the Chinese cooperation with Europe is more important with 12 percent for the 5 most productive European countries (Germany, Italy, France, Spain and the Netherlands) compared to 3 percent for the USA. However, this cooperation aspect changes quite dramatically when considering the top 10%, the top 1% and the h-core of the dataset. Whereas the US articles stay around 10 percent for the Chinese cooperation in each category, and double for British and Australian collaboration, the collaboration factor explodes for the Chinese articles in function of the selective categories: from 11 percent in the total set, to 33 percent in the top 10%, to 43 percent in the top 1% and finally towards 53 percent in the h-core. A similar pattern is found for the collaboration of Chinese researchers with England, Australia, Canada and Europe: the percentage of collaboration articles increases by a factor of 3.5 to 5 when considering the top 1% or h-core. It should be reminded that those figures are not exclusive, as each participating country is counted as a full count, and multi-country studies can involve several countries.

Collaboration with US scholars and other Anglo-Saxon and Western European countries from top institutions increases the chances to be published in decent journals, and improves the citation record. The Chinese research community has used this strategy with success, as explained by Zhang et al (2018). The bibliometric data illustrate this pattern for academic research in management. By this tactic, younger scholars from younger research countries gradually learn to master the research tradition and the publication process.

DISCUSSION AND CONCLUSION

The steady increase of Chinese publications in academic management research has been analyzed in a more detailed way. While the Chinese scholars have reached the same productivity level as the US since 10 years, this statement needs to be nuanced. China did a remarkable overtaking movement in 15 years time, becoming co-leader in productivity at the country level and at the level of the university. However, this phenomenon is relativized by a lower impact: even in the recent years, the average number of citations of Chinese publications constitutes half that of the USA. Chinese publications contain a larger portion of proceedings and Chinese scholars have not succeeded to publish the same proportion of their articles in the elite management journals yet.

However, as their overall strategy, China invested massively in academic research, also in management research, and the results are beginning to give some fruitful results. A common tactic has been to cooperate with other scholars, and gradually build up expertise. This finding confirms Li and Li (2015) 's analysis on patterns of co-authorship in Chinese publications in social sciences. China has played this institutionalization process very well. The Chinese universities and the Chinese researchers have successfully adopted this strategy, that will ultimately help them to perform better and so gain independence in their research.

While the dominant position of the US has been attacked from all continents, the USA maintains their privilege of maturity and benefits from the first important decades of academic research; many important articles in many sub-themes are written in the first decades and those seminal articles will remain an obligatory reference by future scholars. Important to notice, is that the progress of other countries and China has lowered the relative dominance of the USA, but is not the result of a regression of the US publication volume in absolute terms. The US researchers have increased their number of articles and have maintained the same amount of top 10 and h-core articles in absolute terms; the other countries have realized an extra increase of articles resulting in an inflationary increase of new journals in the last two decennia. This US dominance would probably even be more significant, when applying a fractional counting method to multiple authors papers rather than full counting.

Of course, in academic research, where reputation is built on decades and even centuries of tradition and quality, it will always remain very hard to equalize with the older prestigious institutions. This is especially visualized when applying bibliometrics methods that consider the overall publication timeframe; but when taken into account the more recent years, the trend to the increased impact of China is visible and will continue to improve. One should also notice the home advantage of US and British academics, who have the privilege of writing in their native language, and control the major elite publication outlets. English as the lingua franca of modern times will remain a somewhat unfair advantage for native speakers.

Besides these compelling findings, the main contribution of this paper lies in bibliometrics. This application of the f^2 -methodology brings nuances to first level bibliometric analyses based on volume productivity or on total citations. It adds an important qualitative element to the mathematical citation count. With its weights in function of impact (percentile in the citation distribution) it shows how the rankings can vary. The more fine-grained classification of publications into categories of citations allows a more precise categorization and fairer assessments. This nuanced analysis results in more equitable

rankings. Moreover, the application of the compound F²-index and its comparative evaluation with the overall f²-index illustrates the dynamics in bibliometrics, and helps to identify newcomers in the field, university institutions or authors in constant progress.

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