Scientometrics
https://doi.org/10.1007/s11192-018-2786-7

A bibliometric analysis of highly cited papers in the field of Economics and Business based on the Essential Science Indicators database

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Received: 31 December 2017

Abstract Based on the Essential Science Indicators database, this study analyzed 2140 highly cited papers (HCPs) in the field of Economics and Business from 4499 authors, 914 universities, and 64 countries/territories. From this data, three lists were created: the top 76 scientists, 50 most influential universities, and 33 most influential countries/territories. The results show that the USA is the global leader in Business and Economics with 1517 HCPs, ranking number 1. Also, 46 of the top scientists (60.5%), and 37 of the most influential universities (74%) are from the USA. This study also found: (1) the collaboration network among the top 76 scientists is not very close but a relatively tight sub-network with 13 top scientists has formed; (2) all 50 most influential universities are interconnected, and the cooperation between Harvard University and MIT was the strongest, producing 23 HCPs together; (3) the collaboration network among the most influential countries is quite close with a large network of 60 nodes and only four isolated nodes. In addition, this study demonstrates that significant positive correlations exist between authors' HCP and *h*-index, between universities' HCP and *h*-index, and between countries' HCP and *h*-index. Since *h*-index is known to be a reliable indicator, these correlations indicate that when evaluating the academic impact of scholars, universities, and countries, the HCP approach is also considerably useful.

Keywords Highly cited papers · Economics and Business · Essential Science Indicators · Bibliometric analysis · Collaboration network · *h*-Index · Top scientists

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Published online: 28 May 2018

Introduction

Bibliometric analysis is based on indicators (Abramo et al. 2009) and offers a powerful set of methods and measures that can be used to assess the state of a certain scientific discipline and study the structure and process of scholarly communication with the statistical and mathematical procedures (Pardo et al. 2001; Borgman and Furner 2002; De Bakker et al. 2005). In the literature, it has been called many other names such as bibliometric overview (Merigó et al. 2016), bibliometric study (Glänzel 2002; Kumar et al. 2016), and scientometric analysis (Davarpanah and Aslekia 2008), and its research encompasses wide research categories (e.g. stem cell research (Li et al. 2009), tsunami research (Chiu and Ho 2007), medical research (Sooryamoorthy 2010), nano research (Karpagam et al. 2011)). Moreover, in the field of Economics and Business, there are many bibliometric studies concerning special topics including health economics (Wagstaff and Culyer 2012), ecological economics (Hoepner et al. 2012), financial crisis (Hsu and Chiang 2015), financial research in the European Region (Chan et al. 2011), economics (Bonilla et al. 2015), management (Podsakoff et al. 2008), performance management (Cuccurullo et al. 2016), operations management (Hsieh and Chang 2009; Pilkington and Meredith 2009), IT innovation (Zhang et al. 2016), social entrepreneurship (Rey-Martí et al. 2016), and fuzzy research (Merigó et al. 2015). However, the vast majority of these research focuses on just one subject within Economics and Business, with few research papers considering the whole field. In Merigó et al. (2016) focused on the entire body of research in Economics and Business. Based on the data from Web of Science, they derived interesting results about the analysis of the most influential papers, journals, institutions, and countries. However, their research results are limited because they did not take into account the time influence of citations. In this study, a different database (i.e. the Essential Science Indicators database (ESI)) is adopted for more extensive research.

The ESI database is a vital resource for bibliometric analysis and was launched by the Institute for Scientific Information in 2001, based on more than 10 million articles published in more than 12,000 journals included in the Web of Science database. ESI can be used to measure the scientific research performance and track the scientific development trend. It categorizes each research article or review into one of 22 disciplines, including two social sciences (i.e. Economics and Business, and Social Sciences, General). ESI also coined the concept of highly cited papers (HCPs). HCPs are those papers that rank in the top 1% by citation frequency for each year, using a time span limited to 10 years period plus bimonthly updates during the current year. Currently, the ESI database is one of the most important tools in the world to evaluate the influence of researchers, universities, academic institutions, and countries. Previous studies utilized data from ESI to perform scientific evaluation (e.g., Csajbók et al. 2007; Pouris 2007; Kharabaf and Abdollahi 2012; Fu et al. 2011) or to recognize high quality research outputs (e.g., Tabatabaei and Beheshti 2008; Chuang et al. 2011). Although bibliometric analysis of HCPs is applied to many fields, such analysis of the Economics and Business field has not been published.

The objective of this paper is to make a comprehensive study of highly cited papers in the ESI database in the Economics and Business field with respect to the most influential scientists, universities, and countries.

Data and methods

Searches of ESI database identified 2140 highly cited papers in the category of Economics and Business from 2005 to 2014. These records were downloaded from the Web of Science one by one. Take into consideration of the two-month update schedule of the ESI database, the initial data collection was carried out from July 22 to 26, 2015 after the update on July 7. These 2140 HCPs (excluding the two retracted publications) include 1899 articles (88.7%) and 241 reviews (11.3%). Figure 1 shows an increasing trend of HCP count in Economics and Business during the period of 2005–2014. The number of highly cited papers increased from 140 papers in 2005 to 252 papers in 2014, an increase of 80%. The year that had the most highly cited papers was 2013 with 259 papers, followed by 2012 with 257 papers and 2014 with 252 papers. Regression analysis found that the number of HCPs increases with the year of publication, R^2 is 0.8863, and the regression model is statistically significant ($p < .01$).

Several analytical tools have been used in studies of the collaboration network of countries, universities, or authors. These tools, such as CiteSpace II (Chen 2006), VOSviewer (van Eck and Waltman 2010), Pajek (Batagelj and Mrvar 1998), and Sci^2 (Sci^2 Team 2009), provide similar functions. This study adopted the software Sci^2 that was developed by Katy Börner and her research team in Indiana University based on Cyber Infrastructure Shell (CIShell). As an open source software framework, CIShell is powerful for integrating datasets, algorithms, tools, and computing resources easily. Not only can Sci^2 determine statistics and carry out other analysis of data, it can also detect many kinds of networks, for example, co-author networks and co-cited networks.

In the analysis of authors, universities, and countries, the Spearmen correlations between HCP and *h*-index were examined. The *h*-index was proposed by Hirsch to evaluate the academic impact of an individual researcher (Hirsch 2005). Since then, the *h*-index has been applied to evaluate journals (Braun et al. 2005; Schubert 2007; Olden 2007), institutions (Molinari and Molinari 2008; Mugnaini et al. 2008), countries (Jacsó 2009), etc. In calculating h-indices, this paper used the Web of Science database in the field of Business and Economics, over a time span of 2005–2014. Data were collected between late October and early November of 2016. The data was from the Web of Science with the search tags of "AU = (a scientist's name) AND SU = (Business and Economics)"/

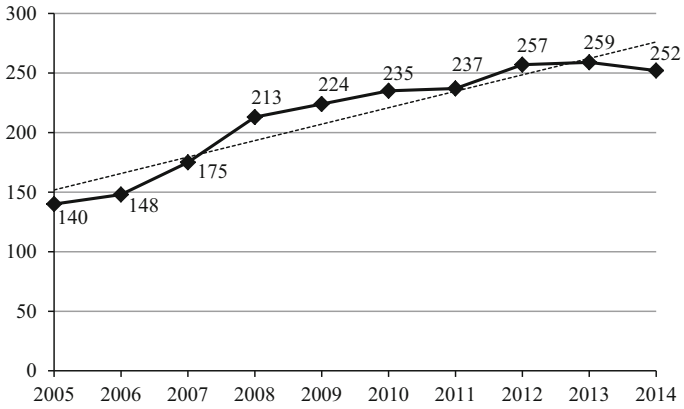

Fig. 1 Trends by year of highly cited papers in Economics and Business (2005–2014)

"AD = (a university's name) AND SU = (Business and Economics)"/"CU = (a country's name) AND SU = (Business and Economics)" for the period of 2005–2014. Searches take into consideration of name variations as identified.

Results

Author analysis

The 2140 HCPs were authored or co-authored by 4499 scientists. Considering that HCP means top 1% in citation rankings, this study looked for the top 1% of these HCP authors. It was determined that 76 scientists had at least 5 HCPs (Table 1). Although the number of such scientists reached 1.6%, the lowest ranked author with 5 HCPs is ranked 34th, which is in the top 1%. Thus, in this paper, a "top scientist" is defined as one who had at least 5 HCPs during the study period.

Using the same ESI database but different criterion, Clarivate Analytics annually released the Highly Cited Researchers (HCRs) list. On its 2017 list, there were 93 HCRs in the field of Economics and Business from 2005 to 2015 (Clarivate Analytics 2017). A comparison found that the two lists overlap 55 scientists while 21 of our 76 top scientists are not on the 2017 HCRs list. Among these 21 top scientists, three scholars (P. Havlik, H. Valin, and E.K. Zavadskas) have 7 HCPs, and three scholars (A. Tabeau, H. Van Meijl, and M. Von Lampe) have 6 HCPs. It is unclear why the 2017 HCRs list included some of the top scientists with 5 HCPs but missed these six scholars with 6 or 7 HCPs.

This study includes all of the 76 top scientists in analysis. The top one scientist with 12 HCPs is J. J. Heckman, one of the two 2000 Nobel Laureates in Economic Sciences for his pioneering work in econometrics and microeconomics. Followed by scientists with 9 HCPs are A. Falk, L. Kilian, M. Lenzen, and M.W. Peng. There are 46 top researchers (60.5%) who come from the USA (i.e. doing their research in the USA). The Netherlands and the UK rank second with 5 top scientists each. Canada, Japan, and China rank fourth with 3 top scientists each, followed by Australia, Austria, Germany, and Lithuania, each with two top scientists. Seven other countries, Belgium, Brazil, Finland, France, Italy, Norway, and Switzerland, have one top scientist each.

As for the *h*-index (Table 1), the best performance was by M.A. Hitt (*h*-index = 33), followed by S.A. Zahra (31), D. Acemoglu (29), A.M. Grant (28), S.A. Zahra (27), M.W. Peng (27), A. Shleifer (26), E.K. Zavadskas (26), T. Sueyoshi (26), J.J. Heckman (25), H. Aguinis (25), and F. Luthans (25). In Fig. 2, scatter plots between HCP and the *h*-index are shown, and a positive correlation between these two factors can be roughly judged. The Spearman correlation coefficient between them is 0.242 ($p < .05$), which indicates that when evaluating the influence of scholars, the HCP and *h*-index are mutually corroborative indicators.

Figure 3 demonstrates that the collaboration networks among the 76 scientists are mostly disconnected except for the 13 scientists in the middle of the graph. For the 43 sub-networks, only one well-connected sub-network has 13 nodes; one sub-network has 7 nodes; two sub-networks each have 3 nodes; 11 sub-networks each have 2 nodes; and the rest are 28 single node without any connections.

The largest sub-network includes P. Havlik (7 HCPs), H. Valin, (7 HCPs), A. Tabeau (6 HCPs), M. Von Lampe (6 HCPs), H. Van Meijl (6 HCPs), D. Willenbockel (5 HCPs), D. Van Der Mensbrugghe (5 HCPs), P. Kyle (5 HCPs), G.C. Nelson (5 HCPs), T. Hasegawa

Table 1 Top 76 scientists in the field of Economics and Business

Top scientist	Country	HCPs		H-index	Top scientist	Country	HCPs		H-index
		No.	Rank				No.	Rank	
Heckman, JJ	USA	12	1	25	Chetty, R	USA	5	34	21
Falk, A	Germany	9	2	19	Diebold, FX	USA	5	34	15
Kilian, L	USA	9	2	21	Duflo, E	USA	5	34	19
Lenzen, M	Australia	9	2	20	Eisenhardt, KM	USA	5	34	14
Peng, MW	USA	9	2	27	Farh, LJL	China	5	34	9
Gneezy, U	USA	8	6	20	Fujimori, S	Japan	5	34	6
Leuz, C	USA	8	6	19	Goto, M	Japan	5	34	22
Saez, E	USA	8	6	22	Graham, JR	USA	5	34	18
Shleifer, A	USA	8	6	26	Grant, AM	USA	5	34	28
Acemoglu, D	USA	7	10	29	Greenwood, R	Canada	5	34	15
Bloom, N	UK	7	10	13	Gronroos, C	Finland	5	34	11
Chrisman, JJ	USA	7	10	23	Harrison, DA	USA	5	34	17
Gomez-Mejia, LR	USA	7	10	18	Hasegawa, T	Japan	5	34	5
Havlik, P	Austria	7	10	9	Helpman, E	USA	5	34	12
Hitt, MA	USA	7	10	33	Heyhoe, E	Australia	5	34	5
Pedersen, LH	USA	7	10	16	Jansen, JJP	Netherlands	5	34	11
Valin, H	Austria	7	10	7	Kyle, P	USA	5	34	10
Zavadskas, EK	Lithuania	7	10	26	Laeven, L	USA/Netherlands/UK/Belgium	5	34	23
Aghion, P	USA	6	19	22	Lounsbury, M	Canada	5	34	14
Fischbacher, U	Switzerland	6	19	14	Lusch, RF	USA	5	34	19
Gabaix, X	USA	6	19	16	Luthans, F	USA	5	34	25
Hail, L	USA	6	19	8	Nelson, GC	USA	5	34	7
Hansen, PR	USA	6	19	12	Nunn, N	Canada/USA	5	34	13
Harvey, CR	USA	6	19	18	Orlikowski, WJ	USA	5	34	13

Table 1 continued

Top scientist	Country	HCPs		H-index	Top scientist	Country	HCPs		H-index
		No.	Rank				No.	Rank	
Imbens, GW	USA	6	19	14	Peters, GP	Norway	5	34	8
Malmendier, U	USA	6	19	15	Sapienza, P	USA	5	34	13
Rand, DG	USA	6	19	6	Schmitz, C	Germany	5	34	9
Stulz, RM	USA	6	19	27	Sueyoshi, T	USA	5	34	26
Tabeau, A	Netherlands	6	19	7	Trevino, LK	USA	5	34	23
Van Meijl, H	Netherlands	6	19	8	Turskis, Z	Lithuania	5	34	18
Vargo, SL	USA	6	19	17	Van Der Mensbrugghe, D	Italy	5	34	7
Von Lampe, M	France	6	19	8	Van Reenen, J	UK	5	34	16
Zingales, L	USA	6	19	17	Volberda, HW	Netherlands	5	34	21
Aguinis, H	USA	5	34	25	Wiedmann, T	UK	5	34	14
Ahlstrom, D	China	5	34	17	Willenbockel, D	UK	5	34	9
Amit, R	USA	5	34	9	Wunder, S	Brazil	5	34	14
Ariely, D	USA	5	34	22	Zahra, SA	USA	5	34	31
Campbell, JY	USA	5	34	16	Zhou, KZ	China	5	34	22

HCPs highly cited papers

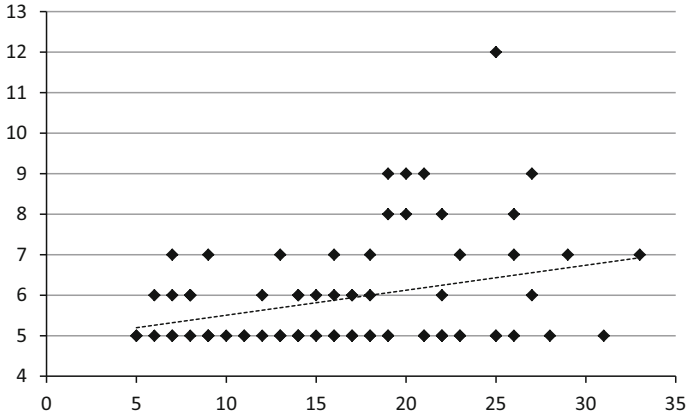

Fig. 2 Scatter plots between highly cited paper counts and h-indices of top 76 scientists

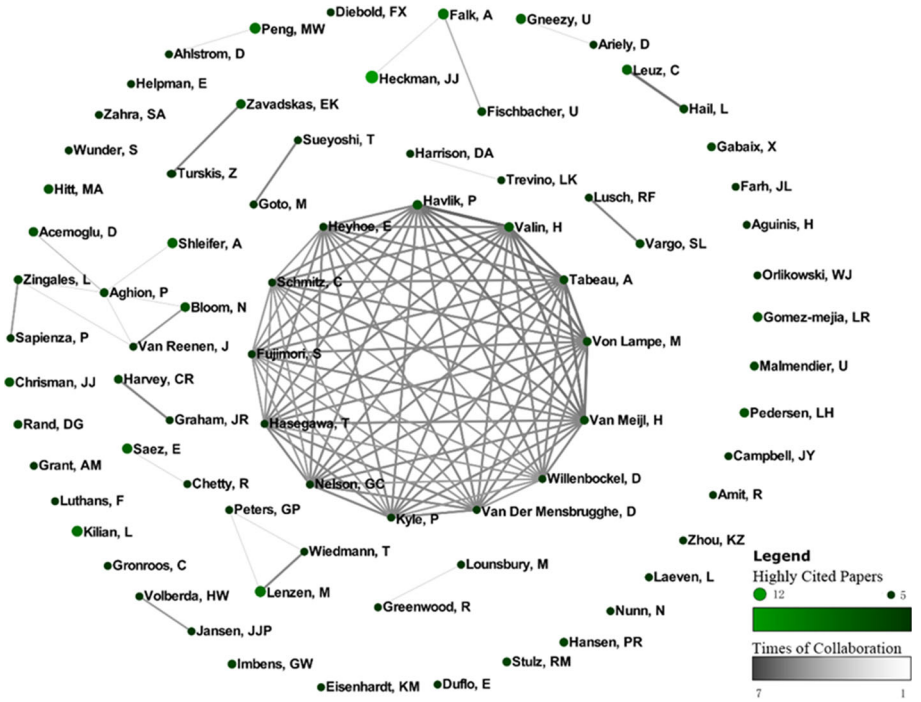

Fig. 3 The collaboration network of top 76 scientists in Economics and Business

(5 HCPs), S. Fujimori (5 HCPs), C. Schmitz (5 HCPs), and E. Heyhoe (5 HCPs). They are strongly interconnected and, among them, the most collaboration was between P. Havlik and H. Valin, who have published 7 HCPs together. These 13 scholars come from many countries: Austria (P. Havlik, H. Valin), the Netherlands (A. Tabeau, H. Van Meijl), France (M. Von Lampe), Japan (S. Fujimori, T. Hasegawa), the USA (P. Kyle, G.C. Nelson), Germany (C. Schmitz), Italy (D. Van Der Mensbrugghe), the UK (D. Willenbockel), and

Australia (E. Heyhoe). Their main research topics include socioeconomic, agricultural economics, climate change, land-use change, ecosystems, and sustainability.

University analysis

There were 1289 institutions which published the 2140 highly cited papers. Of these institutions, there were 914 universities. The 50 most influential universities in Economics and Business are listed in Table 2, all of which published at least 16 HCPs. Among these universities, 37 are US universities, followed by 5 universities in the UK, 3 universities in the Netherlands, and 3 universities in Canada, with China and Australia having 1 most influential university each. Not only has the USA published the most HCPs, but US universities stand tall in the ranking. Twenty-seven of the top 28 universities in the list are US universities, while the other one is in the UK (London Sch Econ), indicating the academic and research level of the USA in the fields of Economics and Business is advanced in the world. Harvard Univ ranks first in the list with 158 HCP, followed by Univ Chicago (94), MIT (93), Univ Penn (89), and Stanford Univ (76). Another four institutions also have published at least 16 HCPs: the National Bureau of Economic Research (236 HCPs, USA), World Bank (23 HCPs, USA), Centre for Economic Policy Research (23 HCPs UK), and Institute of Labor Economics (16 HCPs, Germany). Different from universities, these institutions have unique characters. For example, the National Bureau of Economic Research is a huge organization with a complex staff composition. Therefore, it is very difficult to carry out a comparison between these institutions and the universities. Therefore, the above four institutions were not included in Table 2.

Figure 4 is the scatter plots between the HCPs and *h*-index showing a strong positive correlation between the two factors. The Spearman correlation coefficient between them is 0.870 ($p < .01$), which indicates that when evaluating the influence of universities, the HCP and *h*-index are mutually supportive indicators.

The universities with at least 16 HCPs published a total of 1358 HCPs. Figure 5 demonstrates that the collaboration network graph shows that these influential universities are strongly interconnected, which is a contrast to the co-authorship network (Fig. 3). Harvard Univ accounts for the largest number of HCPs (158), and the cooperation between Harvard Univ and MIT was the strongest, as shown in the picture where the edge between them is the thickest and darkest, representing 23 HCPs written together. In addition, Harvard Univ also collaborated with several other world-renowned universities such as Princeton Univ (9 times), New York Univ (9 times), Univ Chicago (7 times), Stanford Univ (6 times), etc.

The second and third most influential universities are Univ Chicago and MIT, with 94 and 93 HCPs, respectively. These two universities are within some obvious sub-networks, such as, the sub-network "Univ Chicago"/"MIT"/"Harvard Univ"; the sub-network "Univ Chicago"/"Harvard Univ"/"Univ Penn"; and the sub-network "Univ Chicago"/"Harvard Univ"/"Northwestern Univ"/"Stanford Univ". Universities on the graph form a large cooperation network.

Country analysis

The 2140 HCPs were published by 64 countries or territories. Table 3 lists the 33 most influential countries based on at least 6 HCPs. The USA accounts for the most of the 2140 HCPs (1517; 70.9%) as a leader of scientific research in Economics and Business. The second most influential country is the UK with 334 HCPs. The remaining top 10 influential

Table 2 The 50 most influential universities in the field of Economics and Business

University	Country	HCPs		H-index	University	Country	HCPs		H-index
		No.	Rank				No.	Rank	
Harvard Univ	USA	158	1	136	Univ N Carolina	USA	29	22	85
Univ Chicago	USA	94	2	106	Univ So Calif	USA	29	22	74
MIT	USA	93	3	105	Univ Washington	USA	29	22	79
Univ Penn	USA	89	4	114	London Business Sch	UK	28	29	78
Stanford Univ	USA	76	5	101	Univ Oxford	UK	28	29	68
Univ Calif-Berkeley	USA	73	6	103	Univ Toronto	Canada	28	29	80
New York Univ	USA	66	7	96	Erasmus Univ	Netherlands	26	32	83
Northwestern Univ	USA	52	8	93	Ohio State Univ	USA	26	32	71
Univ Michigan	USA	52	9	102	Univ Alberta	Canada	26	32	61
Univ Maryland	USA	50	10	98	Univ Texas-Austin	USA	24	35	56
Columbia Univ	USA	49	11	88	Univ Cambridge	UK	23	36	66
Princeton Univ	USA	46	12	79	Boston Coll	USA	20	37	61
Duke Univ	USA	43	13	90	Tilburg Univ	Netherlands	20	37	68
Arizona State Univ	USA	39	14	86	Univ Arizona	USA	18	39	64
Univ Minnesota	USA	39	14	85	Univ British Columbia	Canada	18	39	72
Yale Univ	USA	38	16	79	Univ Groningen	Netherlands	18	39	60
Indiana Univ	USA	34	17	80	Univ Texas-Dallas	USA	18	39	47
London Sch Econ	UK	31	18	80	Chinese Univ Hong Kong	China	17	43	65
Michigan State Univ	USA	31	18	89	Dartmouth Coll	USA	17	43	63
Texas A&M Univ	USA	30	20	83	Rutgers State Univ	USA	17	43	66
Univ Calif-Los Angeles	USA	30	20	77	Univ Wisconsin	USA	17	43	82
Cornell Univ	USA	29	22	84	York Univ	USA	17	43	64
Penn State Univ	USA	29	22	84	Carnegie Mellon Univ	USA	16	48	69
Univ Calif-San Diego	USA	29	22	67	Univ Sydney	Australia	16	48	56
Univ Illinois	USA	29	22	87	Univ Warwick	UK	16	48	60

HCPs highly cited papers

countries are Canada (160 HCPs), Germany (148 HCPs), the Netherlands (125 HCPs), China (122 HCPs), Australia (97 HCPs), France (82 HCPs), Switzerland (75 HCPs), and Spain (70 HCPs). China has achieved the sixth place, a noticeable progress in Economics and Business research. The HCPs of Economics and Business are mainly distributed in

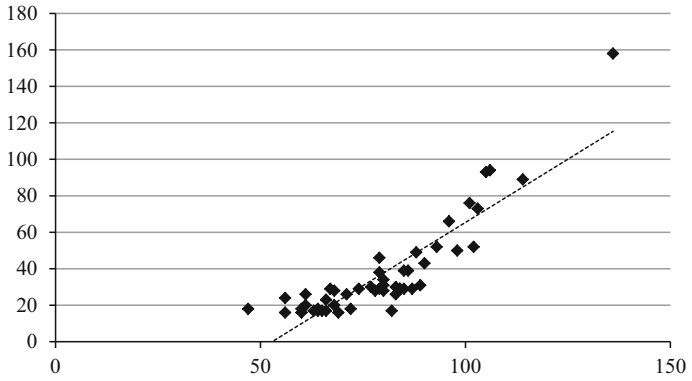

Fig. 4 Scatter plots between highly cited papers and h-indices of 50 most influential universities

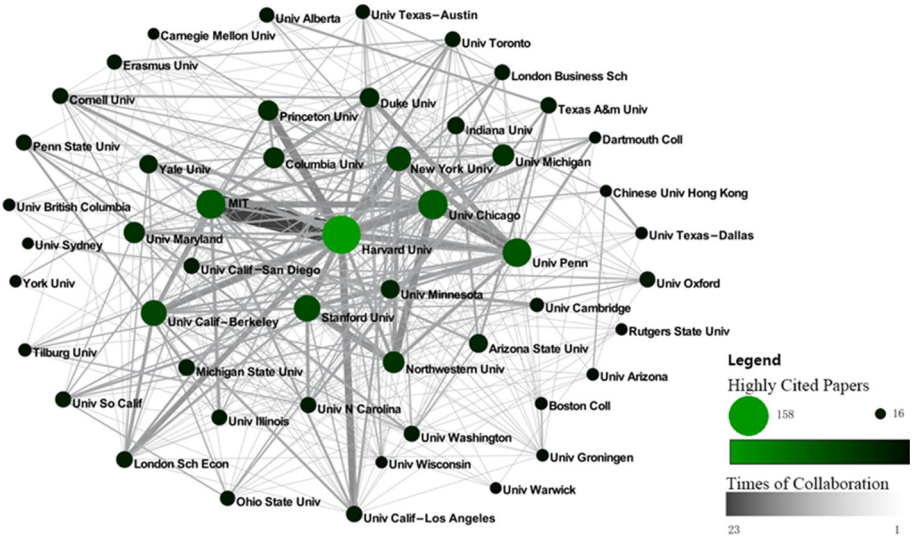

Fig. 5 The collaboration network of universities in Economics and Business

North America and Europe. The USA also has the highest *h*-index (295), followed by the UK (169), Canada (149), the Netherlands (136), China (131), Germany (123), France (112), Australia (111), Spain (108), Taiwan (97), and tied Switzerland and Italy (96).

The scatter plots between HCP and *h*-index are presented in Fig. 6. There is a strong positive correlation between them. The Spearman correlation coefficient of HCP and *h*-index is 0.924 ($p < .01$). HCP and *h*-index are mutually supportive indicators for evaluating academic influence of countries.

The collaborations among the 64 countries/territories are illustrated in Fig. 7. The collaboration network is strongly connected. The sub-networks are four isolated nodes and a large network of 60 nodes. Four countries, Botswana, Mexico, Romania, and South Africa are four isolated nodes without collaborations with any of the 60 well-connected countries. Mexico published two HCPs and the other three countries each published only one HCP. Within the large sub-network, the biggest node is the USA (representing the

Table 3 The 33 most influential countries/territories in the field of Economics and Business

Country/territory	HCPs		H-index	Country/territory	HCPs		H-index
	No.	Rank			No.	Rank	
USA	1517	1	295	Israel	24	18	75
UK	334	2	169	New Zealand	23	19	68
Canada	160	3	149	Finland	22	20	68
Germany	148	4	123	Taiwan	20	21	97
Netherlands	125	5	136	Ireland	19	22	62
China	122	6	131	Japan	19	22	65
Australia	97	7	111	Portugal	16	24	60
France	82	8	112	South Korea	14	25	85
Switzerland	75	9	96	Brazil	12	26	56
Spain	70	10	108	India	12	26	64
Italy	62	11	96	Greece	9	28	62
Sweden	48	12	92	Turkey	8	29	78
Denmark	39	13	80	Lithuania	7	30	39
Belgium	35	14	88	Poland	7	30	37
Norway	31	15	77	Argentina	6	32	31
Singapore	30	16	86	United Arab Emirates	6	32	31
Austria	25	17	73				

HCPs highly cited papers

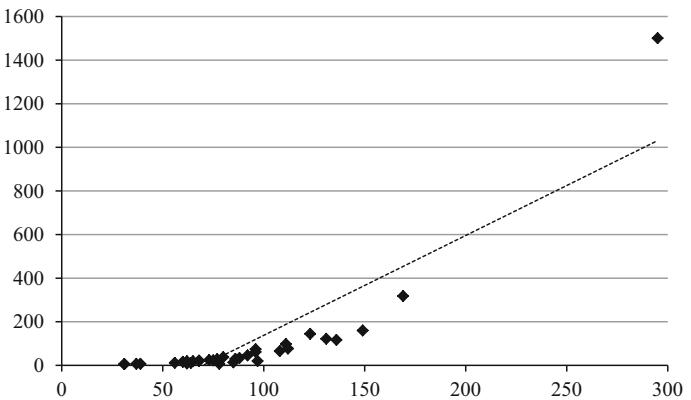

Fig. 6 Scatter plots between highly cited papers and h-indices of 33 most influential countries

1517 HCPs). The closest link is between the USA and the UK, which cooperated the most at 139 times. The other countries USA has cooperated frequently include Canada (79 times), China (77 times), Germany (59 times), the Netherlands (55 times), Switzerland (44 times), and Australia (37 times).

The second biggest node is the UK, with 334 HCPs. There are noticeable sub-networks too: the sub-network "USA"/"UK"/"Netherlands"; sub-network "USA"/"UK"/

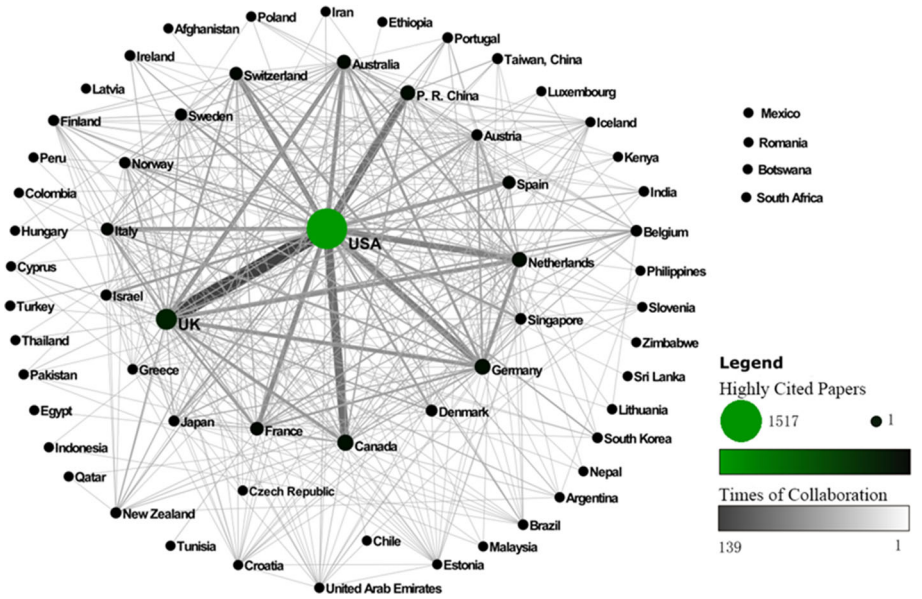

Fig. 7 The collaboration network of countries in Economics and Business

"Germany"; and sub-network "UK"/"Netherlands"/"Germany". China, as a rising influential country, mainly collaborated with the USA and Canada. There is no doubt that the collaboration network graph is complex and ellaborated, suggesting that research in Economics and Business has become increasingly a globally common interest and effort.

Discussion and conclusions

This study analyzed 2140 highly cited papers in Economics and Business between 2005 and 2014, retrieved from the ESI database. The set of 2140 HCPs are author or co-authored by 4499 scientists affiliated with 914 universities in 64 countries/territories. Three lists were derived from data analysis: the top 76 scientists, 50 most influential universities, and 33 most influential countries/territories. Through multidimensional investigation into these lists, some findings are revealed.

Firstly, the study uncovers that the USA's HCP ranks first and is far ahead of other countries around the globe, and the 46 top scientists (60.5%) and 37 most influential universities (74%) are from the USA. The UK's HCP ranks second and it fares well on the other two lists. Although Canada ranks third in HCP number, its performance was inferior to that of the Netherlands on the lists of scientists. There are 5 top scientists and 3 most influential universities from the Netherlands, while only 3 scientists and 3 universities are from Canada. Therefore, Canada and Netherlands can be treated equally as tied for third place. Following them are some developed countries including Germany, France, Switzerland, Australia, etc. Not only have these countries published large numbers of HCPs, they also sometimes appear in the other two lists. As a developing country, China performs well, ranking sixth with 122 HCPs, which is not far behind the leading developed countries. Merigó et al. (2016) also studied the most influential countries in Business and

Economics, obtaining similar results, for example, that the USA is the global leader in Business and Economics, followed by the UK. However, there are some differences between that study and ours. Merigó et al. believed that Canada should rank third, and the rank of the Netherlands was lower than that of Canada and Australia. But in our opinion, the Netherlands was as good as Canada and even better than Australia. Besides, Merigó et al. thought that the Economics and Business research of Asian countries such as China was far behind Western countries, while this study draw a different conclusion: based on this series of analyses, China has matched Germany, France, Switzerland, and Australia.

Secondly, the results of network analysis by the software Sci^2 indicate that the characteristics of the collaboration networks among authors, universities, and countries are different.

1. The collaboration network among the top 76 scholars is not very close, and there are 43 sub-networks. However, the analysis revealed a relatively tight sub-network with 13 top scientists. Most of their research focuses on socioeconomic, agricultural economics, climate change, land-use change, ecosystems, and sustainability.
2. The universities collaboration network is strongly connected. Unlike the co-authorship network of authors, there are no sub-networks among universities. All universities in the graph are interconnected and among them, Harvard accounts for the largest number of HCPs (158), and the cooperation between Harvard and MIT was the strongest, producing 23 HCPs together.
3. The country collaboration network is quite close with a large network of 60 nodes and only four isolated nodes. The biggest node is the USA, indicating it published most HCPs, 1517. The closest link is between the USA and UK, and they cooperated most, writing 139 HCPs together.

Thirdly, this study finds significant positive correlations between authors' HCP and *h*-index, between universities' HCP and *h*-index, and between countries' HCP and *h*-index. Since *h*-index is widely acknowledged to be a valuable evaluation method, these correlations indicate that when evaluating the academic impact of scholars, universities, and countries, the HCP approach should also be considered useful.

To sum up, an overall view of the field of Economics and Business has been achieved. However, this study has some limitations. A finer granular subject classification of the research area would have provided a more detailed picture. The category of Economics and Business needs to be further broken down into subcategories and subjects in analysis. In addition, ESI includes only journal publications, other types of important research output, such as books, conference papers, open access journals, and new journals, should also be examined, which will require additional data collection from other databases and this study was unable to expand. Moreover, it might also be useful to distinguish the two types of papers, original research papers and review papers, because the number of citations of a review paper is likely higher than that of an original paper. Future research should consider these limitations in method design.

Acknowledgements The present study is an extended version of an article presented at the 16th International Conference on Scientometrics and Informetrics, Wuhan (China), 16–20 October 2017 (Wan et al. 2017). This research was supported in part by the National Natural Science Foundation of China (Grants 71273250). We would like to thank the editors and anonymous reviewers for their constructive comments and suggestions, which helped us to improve the paper.

References

Abramo, G., D'Angelo, C. A., & Caprasecca, A. (2009). Allocative efficiency in public research funding: Can bibliometrics help? *Research Policy, 38*(1), 206–215.

Batagelj, V., & Mrvar, A. (1998). Pajek: A program for large network analysis. *Connections, 21*(2), 47–57.

Bonilla, C. A., Merigó, J. M., & Torres-Abad, C. (2015). Economics in Latin America: a bibliometric analysis. *Scientometrics, 105*(2), 1239–1252.

Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. *Annual Review of Information Science and Technology, 36*(1), 3–72.

Braun, T., Glänzel, W., & Schubert, A. (2005). A Hirsch-type index for journals. *The Scientist, 19*(22), 8–10.

Chan, K. C., Chang, C. H., & Chen, C. R. (2011). Financial research in the European region: a long-term assessment (1990–2008). *European Financial Management, 17*(2), 391–411.

Chen, C. (2006). CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for Information Science and Technology, 57*(3), 359–377.

Chiu, W. T., & Ho, Y. S. (2007). Bibliometric analysis of tsunami research. *Scientometrics, 73*(1), 3–17.

Chuang, K. Y., Wang, M. H., & Ho, Y. S. (2011). High-impact papers presented in the subject category of water resources in the essential science indicators database of the institute for scientific information. *Scientometrics, 87*(3), 551–562.

Clarivate Analytics. (2017). Highly cited researchers. Retrieved March 3, 2018 from https://clarivate.com/hcr/2017-researchers-list/.

Csajbók, E., Berhidi, A., Vasas, L., & Schubert, A. (2007). Hirsch-index for countries based on Essential Science Indicators data. *Scientometrics, 73*(1), 91–117.

Cuccurullo, C., Aria, M., & Sarto, F. (2016). Foundations and trends in performance management. A twenty-five years bibliometric analysis in business and public administration domains. *Scientometrics, 108*(2), 595–611.

Davarpanah, M. R., & Aslekia, S. (2008). A scientometric analysis of international LIS journals: Productivity and characteristics. *Scientometrics, 77*(1), 21–39.

De Bakker, F. G., Groenewegen, P., & Den Hond, F. (2005). A bibliometric analysis of 30 years of research and theory on corporate social responsibility and corporate social performance. *Business and Society, 44*(3), 283–317.

Fu, H. Z., Chuang, K. Y., Wang, M. H., & Ho, Y. S. (2011). Characteristics of research in China assessed with Essential Science Indicators. *Scientometrics, 88*(3), 841–862.

Glänzel, W. (2002). Coauthorship patterns and trends in the sciences (1980–1998): A bibliometric study with implications for database indexing and search strategies. *Library Trends, 50*(3), 461–475.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America, 102*(46), 16569–16572.

Hoepner, A. G., Kant, B., Scholtens, B., & Yu, P. S. (2012). Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions. *Ecological Economics, 77,* 193–206.

Hsieh, P. N., & Chang, P. L. (2009). An assessment of world-wide research productivity in production and operations management. *International Journal of Production Economics, 120*(2), 540–551.

Hsu, C. L., & Chiang, C. H. (2015). The financial crisis research: a bibliometric analysis. *Scientometrics, 105*(1), 161–177.

Jacsó, P. (2009). The h-index for countries in web of science and scopus. *Online Information Review, 33*(4), 831–837.

Karpagam, R., Gopalakrishnan, S., Natarajan, M., & Babu, B. R. (2011). Mapping of nanoscience and nanotechnology research in India: a scientometric analysis, 1990–2009. *Scientometrics, 89*(2), 501–522.

Kharabaf, S., & Abdollahi, M. (2012). Science growth in Iran over the past 35 years. *Journal of Research in Medical Sciences, 17*(3), 275–279.

Kumar, L., Sripada, S., & Sureka, A. (2016). A bibliometric study of Asia Pacific software engineering conference from 2010 to 2015. arXiv:1610.09635 [cs.SE]. https://arxiv.org/abs/1610.09635. Accessed November 1, 2016.

Li, L. L., Ding, G., Feng, N., Wang, M. H., & Ho, Y. S. (2009). Global stem cell research trend: Bibliometric analysis as a tool for mapping of trends from 1991 to 2006. *Scientometrics, 80*(1), 39–58.

Merigó, J. M., Gil-Lafuente, A. M., & Yager, R. R. (2015). An overview of fuzzy research with bibliometric indicators. *Applied Soft Computing, 27,* 420–433.

Merigó, J. M., Rocafort, A., & Aznar-Alarcón, J. P. (2016). Bibliometric overview of business and economics research. *Journal of Business Economics and Management, 17*(3), 397–413.

Molinari, A., & Molinari, J. F. (2008). Mathematical aspects of a new criterion for ranking scientific institutions based on the h-index. *Scientometrics, 75*(2), 339–356.

Mugnaini, R., Packer, A. L., & Meneghini, R. (2008). Comparison of scientists of the Brazilian Academy of Sciences and of the National Academy of Sciences of the USA on the basis of the h-index. *Brazilian Journal of Medical and Biological Research, 41*(4), 258–262.

Olden, J. D. (2007). How do ecological journals stack-up? Ranking of scientific quality according to the h index. *Ecoscience, 14*(3), 370–376.

Pardo, C., Reolid, M., Delicado, M. V., Mallebrera, E., & García-Meseguer, M. J. (2001). Nursing research in Spain: Bibliometrics of references of research papers in the decade 1985–1994. *Journal of Advanced Nursing, 35*(6), 933–943.

Pilkington, A., & Meredith, J. (2009). The evolution of the intellectual structure of operations management—1980–2006: A citation/co-citation analysis. *Journal of Operations Management, 27*(3), 185–202.

Podsakoff, P. M., MacKenzie, S. B., Podsakoff, N. P., & Bachrach, D. G. (2008). Scholarly influence in the field of management: A bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century. *Journal of Management, 34*(4), 641–720.

Pouris, A. (2007). The international performance of the South African academic institutions: A citation assessment. *Higher Education, 54*(4), 501–509.

Rey-Martí, A., Ribeiro-Soriano, D., & Palacios-Marqués, D. (2016). A bibliometric analysis of social entrepreneurship. *Journal of Business Research, 69*(5), 1651–1655.

Schubert, A. (2007). Successive h-indices. *Scientometrics, 70*(1), 201–205.

Sci^2 Team. (2009). Science of Science (Sci^2) Tool. Indiana University and SciTech Strategies. Retrieved November 24, 2016 from https://Sci2.cns.iu.edu.

Sooryamoorthy, R. (2010). Medical research in South Africa: A scientometric analysis of trends, patterns, productivity and partnership. *Scientometrics, 84*(3), 863–885.

Tabatabaei, N., & Beheshti, J. (2008). Interdisciplinary outreach of library and information science research as reflected in ''Essential Science Indicators''. In *Proceedings of the 36th Conference of the Canadian Association for Information Science (CAIS)* (pp. 5–7). University of British Columbia.

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523–538.

Wagstaff, A., & Culyer, A. J. (2012). Four decades of health economics through a bibliometric lens. *Journal of Health Economics, 31*(2), 406–439.

Wan, S., Zhang, N., Wang, P., Zhang, P., & Wu, Q. (2017). A brief analysis of top scientists in the field of Economics and Business based on the Essential Science Indicators database. In: *Proceedings of ISSI 2017*: *The 16th international conference on scientometrics and informetrics* (pp. 896–901). China: Wuhan University.

Zhang, X., Chen, H., Wang, W., & Ordóñez de Pablos, P. (2016). What is the role of IT in innovation? A bibliometric analysis of research development in IT innovation. *Behaviour and Information Technology, 35*(12), 1130–1143.