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Researchers' Mobility, Productivity and Impact: Case of Top Producing Authors in Seven Disciplines

Gali Halevi[1] · **Henk F. Moed**[2] · **Judit Bar-Ilan**[3]

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Abstract The purpose of this study was to examine whether scientific mobility, either between countries or between affiliations has an effect on researchers' productivity and impact. In order to investigate this issue, we examined the relationships between the number of institutional affiliations and countries of the top 100 authors in seven disciplines. The selected authors' profiles contained the number of affiliations and countries each author is assigned. We studied the number of affiliations and countries and compared them to three bibliometric indicators: the number of publications in international, peer-reviewed journals, h-index and Field Weighted Citations Impact. Our findings show that although there are differences in the relationship between mobility, productivity and impact between disciplines, mobility between at least two affiliations has an overall positive effect on both output and impact while mobility between countries does not. Therefore, in most disciplines positive impact and productivity effects are tracked in affiliation mobility within a single country.

Keywords Scientific mobility · Scientific productivity · Scientific output · Bibliometrics · International research · h-Index · Citations · Scientific publications

✉ Gali Halevi
gali.halevi@mssm.edu

Henk F. Moed
hf.moed@gmail.com

Judit Bar-Ilan
Judit.Bar-Ilan@biu.ac.il

[1] Icahn School of Medicine at Mount Sinai, 1428 Madison Ave, New York, NY 10029, USA

[2] Department of Computer, Control and Management Engineering Antonio Ruberti, University of Rome "La Sapienza", Rome 00185, Italy

[3] Department of Information Science, Bar-Ilan University, Ramat Gan 5290002, Israel

Introduction

The number of publications and the number of citations a researcher receives are, by far, the most common measures of productivity and impact used for promotion and tenure purposes. With the globalization of the scientific world, online resources to track professional opportunities, potential collaborations and institutional research are used by researchers to carve their careers paths. As a result of these trends, the scientific community is seeing more researchers moving from one affiliation to another within or outside their country of origin.

In this article we were looking to determine whether affiliation or country mobility have a statistical effect on a researchers' productivity in terms of larger amount of publications and their citation impact in terms of three distinct citation-based measures: (1) Total number of received citations (2) h-index and (3) Field Weighted Citations Impact (FWCI). Affiliation mobility pertains to a researcher moving from one affiliation to another throughout his/her career while country mobility pertains to movement from one country to another.

The overall phenomenon of researcher mobility is becoming the focus of studies that range from research policy [7, 13] knowledge transfer [5] to productivity [3]. Studies done in this area were able to identify phenomena such as "Brain Drain" which denotes the movement of researchers, mainly due to economic reasons, to "winning countries" which receive them and the "losing countries" that see their scientific human capita depleted [12, 17]. "Brain Circulation" is another term which emerged from these studies focusing on the movement of scientists, mainly looking to further their education or gain experience in host countries and their return to their home countries later on [1, 8, 11, 16, 15] and the term "Brain War"which emerged as a way to describe the competitive aspects of scientists' movement, and whether a country will attract or restrict such movement depending on the research areas that are of interest to it [1, 10].

Several studies describe the effect of mobility on productivity in terms of publications output reporting mixed results. Baruffaldi and Landoni [3] found that scientists in Italy and Portugal who keep ties with their home countries tend to be slightly more productive than those who do not do so, which can be attributed to their collaborative tendencies. Contrary to that Fernandez-Zubieta et al. [6] did not find evidence that mobility per se increases academic performance and found that it actually has negative effect with reduced quality and quantity of research output. Studying 1100 Norwegian university researchers, Aksnes et al. [2] also found that mobility has a marginal effect on research performance. Gibson and McKenzie [9] examined the migration outcomes and scientific productivity of researchers from three small island countries and found that those who returned to their home countries did not have greater research impact than individuals who never migrated. However, emigrant researchers tend to have much greater research output and impact than researchers in the source country.

The literature shows a variety of results, which are difficult to generalize. This could be a result of their focusing on a country, region or a specific discipline, thus making the results relevant to a very specific phenomenon.

Table 1 Journals and records

Discipline	Journals	Total # of publications 2010–2015
Neuroscience	The Lancet Infectious Diseases	1480
	Clinical Infectious Diseases	
	Journal of Infectious Diseases	
	Current Opinion in Infectious Diseases	
	Emerging Infectious Diseases	
	Pediatric Infectious Diseases	
	BMC Infectious Diseases	
	Infection Genetics and Evolution	
	International Journal of Infectious Diseases	
	Comparative Immunology, Microbiology and Infectious Diseases	
Mechanical Engineering	Journal of Biomechanical Engineering	6377
	Archives of Civil and Mechanical Engineering	
	Proceedings of the Institutions of Mechanical Engineers Part J. Jr. of Engineering Tribology	
	Proceedings of the Institutions of Mechanical Engineers Part D: Jr. of Automobile Engineering	
	Proceedings of the Institutions of Mechanical Engineers Part H: Jr. of Engineering in Medicine	
	Proceedings of the Institutions of Mechanical Engineers Part I: Jr. Of Systems and Control Engineering	
	Chinese Journal of Mechanical Engineering (English Edition)	
	International Journal of Mechanical and Materials Engineering	
	Proceedings of the Institutions of Mechanical Engineers Part P: Journal of Sports Engineering	
	Proceedings of the Institutions of Mechanical Engineers Part C: Journal of Mechanical Engineering Science	
Arts and Humanities	International Journal of the Humanities	3567
	Arts and Humanities in Higher Education	
	Leonardo	
	Critical Arts	
	Foreign Literature Studies	
	Third Text	
	Rupkatha Journal of Interdisciplinary Studies in Humanities	
	Technoetic Arts: a Journal of Speculative Research	
	Visual Resources	
	Daedalus	
Oncology	Annals of Surgical Oncology	11,195
	Journal of Clinical Oncology	
	Annals of Oncology	

Table 1 continued

Discipline	Journals	Total # of publications 2010–2015
	Psycho-Oncology	
	International Journal of Clinical Oncology	
	International Journal of Radiation Oncology Biology Physics	
	Journal of Oncology Practice	
	Pediatric Blood and Cancer	
	Supportive Care in Cancer	
	Clinical Journal of Oncology Nursing	
Environmental Geology	Environmental Earth Sciences	25,818
	Arabian Journal of Geosciences	
	Science of the Total Environment	
	Applied Geochemistry	
	Journal of Coastal Research	
	12th International Multidisciplinary Scientific GeoConference and EXPO—Modern Management of Mine Producing, Geology and Environmental Protection, SGEM 2012	
	Journal of Hydrology	
	Journal of Environmental Studies	
	Journal of Environmental Radioactivity	
	Natural Resources Research	
Business	Journal of Business Ethics	42,274
	Lecture Notes in Business Information Processing	
	Small Business Economics	
	Strategic Direction	
	Industrial Marketing Management	
	Science and Engineering Ethics	
	Review of Quantitative Finance and Accounting	
	Journal of Business Research	
	Journal of Real Estate Finance and Economics	
	Journal of International Business Studies	
Infectious Diseases	The Lancet Infectious Diseases	20,748
	Clinical Infectious Diseases	
	Journal of Infectious Diseases	
	Emerging Infectious Diseases	
	Clinical Microbiology and Infection	
	Current Opinion in Infectious Diseases	
	Pediatric Infectious Diseases Journal	
	Infection, Genetics and Evolution	
	BMC Infectious Diseases	
	Diagnostic Microbiology and Infectious Disease	

This article sought out to examine whether there is a relationship between researchers' mobility, productivity and scientific impact by studying seven different, pre-defined, disciplines, listed below in Table 1.

The study presented in this paper is based on relatively small sets of 100 authors in seven disciplines. The authors were not drawn randomly from the total population of authors in a particular discipline, but rather from the very top of the author productivity distribution in terms of number of published articles. In other words, the study focuses on the most active researchers as reflected in their publication practices. The study aims to analyze the mobility patterns of *this* group of authors. Its outcomes are complementary to those from other studies mentioned above, which analyze sets of authors with different productivity scores. It calculates *descriptive* statistics of the sets analyzed, and makes observations on the differences in the degree of mobility of the various subclasses of authors, but does *not* attempt to analyze their statistical significance, in terms of whether the observed differences are representative for a wider group of frequently publishing authors, or in the total population of authors.

Data

Using SciVal, an information product created by Elsevier offering access to bibliometric indicators of several thousands of research institutions and 220 countries worldwide, (See www.info.scival.com), we defined a diverse list of seven disciplines: (1) Neuroscience (2) Mechanical Engineering (3) Arts & Humanities (4) Oncology (5) Environmental Geology (6) Business (7) Infectious Diseases.

In SciVal, disciplines can be custom defined by the user to include the collections of journals one would like to analyze and the year ranges they cover. In our case, we selected the top 10 journals in terms of their SNIP (Source Normalized Impact per Paper) score in each discipline by searching for the specific research area in the Scopus Journal search form. SNIP is a citation-based journal impact measure developed at the Centre for Science and Technology Studies at Leiden University [14, 18]. Its main feature is that it corrects for differences in citation practices between subject fields, enabling one to compare journals from different subject fields in terms of their citation impact.

SciVal has a pre-defined 5 year analytical range. Therefore, we limited the publication dates to 2010–2015 which is the widest date range allowed by SciVal. This allowed us to look at the top productive researchers in these areas in recent years in terms of number of publications. Table 1 lists the journal names and total number of publications per each of the disciplines we studied.

The choice of these disciplines was not random. Examining the citation behavior and overall publications output in the 27 Scopus disciplines we selected disciplines that display heterogeneous trends. The main reason for this was to enable a wider look into the issues of mobility, productivity and impact across disciplines and be able to detect differences and similarities between a diverse set of disciplines.

Using SciVal disciplinary *overview* (See http://www.elsevier.com/online-tools/research-intelligence/products-and-services/scival), we extracted the top 100 authors between 2010 and 2015 in terms of publications in each of the seven disciplines. Each author indexed in SciVal has a profile that includes his/her identified affiliations and countries. The author profiles in SciVal are prepopulated and automatically track an author's affiliation and countries based on the information listed on their publications. In cases where an affiliation or country cannot be determined, the profile includes an "unknown" tag. Examining each of the 700 author profiles individually, we recorded the number of identified affiliations and the number of identified countries.

The measures of impact we used in this study include the authors' h-index and their Field Weighted Citation Impact; two indicators available via the SciVal disciplinary overview (see http://www.snowballmetrics.com/wp-content/uploads/snowball-metrics-recipe-book-upd.pdf). The h-Index is an indicator which measures both the productivity and citation impact of the published body of work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they received in other publications. The h-index is applied to the overall body of the researcher's work while the Field Weighted Citation Impact measures the ratio of total citations actually received to the total citations that would be expected based on the average of the subject field.

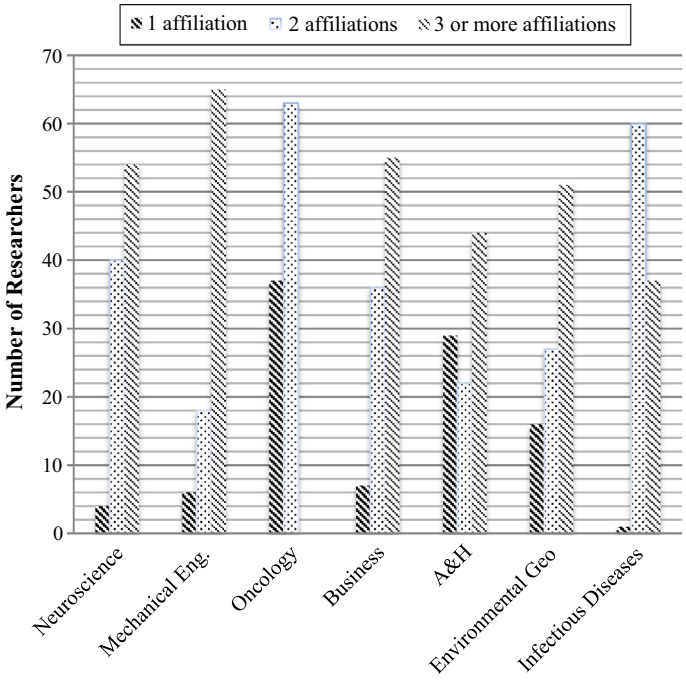

Fig. 1 Total number of authors and affiliations per discipline

Results

Mobility Between Affiliations and Countries

Figure 1 shows that five of the seven disciplines demonstrate high mobility with top researchers moving between three or more affiliations during their career. This is particularly evident in Mechanical Engineering where the number of researchers with three or more affiliations is almost triple compared to one or two affiliations. Oncology and Infectious Diseases are also interesting disciplines in which one affiliation almost does not exist while two or more affiliations are common when examining the top 100 authors. Other disciplines that display high mobility between two or more affiliations are Business, Arts & Humanities (A&H) and Environmental Geology.

Figure 2 depicts the number of researchers that have one country listed in their profiles and those who have two or more countries listed. As can be seen in this figure, all disciplines display mobility between countries. However, it is worth noting that Mechanical Engineering has the lowest number of researchers with two

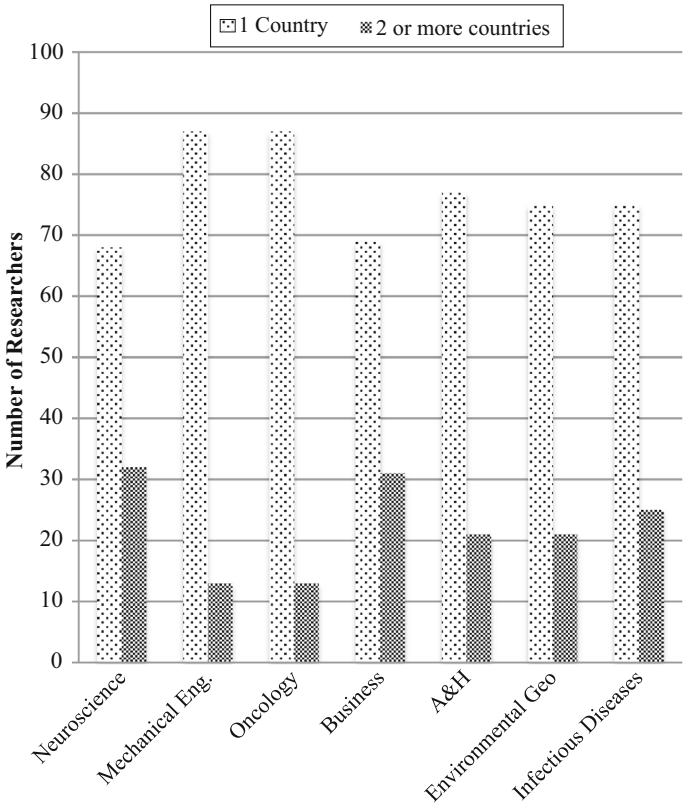

Fig. 2 Total number of authors and countries per discipline

or more countries listed in their profile. As mentioned above, Mechanical Engineering researchers are highly mobile between affiliations and Fig. 2 shows that they move within one country. Similarly one should note Infectious Diseases which although displays high mobility between affiliations shows moderate mobility between countries. Neuroscience and Business show the highly mobile disciplines with almost 50 % of researchers having two or more countries listed in their profiles.

Relationship Between Number of Publications and Number of Affiliations and Countries

In order to examine whether the number of affiliations or countries has an impact on the number of publications produced by researchers in each field, we calculated the average number of publications grouped by one affiliation, two affiliations and three or more affiliations. Although there were cases of disciplines that had authors with four listed affiliations, these were too few to calculate and therefore these cases were omitted from the calculation. Figure 3 shows that in most disciplines, two affiliations seem to increase the number of articles output while a third affiliation seems to decrease it. This includes Neuroscience and Infectious Diseases with a negative effect; Business, Oncology and Environmental Geology with no effect. The two exceptions are Mechanical Engineering and A&H, which show an increase in the average number of publications as the number of affiliations increases. In the case of Mechanical Engineering, it should be noted that six of the researchers

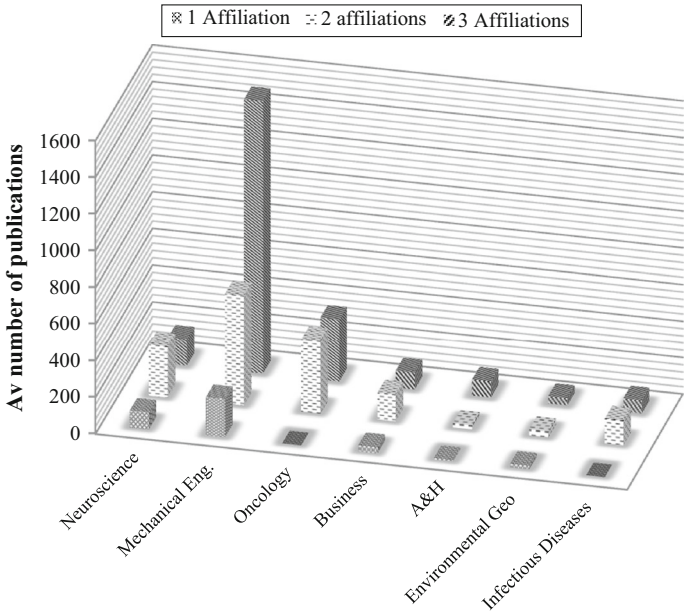

Fig. 3 Average number of publications and affiliations per discipline

examined have a significant amount of articles which overall contributed to high number displayed in Fig. 3.

The results are slightly different when looking at the relationships between the average number of publications grouped by one country and two or more countries. As can be seen in Fig. 4, mobility between countries has positive effect on the average number of publications in Neuroscience, negative effect in Mechanical Engineering and hardly any effect on all the other disciplines. Therefore, while affiliation mobility has a positive effect on the number of publications in Mechanical Engineering, country mobility has a negative one. Overall, it seems that country mobility does not contribute to the average number of publications in these disciplines.

Relationship Between Number of Citations and Number of Affiliations and Countries

Moving between two and three affiliations seems to increase citations. As can be seen from Fig. 5, the average citations in all disciplines increase when two or three affiliations are identified. Neuroscience, Oncology and Infectious Diseases have the highest average citations when two affiliations are identified. In Neuroscience the average numbers of citations more than doubles when two affiliations are identified than when one or three are. Mechanical Engineering shows the highest average citations when three affiliations are identified, very similarly to A&H and Business.

The number of countries has very little effect on the average number of citations in most cases. As can be seen in Fig. 6 in Neuroscience, Mechanical Engineering and Infectious Diseases mobility between countries has a slight negative effect on

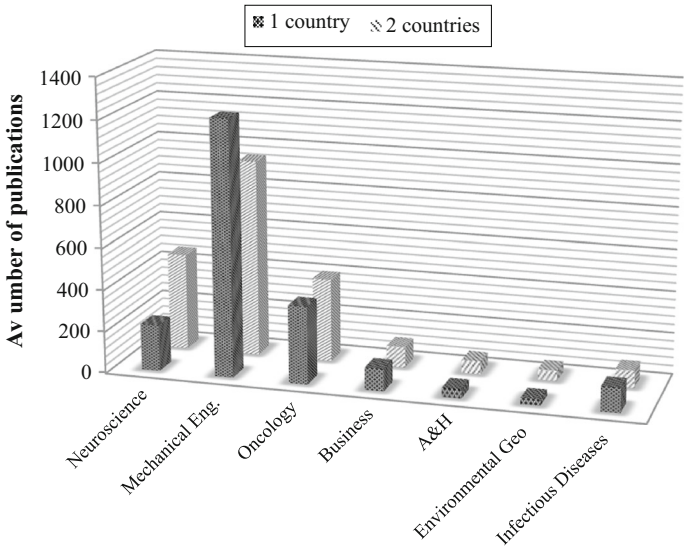

Fig. 4 Average number of publications and countries per discipline

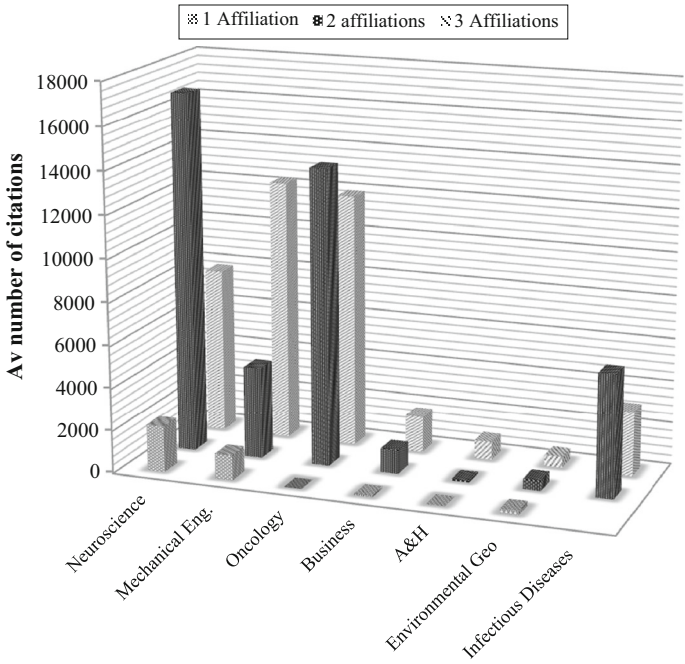

Fig. 5 Average number of citations and affiliations per discipline

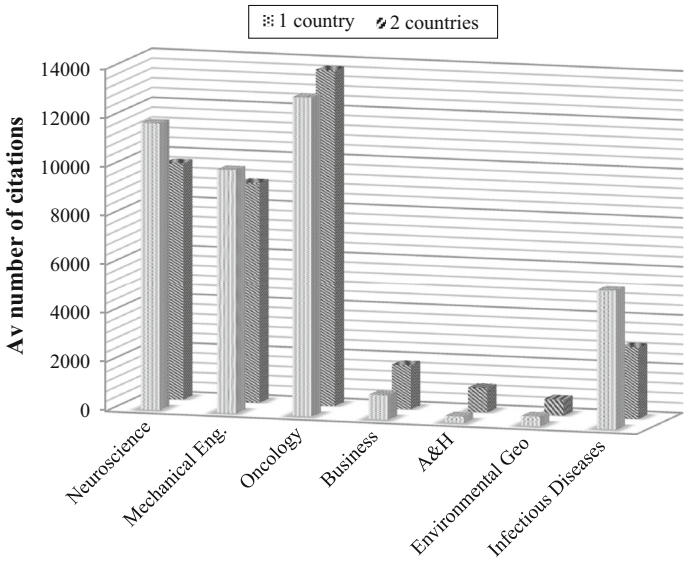

Fig. 6 Average number of citations and countries per discipline

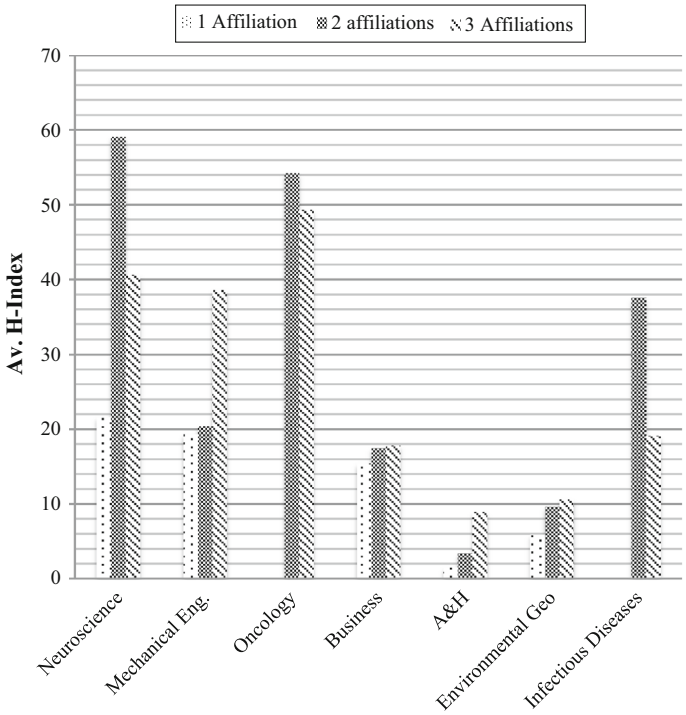

Fig. 7 Average h-index and number of affiliations

the average number of citations. In Oncology, Business, A&H and Environmental Geology mobility between countries has a small positive effect on the average number of citations.

Relationship Between Number of Affiliations and Countries and the h-Index

A positive effect of number of affiliations on the average h-index is seen in Neuroscience, Oncology and Infectious Diseases. However, it is worth noticing that while two affiliations seem to have positive outcome with the average h-index, three affiliations have negative effect in these disciplines. Mechanical Engineering and A&H are showing positive effect of three affiliations on the average h-index with a slight improvement in Business and Environmental Geology (see Fig. 7).

Country mobility has slight negative effect in the average h-index except in Business, A&H and Environmental Geology (see Fig. 8).

Relationship Between Number of Affiliations and Countries and the Field Weighted Citations Impact

Field-Weighted Citation Impact in SciVal indicates how the number of citations received by an entity's publications compares with the average number of citations received by all other similar publications in the data universe [4, p. 61].

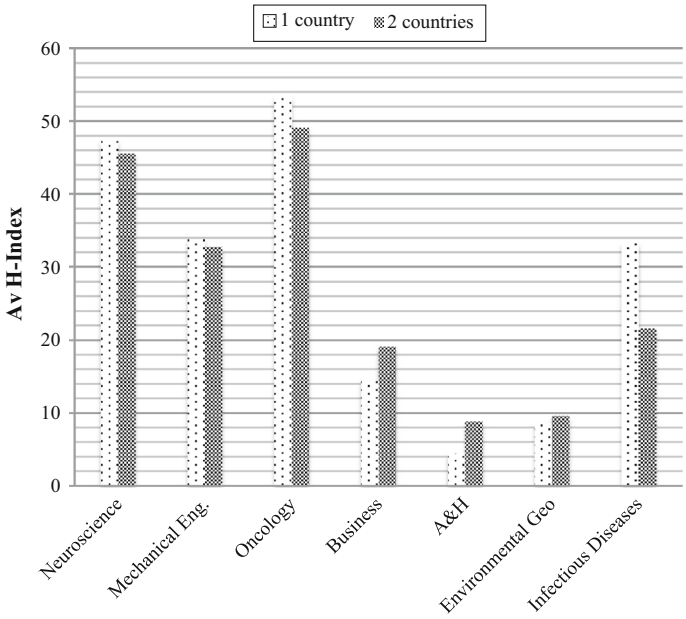

Fig. 8 Average h-index and number of countries

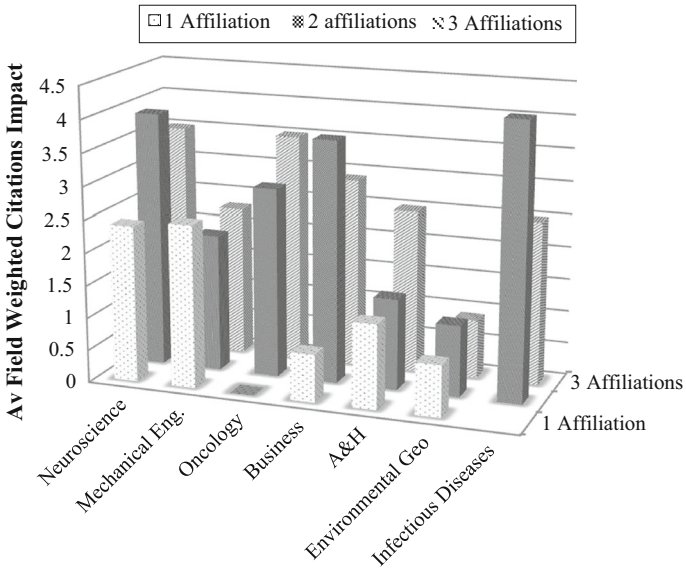

Fig. 9 Av. FWCI and number of affiliations per discipline

The Field-Weighted Citation Impact of the entire Scopus database, is 1.00. Figure 9 shows that two affiliations have a positive effect on the FWCI indicator in Neuroscience, Environmental Geology, Business and Infectious Diseases while

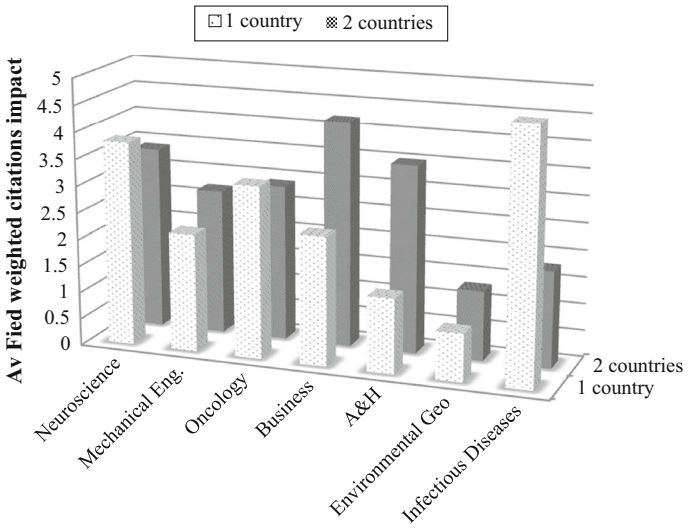

Fig. 10 Av FWCI and number of countries

three affiliations have positive effect on FWCI in Oncology, where one affiliation is not found in the top 100 profiles. One affiliation has positive effect on FWCI in Mechanical Engineering only.

Finally Fig. 10 show that country mobility has positive effect on FWCI in Business, A&H, and Environmental Geology and slightly in Mechanical Engineering. Country mobility has negative effect on FWCI in Neuroscience, Oncology and Infectious Diseases.

Summary

Looking at the most common trends per each discipline (see Table 2), we can summarize them as follows:

1. Neuroscience sees the most benefit when researchers move between two affiliations and two countries.
2. Mechanical Engineering sees the most benefit the most when researchers move between three affiliations within one country.
3. Oncology sees the most benefit when researchers move between two affiliations in one or two countries.
4. Businesssees the most benefit when researchers move between two or three affiliations in two countries.
5. Arts & Humanitiessees the most benefit when researchers move between three affiliations in two countries.
6. Environmental Geologysees the most benefit when researchers move between two or three affiliations in two countries.

Table 2 Summary of results

	Higher Av number of publications	Higher Av number of citations	Higher Av H-index	Higher Av FWCI
1 Affiliation	None	None	None	Mechanical Engineering (slight)
2 Affiliations	Neuroscience	Neuroscience	Neuroscience	Neuroscience
	Oncology	Oncology	Oncology	Business
	Business	Infectious Diseases	Infectious Diseases	Environmental Geo (slight)
	Infectious Diseases			Infectious Diseases
3 Affiliations	Mechanical Engineering	Mechanical Engineering	Mechanical Engineering	Oncology
	Arts and Humanities	Arts and Humanities	Business	Arts and Humanities
		Business (slight)	Arts and Humanities	
		Environmental Geo (slight)	Environmental Geo	
1 Country	Mechanical Engineering	Neuroscience	Neuroscience (slight)	Neuroscience
	Business (slight)	Mechanical Engineering	Mechanical Engineering	Oncology
	Infectious Diseases	Infectious Diseases	Oncology	Infectious Diseases
			Infectious Diseases	
2 Countries	Neuroscience	Oncology	Business	Mechanical Engineering
	Oncology (slight)	Business	Arts and Humanities	Business
	Arts and Humanities	Arts and Humanities	Environmental Geo (slight)	Arts and Humanities
	Environmental Geo	Environmental Geo		

7. Infectious Diseases sees the most benefit when researchers move between two affiliations in one country.

Conclusions

When examining the top 100 performing researchers in the seven disciplines studied in this paper, mobility between at least two affiliations increases both output and impact. Other than a slight increase in FWCI in Mechanical Engineering within one affiliation all other indicators are showing positive effects of affiliation mobility on productivity and impact. The disciplines that see the most benefit from affiliation mobility are Mechanical Engineering, Oncology, Arts & Humanities and Infectious Diseases. There are disciplines such as Oncology and Infectious Diseases where

there are small or no cases of one affiliation to be found in the researchers profiles. This is an interesting result to which we do not have explanation.

Mobility between countries does not seem to have the same impact as affiliation mobility. In most disciplines an increase in output and impact are tracked in affiliation mobility within one country. There are some disciplines such as Environmental Geology, Arts & Humanities and Business that see more benefits in country—mobility than others. This could be because of the actual nature of these disciplines having more global aspects to their research than others.

Therefore it seems important that researchers will move from one affiliation to another during the course of their careers. This can probably be explained in terms of gaining experience and expanding one's networks. The number of affiliations a researcher moves to, whether two or three might not make a significant difference. Country mobility does not seem to have a significant impact except in specific disciplines such as Arts & Humanities, Business and Environmental Geology.

Limitations and Further Study

The results presented in this study are limited to the top 100 authors in each defined discipline. These authors might not be representing the discipline as whole in terms of number or publications. We chose these authors in order to discover whether these top producing authors have certain characteristics in terms of mobility and whether mobility has an effect on their productivity and impact. Further study should be conducted on the medium and low producing authors in each discipline. Comparing high, medium and low producing authors might reveal more about the effect of mobility on output and impact.

The results also show that the relationship between mobility and productivity and impact cannot be generalized across disciplines. Therefore, there is a need to examine each discipline in more detail while looking at sub-disciplines within it. Aggregating sub-disciplinary results from the bottom up might shed more light on the overall trends within the discipline as a whole.

In addition, our study was limited to five years only. Further study into year ranges going back further, could shed light the evolution of mobility and its effect on productivity and impact.

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