Internationality at university level

András Schubert¹ · Gábor Schubert²

Received: 8 November 2019 / Published online: 2 May 2020
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Abstract

University level indicators of internationality have been compiled and presented. 18 universities from three countries, Hungary, Israel and Sweden were selected as sample. “Breadth” and “depth” of internationality were distinguished and characterized by bibliometric and webometric tools.

Keywords Internationality · Universities · Partnership Ability Index · Website visitor statistics

Introduction

The term “international” prevails in the literature of scientometrics. A simple topic search in the Web of Science shows that about 20% of all papers with the keyword “bibliomet* or scientomet* or informet* or altmet*” also contains “international* or multinational* or cross-national*”. It is about three times more than scientometrics-related papers with the keyword “interdisciplin* or multidisciplin* or cross-disciplin*”, another favored topic.

Yet, attempts to measure internationality, whether within or outside the realm of scientometrics, are relatively sparse. This abstention is certainly resulted from the lack of consensus about the meaning, let alone the method of measurement of the concept of internationality. As one of the prominent researchers of the topic formulated: “The two central problems [...] are: (1) Global under-representation as a result of the use of the literal definition of the word international in its minimal sense and, (2) Widespread usage of the term international without any evaluation of its degree with reference to appropriate measures or indices.” (Buela-Casal et al. 2006).

Buela-Casal et al. (2005) and his coworkers proposed a multicriterion “Internationality Index” to measure the internationality of journals. The method is scarcely generalizable for

This paper is dedicated to the memory of Judit Bar-Ilan (1958–2019), an outstanding scholar and an inimitable friend and colleague.

✉ András Schubert
schuba@iif.hu

¹ Library and Information Center, Hungarian Academy of Sciences, Budapest, Hungary

² Stockholm University, Library, Stockholm, Sweden

studying objects other than journals, and did not gain widespread use outside the Spanish psychology community.

A critical point in studying internationality is the distinction between its “breadth” and “depth”, similarly as Zhao and Wei (2018) defined the breadth and depth of collaboration, in general. Breadth, in the present case, roughly means the number of countries involved, depth is related to the extent of international links. As an extreme case, 90% of the publications of Andorra is published in international co-operation, that is, the extent (depth) of publication internationality is enormous, but practically all of these international papers have been published with Spain as co-operating partner, i.e., the breadth of internationality is, to say the least, moderate. On the other hand, international co-operation is involved in not more than 20% of US publications, but the range of co-operating partners is the widest possible.

In one of the first large-scale international co-authorship statistics, Frame and Carpenter (1979) used the most straightforward pure “depth” indicator: the proportion of internationally co-authored papers in the publication output of countries. In a follow-up study, Schubert and Braun (1980) confirmed the results of Frame and Narin, and also proposed a “Cooperation Index” taking into account the inherent correlation between the “foreign co-authorship ratio” and the total publication output of the countries. A pioneering attempt to map the co-authorship network of countries has also been made. The complementary indicator of “foreign co-authorship ratio”, “domesticity”, has later been extended from co-authorship to reference and citation internationality, as well (Glänzel and Schubert 2005).

In the original version of Buéla-Casal’s “Internationality Index” (Buéla-Casal et al. 2005), co-authorship internationality was taken into account through a “breadth” indicator (the number of countries from which the authors of the articles came from). In a parallel paper (Perakakis et al. 2005) the use of the Gini Coefficient as dispersion indicator has also been considered.

Being a conservation biologist, Calver et al. (2010) noticed the analogy between the problems of internationality with that of multispecies ecological populations. He proposed a set of indicators originated from ecology to characterize the ‘richness’, ‘diversity’ and ‘evenness’ for the country of origin of authors, editors, citations, etc. Recently Calver et al. (2018), a similar system of indicators has been proposed to characterize, beyond internationality, interdisciplinarity, as well.

Recently, “traditional” bibliometric dimensions of internationality have been supplemented with altmetric elements (Didegah et al. 2017).

In the present paper, internationality is considered at the level of universities. Statistics about international cooperation in individual universities are certainly included in various university reports and similar documents. We are not aware, however, that a targeted, comparative study on this topic has ever been published.

Distinctive features of studying internationality at university level

Since most of the existing scientometric studies of internationality concern to journals, attention should be paid to the main similarities and differences between studying universities and journals.

1. Most of the universities have an inherent “nationality”, while the majority of scientific journals are published by multinational publishers. Journals of national societies or, as a matter of fact, universities are rather the exception than the rule. The concept of

- “domesticity” has much more relevance for universities than for journals, whether co-authorship, references or citations are concerned.
2. There is no university counterpart of the editorial boards of journals. International governing bodies or supervisory committees may exist but their significance is usually negligible.
 3. Universities usually have well-defined, unique internet domain names that make them eligible for webometric analysis. Journals’ web pages are frequently hidden under the umbrella of the publisher’s website.

Speaking about assessing universities, one cannot avoid encountering issues of university ranking. Indeed, except for the Shanghai (ARWU) ranking, all major university ranking systems [Times Higher Education (THE), Quacquarelli Symonds (QS), Leiden (CWTS)] include some kind of “internationality” indicator. These indicators are then in a more or less transparent way weighed into the final composite score. In this respect, it is very important to reiterate what Bucla-Casal et al. (2006) emphasized in context of journals: “It should be made clear that internationality per se is not to be equated with quality”. Glänzel and Schubert (2001) found that while international co-authorship in chemistry, as a rule, results in publications with higher citation impact than purely domestic papers, some of the international co-operation links between countries are “hot”, i. e., co-authored papers have higher impact than that of any of the two contributing countries, while others are “cool”.

This is even more true for universities. Whether and in what extent internationality is desirable in the activities of a university, should be gauged by competent decision makers of the university. Well-targeted indicators may efficiently help them, but an uncompromising weighing scheme may cause more harm than benefit.

Methodology and results

Universities under study

A total of 18 universities, six from each of three countries: Hungary, Israel and Sweden were chosen for analysis. The universities were selected on the basis of their more-or-less unanimous top positions in the well-known university rankings (ARWU, CWTS, THE, QS).

Table 1 lists the website address of the selected universities, as well as their WoS “Organization-Enhanced” labels.

Bibliometric indicators

Bibliometric indicators of the universities were determined on the basis of Clarivate’s Web of Science (WoS) Core Collection database. Publications of the universities were retrieved by “Organization-Enhanced” search using their WoS label as search term (see Table 1). Items published in 2017–2018 and citations to them from the date of their publication up to the date of the analysis (September, 2019) were taken into consideration.

Table 1 The 18 universities selected for the study

Website address	WoS label
<i>Hungary</i>	
bme.hu	Budapest University of Technology & Economics
elte.hu	Eotvos Lorand University
pte.hu	University of Pecs
semmelweis.hu	Semmelweis University
unideb.hu	University of Debrecen
u-szeged.hu	Szeged University
<i>Israel</i>	
bgu.ac.il	Ben Gurion University
biu.ac.il	Bar Ilan University
huji.ac.il	Hebrew University of Jerusalem
tau.ac.il	Tel Aviv University
technion.ac.il	Technion Israel Institute of Technology
weizmann.ac.il	Weizmann Institute of Science
<i>Sweden</i>	
gu.se	University of Gothenburg
ki.se	Karolinska Institutet
kth.se	Royal Institute of Technology
lu.se	Lund University
su.se	Stockholm University
uu.se	Uppsala University

Table 2 Basic publication and citation statistics of the 18 universities

University	# Publications	# Citing publications	# Citations	Cit/Pub	h-Index
bme.hu	1863	4778	6175	3.31	22
elte.hu	2635	12,597	18,705	7.10	46
pte.hu	1562	5342	5955	3.81	25
semmelweis.hu	2945	12,088	13,911	4.72	45
unideb.hu	2478	8233	11,135	4.49	40
u-szeged.hu	2525	11,642	16,528	6.55	38
bgu.ac.il	5302	14,913	17,571	3.31	36
biu.ac.il	3215	8764	10,659	3.32	33
huji.ac.il	7647	30,719	35,593	4.65	56
tau.ac.il	11,945	45,715	52,952	4.43	45
technion.ac.il	5499	23,772	27,768	5.05	55
weizman.ac.il	3296	22,154	29,039	8.81	61
gu.se	8780	39,547	48,011	5.47	64
ki.se	16,492	83,500	98,211	5.96	98
kth.se	6223	25,986	34,859	5.60	51
lu.se	12,092	57,723	67,617	5.59	73
su.se	6738	31,459	42,057	6.24	62
uu.se	11,437	51,404	66,299	5.80	74

Publication and citation statistics

Basic publication and citation statistics were collected using the “Analyze Results” and “Create Citation Report” functions of the WoS and are given in Table 2.

“Depth” of internationality and related indicators

As mentioned above, the most straightforward indicator of the depth of internationality is the proportion of international publications and citations. A publication or a citation is considered international if any of its authors is from outside the home country of the university in question.

A set of indicators characterizing the international publications and citations of the 18 universities are collected in Table 3. The last column (% Citation advantage of international publications) is the ratio of the mean citation rate per paper of the international publications (third data column of Table 3) to that of the university’s overall value (fourth data column of Table 2).

“Breadth” of internationality and related indicators

An apparently obvious measure of the breadth or scope of internationality is the number of countries involved. However simple it may sound, counting countries raises several theoretical and technical questions. As of 2019, the United Nations (UN) recognizes 195 sovereign countries. In addition, there are 61 dependent areas (dependencies), and 6 disputed

Table 3 Indicators characterizing the international publications and citations of the 18 universities

	% International in total publications	% International in total citing papers	Citations per international publications	% Citation advantage of international publications
bme.hu	44.2	81.1	4.43	133.8
elte.hu	61.1	86.0	10.39	146.3
pte.hu	42.6	88.7	6.90	181.1
semmelweis.hu	59.1	91.6	6.82	144.4
unideb.hu	53.5	83.0	6.86	152.6
u-szeged.hu	48.5	89.5	11.65	178.0
bgu.ac.il	46.7	82.9	4.63	139.8
biu.ac.il	40.1	83.5	5.27	159.0
huji.ac.il	50.3	88.8	6.98	149.9
tau.ac.il	48.7	87.7	6.82	153.7
technion.ac.il	49.7	75.1	7.22	143.0
weizman.ac.il	65.9	89.7	10.59	120.2
gu.se	59.2	86.2	7.40	135.3
ki.se	68.7	87.7	7.37	123.7
kth.se	69.2	84.6	6.48	115.6
lu.se	63.4	85.1	7.16	128.1
su.se	69.1	84.8	7.80	125.0
uu.se	62.8	83.1	7.57	130.7

territories. There is no general consensus how many (and which) of them are to be taken into account in compiling statistics by countries.

Web of Science apparently does not provide a full list of the countries covered, but as witnessed by the Country/Region option of the “Analyze Results” function, it uses a rather wide definition. In the present analysis, we tried to accommodate ourselves to the WoS practice. A notable exception is the United Kingdom which is considered in this study a single country as opposed to the WoS practice of treating England, Scotland, Wales and North-Ireland separately.

It has to be noted that WoS Country/Region list contains a large number of erroneous entries. There are OCR errors (e.g., Sndia), deficient or miscoded items (Sultanate, Tbilisi) among them; a number of items were assigned to United Kingdom, in spite of the above mentioned general practice of the database. Although most of these errors occurred only once or very few times, therefore, only an insignificantly tiny fraction of the total items of the database were involved, the apparent number of countries increased significantly. Reliable country statistics can be made only after manually cleaning all occurring country codes; that was carefully done in our analysis.

For a more refined characterization of the breadth of internationality, the Partnership Ability Index, PHI (Schubert 2012), can be used. PHI is a Hirsch-type indicator (Schubert and Schubert 2019) defined on the model of the h-index. In our case, a university has an international co-authorship Partnership Ability Index PHI if PHI is the greatest number of countries having at least PHI co-authored publications with the given university; a university has an international citedness Partnership Ability Index PHI if PHI is the greatest number of countries citing the given university in at least PHI publications.

Another aspect of the breadth of internationality is the average number of countries per paper. It should be noticed that in case of co-authorship, the home country of the university is a contributing country by definition, therefore the indicator values concerning to the effective partner countries are one less than the table values.

The indicators characterizing the breadth of internationality of the co-authorship and citedness patterns of the 18 universities are summarized in Table 4.

Country names behind the numbers

However telling indicators of internationality may be, more often than not, the real substance is in the details, i. e., in the finer structure of international co-authorship and citation patterns. Table 6 in the “Appendix” contains for each university under study the top 20 countries contributing to the internationality of the institutions in question either as collaborating partners or as sources of citations.

In the tables, next to the number of publications, a size-normalized “preference factor” is also indicated. These indicators were calculated according to Schubert and Glänzel (2006). The co-authorship preference factor is the quotient of the share of a country in all co-authorships of a university divided by the share of the same country in world total publications. Citation preference is defined in perfectly analogous way. A preference factor larger than 1 signifies that the country’s contribution as collaborating partner (or as source of citations) is larger than it would be expected by its mere size.

Table 4 Indicators characterizing the breadth of internationality of the co-authorship and citedness patterns of the 18 universities

	Co-authorship			Citedness		
	# of contributing countries	PHI	Average number of countries per paper	# of citing countries	PHI	Average number of countries per paper
bme.hu	64	20	1.76	94	35	1.62
elte.hu	115	59	7.62	141	64	3.87
pte.hu	131	31	3.01	165	43	2.02
semmelweis.hu	99	36	3.26	133	45	1.77
unideb.hu	113	54	7.17	125	63	3.98
u-szeged.hu	94	33	2.55	128	46	2.06
bgu.ac.il	113	31	1.94	151	46	1.68
biu.ac.il	78	22	1.69	116	37	1.52
huji.ac.il	157	39	2.37	180	57	1.78
tau.ac.il	160	54	3.13	183	72	2.25
technion.ac.il	101	47	3.61	144	65	2.24
weizman.ac.il	92	46	5.05	135	66	2.44
gu.se	159	46	2.83	194	71	1.86
ki.se	168	63	3.29	187	80	1.84
kth.se	99	53	3.70	137	66	2.23
lu.se	164	64	3.84	197	84	2.33
su.se	140	52	4.22	181	70	2.54
uu.se	167	59	3.70	200	82	2.53

The home country, contributing to all publications of its universities by definition, is omitted from the co-authorship lists. Its high contribution as citation source is not logically necessary, but in practice, “self-preference” is outstandingly high, as witnessed by the lists.

Webometric indicators

The term ‘webometrics’ was introduced into the literature by Almind and Ingwersen (1997). As they wrote: “While informetrics is the research into information in a broad sense and not only limited to scientific communication, the approach taken here will be called Webometrics, which covers research of all network-based communication using informetric or other quantitative measures”. Despite of the caveat, the term is used by the authors themselves and their followers mainly as a tool for the analysis of scientific information (Björneborn and Ingwersen 2001; Bar-Ilan 2008). In wider context, the term ‘web metrics’ or ‘web analysis’ is used, instead.

Webometrics became an important actor in university evaluations since, in 2004, the Madrid based Cybermetrics Lab launched the www.webometrics.info website with regularly updated lists of indicators largely based on the web presence of world’s universities. Web based indicators of Webometrics.info are those of ‘presence’: the size (number

of pages) of the main web domain of the institution (based on Google), and ‘visibility’: the number of external links to the institution’s webpages (based on the services Ahrefs and Majestic). No decomposition of visibility indicators by countries (sources of links) is given, therefore, the aspect of internationality is missing from this collection.

In this study, a first attempt is made to use a webometric measure which, to our knowledge, until now escaped the attention of scientometric analysts: the number and distribution of visitors of university websites. Certainly, visitor statistics is permanently tracked and recorded by the IT departments of universities, but no comparative analysis has been found in the literature.

The website Visitors Detective (www.visitorsdetective.com) was used as source. This Tel-Aviv based website is, in its own words, “an advanced website traffic estimator that offers an accurate report about the number of visitors to a website”. Although no methodological details of its operation is published, the results provided seem to be stable and credible. For any website address, beside the overall current daily traffic, even the free version provides the traffic history for any period back to 1 year and, what is most important for the present study, the distribution of the traffic by source country. In spite of its obvious uncertainties and deficiencies, it seems to be an interesting experiment to use this tool for comparing the website traffic of the universities under study.

Table 5 contains two basic statistics: the total number of daily visitors and the percentage share of non-domestic (international) visitors. The date of sampling was October 15, 2019.

For the same day, the country distribution of visitors is given in Table 7 (see “Appendix”).

Table 5 Basic website traffic indicators of the 18 universities

	Number of total daily visitors	% International visitors
bme.hu	26,374	26.90
elte.hu	41,676	22.20
pte.hu	25,639	6.09
semmelweis.hu	8715	32.53
unideb.hu	34,991	18.00
u-szeged.hu	25,410	16.38
bgu.ac.il	27,166	61.04
biu.ac.il	20,037	51.65
huji.ac.il	46,165	59.22
tau.ac.il	55,749	61.10
technion.ac.il	33,092	41.46
weizman.ac.il	25,382	45.34
gu.se	79,091	31.27
ki.se	38,171	32.47
kth.se	143,097	30.50
lu.se	96,143	40.80
su.se	60,434	29.93
uu.se	108,389	30.30

Discussion

The collection of data and indicators presented in Tables 1, 2, 3, 4, 5, 6, and 7 lends itself to analysis and interpretation from a myriad of aspects. The authors encourage the readers to find the perspective of their specific interest. Some examples will be given in the present section.

Before considering some positive examples, an important warning should be stressed. However tempting it is, the mere possibility of ordering objects by some measurable feature is not sufficient ground to make, let alone publish, ranked lists, rankings. As we can read in an excellent recent book (Érdi 2020) on the topic: “We should keep in mind the lesson [...]: ranking reflects a mixture of the reality and illusion of objectivity, and it is also subject to manipulation”.

Of course, for well defined, specific purposes comparisons and even rankings might be useful, but it must be kept in mind that no indicator conveys inherent value judgement in itself. It is a question of human decision that a higher value of an indicator is favorable, unfavorable or neutral in a given aspect. As mentioned in the “Introduction” section, only competent decision makers can decide what type and what extent of internationality is desirable at a university. Comparisons and rankings may help decisions only after the objectives had been clearly laid down.

Country patterns

Co-authorship internationality and citation advantage of international publications

Figure 1 displays two indicators of Table 3 to make country patterns visible. There is a statistically significant overall negative correlation between the two variables: the higher the percentage share of internationally co-authored publications, the smaller the advantage internationality means in citation rate. This is the consequence of the simple fact that, without exception, international publications receive higher citation rates than domestic ones.

Fig. 1 Citation advantage versus percentage of international publications

Fig. 2 Co-authorship- and citation-based PHI versus h-index

Sweden stands out in co-authorship internationality. Israel closely follows the overall trend. For the Hungarian universities (with the single exception of the BME), international co-authorship means above average driving power for reaching higher citation rates.

Hirsch-type indices

Figure 2 shows the relation between the co-authorship- and citation-based PHI and the h-index (see data in Tables 2 and 4). Both PHI indices are in significant positive correlation with the h-index, partly because of their size-dependence. Conspicuously, points referring to Hungarian and Swedish universities are completely disjoint; Israel overlaps with both.

Fig. 3 Average citation rate versus average paper internationality

Internationality and citation rates

A more direct relation between internationality and citation rate is seen in Fig. 3. In accordance with the fact that internationality has a citation advantage for all universities under study, average citation rate is positively correlated with the average number of collaborating countries per paper (see data in Tables 3 and 4). No country-specific behavior can be observed in this respect. The most probable reason of the separate position of the two Hungarian universities (ELTE and UniDeb) is their overly active participation in large mega-authored projects (particularly in CERN-based high energy particle physics research), which has positive effect on both their international embeddedness and citation rate.

Preference factors

Apparently, the nature of co-authorship and citedness preference is substantially different. An institute has an active role in selecting its collaborating partners, while its role is largely passive in determining the source of citations to its publications. In fact, a non-negligible part of non-domestic (“international”) citations comes from international collaborations of the university in question (actually, “institutional self-citations”), that is, the two kinds of international relations (co-authorship and citedness) are not completely independent.

Anyhow, the two kinds of preference factors are positively related, as seen in Fig. 4 (based on the data in Table 6). Obviously, beside the “self-citation” component, the preference is strongly influenced by other factors. It becomes clear, if the “high end” of the preference plot is considered.

Countries with the highest preference to collaborate with Hungarian universities and to cite their publication are the Czech Republic and Austria, as well as Greece and Portugal. As to the first two, geography is a simple and evident explanation; the latter appears to be the consequence of joint participation in the large “mega-authored” projects.

In the case of Sweden, the strongest preference is evinced by Norway, Denmark and Finland, for doubtlessly geocultural reasons.

Fig. 4 Relation between the citedness and co-authorship preference factors

Countries with the highest preference toward Israel—at much lower level than that found in the other two countries—are Switzerland and Austria. No straightforward explanation could be found for these connections the nature of which might be revealed by a deeper, itemized analysis of co-authored and citing papers.

It is interesting to note that the relation between the citedness and co-authorship preference factors can be well approximated by a power function—actually, the best fit is very close to a square root law.

Disciplinary patterns

Universities, by definition, implicate a kind of universality. Yet, some universities are more universal than others. These others are more or less oriented towards some specific areas of knowledge, such as physical and engineering sciences (“technical universities” in what follows) or medical and life sciences (“medical universities”). In the selected universities of each of the three countries there is one “technical university” (BME, Technion and KTH) and one “medical university” (Simmelweis, Weizmann and Karolinska). One may wonder whether these specialized universities exhibit some specific pattern in their indicators of internationality.

The relation among three indicators, the average number of collaborating countries per publication, the percentage of international publications and the percentage citation advantage is shown in Fig. 5.

As witnessed by Fig. 5, disciplinary orientation does not seem to be directly related to the universities’ internationality. The relatively low internationality of BME and the high internationality of the Weizmann Institute might be explicable by other factors.

Disciplinary differences in international collaboration and its citation impact are certainly exist (see, e.g., Puuska et al. 2014), but how these differences are manifested at university level, remains to be studied.

Fig. 6 Estimated and observed PHI values. Filled circles: co-authorship PHI; empty circles: citation PHI

Validity of Glänzel's estimation for PHI

According to Glänzel's model (Glänzel 2006), PHI is in a simple relation with the number of papers, n , and the average number of countries per paper, x : $PHI = c \cdot n^{1/3} \cdot x^{2/3}$, where c is a positive constant of the order of 1 (see also Schubert 2012). The impressive agreement between estimated and observed values in Fig. 6 is a convincing proof that Glänzel's model is valid also in this case. Consequently, following the idea of Prathap (2010), a good estimation of PHI can be given from the number of papers and the average number of collaborating countries per paper without the detailed knowledge of the full distribution.

Fig. 7 Number of visitors versus number of publications

Fig. 8 Internationality of visitors and publications

Webometric indicators

Webometric ranking of universities (as published in webometrics.com) show moderate similarity with bibliometrics-based rankings (Aguillo et al. 2010). A corresponding result was found if the basic bibliometric and webometric indicators of our sample, the number of publications and the number of visitors, were considered. As seen in Fig. 7, a moderately positive overall correlation can be found between the two indicators. Israeli universities seem to follow the overall trend quite closely, while Hungarian and Swedish data behave rather haphazardly.

As the indicators of internationality is considered, even this moderate correlation appears to vanish. Percentage share of internationally co-authored publications and percentage share of international (non-domestic) visitors are completely uncorrelated (see Fig. 8). The three countries, nevertheless, exhibit some specific patterns: Swedish universities form a cluster of high international co-authorship, average international visitors; Israeli universities have higher-than-average, Hungarian universities have lower-than-average share in international visitors independently of co-authorship internationality.

The positive side of the apparent discrepancy between bibliometric and webometric indicators is that they can be interpreted as separate, even independent, dimensions of the impact of scientific research. The problem is that, while there are several decades of experience in interpreting bibliometric indicators (including cautionary warnings against traps and trickeries), very few is known about the motivations, driving forces of phenomena reflected by webometric indicators, let alone their science policy significance.

As an example, one of the most striking feature of the country distributions of the website visitors in Table 7, is the predominant presence of India and Pakistan

among the top countries in practically all universities. Most probably this feature is related to the fact that most web design and search engine optimization services are located in these two countries, and their activity is reflected in this indicator. Whether this feature is desirable, undesirable or neutral should be decided by competent policy makers, and the use of this indicator in evaluation should be considered accordingly.

We close this discussion by reiterating that this section contains just a few of the countless possible analyses and interpretations, and the readers are encouraged to find the perspective of their specific interest. And the fundamental maxim remains: comparisons and rankings may help decisions only after the objectives had been clearly laid down.

Conclusions

1. Indicators of internationality used, e. g., for national comparisons or for journals can easily be adapted to the analysis of universities.
2. Internationally co-authored papers have definite citation advantage over domestic ones.
3. Partnership Ability Index is a useful measure of the “breadth” of internationality. Glänzel’s model proved to be valid for this Hirsch-type indicator, as well.
4. Co-authorship and citedness preference factors are correlated, and are determined by multiple influences; geographical closeness and joint participation in large international projects being the most decisive.
5. At university level (at least in the sample under study) disciplinary specialization does not seem to have effect on internationality.
6. Visitor statistics is a possible alternative to webpage or backlink counts in constructing webometric indicators. Like other webometric indicators, it appears to be uncorrelated with bibliometric indicators, and also like the others, it does not lend itself to straightforward interpretation.

Acknowledgements Open access funding provided by Library and Information Centre of the Hungarian Academy of Sciences (MTA KIK).

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Appendix

See Tables 6 and 7.

Table 6 The top 20 countries contributing to the internationality of the 18 universities

bme.hu			elte.hu			pte.hu			
Hungary—Collaborating countries: number of publications and preference factors									
1	Germany	178	1.13	UK	733	0.56	Germany	230	1.02
2	USA	130	0.19	USA	702	0.17	USA	191	0.19
3	UK	119	0.56	Germany	600	0.62	UK	182	0.60
4	France	72	0.70	France	532	0.84	Italy	176	1.20
5	Italy	60	0.59	Italy	458	0.73	Spain	156	1.24
6	Japan	55	0.50	Spain	453	0.85	France	140	0.94
7	China	54	0.12	Austria	438	2.93	Belgium	121	2.53
8	Spain	54	0.62	China	417	0.15	Sweden	109	1.89
9	Switzerland	51	1.08	Switzerland	413	1.43	Austria	90	2.57
10	Austria	50	2.06	Czech Rep.	402	3.63	Netherlands	87	1.00
11	Romania	48	4.53	Russia	394	1.34	Romania	81	5.31
12	Netherlands	44	0.73	Poland	391	1.71	Poland	80	1.49
13	Czech Rep.	43	2.39	Finland	367	3.30	Switzerland	77	1.14
14	Sweden	37	0.92	Brazil	363	0.93	Denmark	67	1.65
15	Poland	36	0.97	Belgium	355	1.74	Czech Rep.	66	2.54
16	Belgium	35	1.05	Portugal	342	2.53	Greece	59	2.56
17	Russia	26	0.54	Korea	339	0.71	China	52	0.08
18	Slovakia	24	4.75	India	333	0.60	Norway	49	1.69
19	Iran	20	0.44	Greece	331	3.37	Estonia	47	12.15
20	Australia	18	0.18	Taiwan	328	1.66	Croatia	45	5.97
semmelweis.hu			unideb.hu			u-szeged.hu			
1	USA	706	0.36	USA	617	0.17	USA	382	0.28
2	Germany	650	1.42	Germany	533	0.62	UK	376	0.90
3	UK	542	0.87	UK	527	0.46	Germany	280	0.90
4	Italy	394	1.32	France	425	0.76	France	176	0.86
5	France	290	0.96	Italy	421	0.76	Italy	165	0.82
6	Austria	270	3.80	Spain	388	0.82	Austria	142	2.97
7	Spain	263	1.03	Czech Rep.	375	3.83	Poland	134	1.83
8	Netherlands	251	1.42	Austria	364	2.76	Spain	129	0.75
9	Canada	216	0.71	Poland	359	1.77	Netherlands	129	1.08
10	Sweden	194	1.66	China	356	0.14	Belgium	128	1.96
11	Switzerland	186	1.35	Belgium	347	1.92	Canada	104	0.50
12	Poland	180	1.65	Russia	336	1.29	Russia	94	0.99
13	Belgium	178	1.84	Switzerland	330	1.29	Sweden	94	1.19
14	Czech Rep.	159	3.02	Korea	323	0.77	Switzerland	92	0.99
15	Denmark	157	1.90	India	321	0.65	Australia	84	0.44
16	Israel	144	2.36	Croatia	317	11.15	Romania	84	4.03
17	Australia	134	0.47	Finland	315	3.21	China	82	0.09
18	Finland	103	1.95	Greece	314	3.62	Japan	75	0.35
19	Greece	99	2.12	Brazil	308	0.89	Czech Rep.	72	2.03
20	Romania	94	3.04	Mexico	297	2.63	Denmark	72	1.29

Table 6 (continued)

bme.hu			elte.hu			pte.hu			
Hungary—Citing countries: number of publications and preference factors									
1	China	1046	0.96	USA	4580	0.45	USA	1419	0.63
2	Hungary	904	37.85	UK	2860	0.90	UK	727	1.04
3	USA	748	0.46	Germany	2567	1.10	China	665	0.44
4	Germany	606	1.63	China	2392	0.35	Hungary	605	18.11
5	UK	452	0.90	France	1811	1.17	Germany	600	1.15
6	Italy	348	1.44	Hungary	1763	11.70	Italy	526	1.56
7	France	274	1.12	Italy	1669	1.10	Spain	410	1.43
8	Spain	224	1.09	Spain	1452	1.12	France	369	1.08
9	Japan	198	0.76	Switzerland	1166	1.66	Australia	348	1.08
10	India	184	0.86	Russia	1082	1.51	Canada	312	0.90
11	Russia	147	1.30	Australia	1045	0.72	Netherlands	254	1.27
12	Poland	146	1.66	Japan	1003	0.61	Switzerland	238	1.53
13	Iran	145	1.36	Poland	990	1.78	Sweden	236	1.78
14	Netherlands	144	1.01	Brazil	984	1.03	Brazil	213	1.01
15	Switzerland	142	1.28	Netherlands	904	1.00	Belgium	200	1.82
16	Korea	128	0.70	Canada	888	0.57	Poland	191	1.55
17	Canada	127	0.51	India	872	0.65	Japan	182	0.50
18	Australia	125	0.54	Austria	824	2.27	Austria	147	1.83
19	Brazil	114	0.76	Czech Rep.	790	2.94	Denmark	147	1.57
20	Belgium	103	1.31	Portugal	737	2.25	Greece	133	2.52
	Sweden	102	1.08	Sweden	693	1.16	India	122	0.41
semmelweis.hu			unideb.hu			u-szeged.hu			
1	USA	3723	0.84	USA	2468	0.36	USA	3878	0.77
2	UK	1635	1.18	China	1593	0.34	Germany	1852	1.60
3	Germany	1557	1.51	UK	1419	0.67	UK	1846	1.18
4	China	1403	0.47	Hungary	1401	13.82	China	1704	0.50
5	Italy	1302	1.95	Germany	1325	0.84	Italy	1231	1.64
6	Hungary	1020	15.43	Italy	1155	1.13	Hungary	1226	16.50
7	France	939	1.39	France	966	0.93	France	1035	1.36
8	Canada	777	1.13	Spain	913	1.05	Spain	858	1.34
9	Netherlands	763	1.93	Switzerland	748	1.58	Japan	740	0.91
10	Spain	677	1.19	Poland	719	1.92	Netherlands	677	1.52
11	Switzerland	508	1.65	Brazil	640	1.00	Canada	657	0.85
12	Australia	496	0.78	India	639	0.70	Australia	631	0.88
13	Japan	493	0.68	Russia	633	1.31	Switzerland	516	1.49
14	Sweden	432	1.65	Czech Rep.	623	3.45	India	451	0.68
15	Belgium	392	1.81	Austria	590	2.42	Brazil	429	0.91
16	Austria	358	2.25	Greece	559	3.49	Sweden	425	1.45
17	Poland	321	1.32	Australia	553	0.56	Poland	412	1.50
18	Brazil	288	0.69	Turkey	520	1.32	Russia	374	1.06
19	Denmark	288	1.56	Korea	518	0.67	Chile	334	3.64
20	Korea	282	0.56	Portugal	507	2.30	Belgium	324	1.33

Table 6 (continued)

bgu.ac.il				biu.ac.il			huji.ac.il		
<i>Israel—Collaborating countries: number of publications and preference factors</i>									
1	USA	1170	0.55	USA	632	0.56	USA	2042	0.54
2	Germany	412	0.83	Germany	194	0.74	Germany	788	0.91
3	UK	317	0.48	UK	182	0.52	UK	754	0.64
4	Canada	239	0.73	Italy	111	0.66	Italy	481	0.85
5	Italy	231	0.72	France	103	0.60	France	449	0.78
6	France	196	0.60	Canada	83	0.48	Canada	381	0.66
7	China	169	0.12	China	68	0.09	Spain	326	0.68
8	Spain	153	0.56	Australia	59	0.36	Switzerland	300	1.15
9	Switzerland	141	0.95	Spain	59	0.41	Australia	288	0.53
10	Netherlands	132	0.69	Switzerland	56	0.72	Netherlands	269	0.80
11	Australia	115	0.37	Netherlands	56	0.56	China	261	0.10
12	Russia	114	0.76	India	53	0.35	Belgium	190	1.03
13	India	101	0.35	Russia	42	0.53	Sweden	171	0.77
14	Poland	101	0.86	Japan	38	0.21	Russia	158	0.59
15	Sweden	99	0.79	Denmark	29	0.62	Austria	147	1.09
16	Denmark	82	0.92	Korea	28	0.22	Denmark	145	0.93
17	Belgium	76	0.73	Sweden	28	0.42	India	143	0.29
18	Brazil	73	0.36	Poland	26	0.42	Poland	141	0.68
19	Japan	58	0.17	Belgium	25	0.45	Japan	134	0.22
20	Austria	51	0.67	Austria	22	0.55	Singapore	115	1.09
tau.ac.il				technion.ac.il			weizman.ac.il		
1	USA	3316	0.43	USA	1400	0.34	USA	1240	0.36
2	UK	1660	0.68	UK	851	0.66	UK	798	0.74
3	Germany	1372	0.76	Germany	711	0.75	Germany	732	0.92
4	Italy	1214	1.04	France	497	0.79	France	495	0.94
5	Canada	982	0.82	Italy	487	0.79	Italy	399	0.77
6	France	975	0.82	China	451	0.16	China	374	0.16
7	Spain	831	0.83	Canada	420	0.66	Switzerland	353	1.47
8	Netherlands	775	1.12	Netherlands	411	1.12	Spain	346	0.78
9	Switzerland	679	1.26	Spain	398	0.75	Netherlands	338	1.10
10	Australia	621	0.55	Switzerland	385	1.35	Sweden	338	1.66
11	China	608	0.12	Australia	333	0.56	Japan	333	0.59
12	Russia	562	1.02	Russia	322	1.11	Canada	332	0.62
13	Denmark	501	1.55	Denmark	310	1.81	Russia	318	1.30
14	Sweden	500	1.09	Sweden	307	1.27	Denmark	305	2.12
15	Poland	478	1.12	Poland	297	1.32	Australia	300	0.60
16	Austria	459	1.65	Japan	295	0.44	Poland	259	1.37
17	Japan	445	0.35	Austria	294	2.00	Portugal	259	2.32
18	Greece	414	2.26	Portugal	273	2.05	Austria	258	2.09
19	Czech Rep.	411	1.99	Norway	267	2.19	Chile	258	4.06
20	Brazil	406	0.56	Czech Rep.	264	2.42	Czech Rep.	257	2.80

Table 6 (continued)

bgu.ac.il			biu.ac.il			huji.ac.il			
Israel—Citing countries: number of publications and preference factors									
1	USA	4496	0.86	USA	2424	0.87	USA	10,083	0.89
2	China	2693	0.76	China	2020	1.07	China	5234	0.68
3	Israel	2548	15.91	Israel	1443	16.96	UK	3978	1.12
4	UK	1586	0.97	Germany	821	1.28	Germany	3551	1.35
5	Germany	1495	1.24	UK	791	0.91	Israel	3430	9.85
6	Italy	965	1.23	France	424	1.00	Italy	2349	1.38
7	France	833	1.05	Italy	413	0.99	France	2077	1.20
8	Spain	757	1.13	Canada	390	0.91	Australia	1732	1.06
9	Canada	735	0.91	Australia	377	0.95	Canada	1705	0.97
10	Australia	706	0.94	Spain	341	0.96	Spain	1672	1.15
11	Netherlands	527	1.13	Korea	319	1.01	Netherlands	1322	1.31
12	India	496	0.71	Japan	271	0.60	Japan	1307	0.71
13	Japan	493	0.58	Netherlands	265	1.07	Switzerland	1158	1.47
14	Switzerland	473	1.31	India	257	0.70	Sweden	841	1.26
15	Russia	376	1.02	Switzerland	221	1.15	Brazil	780	0.73
16	Sweden	367	1.20	Sweden	149	0.91	India	763	0.50
17	Brazil	362	0.74	Russia	144	0.74	Belgium	714	1.29
18	Korea	319	0.54	Belgium	138	1.02	Denmark	704	1.49
19	Denmark	291	1.34	Brazil	135	0.52	Korea	691	0.53
20	Poland	290	1.01	Poland	134	0.88	Russia	613	0.76
	Belgium	289	1.13	Austria	125	1.26	Poland	530	0.85
tau.ac.il			technion.ac.il			weizman.ac.il			
1	USA	16,170	0.76	USA	7507	0.68	USA	8549	0.76
2	UK	6882	1.03	China	5066	0.67	China	4323	0.57
3	China	6814	0.47	UK	3052	0.88	Germany	3734	1.43
4	Germany	5959	1.21	Israel	2957	8.70	UK	3307	0.94
5	Israel	5621	8.59	Germany	2784	1.09	Israel	2293	6.64
6	Italy	4854	1.52	Italy	2024	1.22	France	2080	1.21
7	France	3922	1.21	France	1850	1.10	Italy	1855	1.10
8	Spain	3220	1.18	Spain	1542	1.09	Japan	1574	0.86
9	Canada	3035	0.92	Canada	1389	0.81	Spain	1450	1.01
10	Australia	2803	0.91	Australia	1352	0.85	Switzerland	1381	1.77
11	Netherlands	2470	1.30	Japan	1184	0.66	Canada	1245	0.72
12	Switzerland	2406	1.63	Switzerland	1158	1.51	Australia	1204	0.74
13	Japan	2275	0.66	Netherlands	1120	1.14	Netherlands	1144	1.14
14	Brazil	1672	0.83	Brazil	865	0.83	Russia	1071	1.35
15	Sweden	1588	1.26	India	851	0.58	India	998	0.67
16	Russia	1482	0.98	Russia	844	1.08	Sweden	958	1.45
17	India	1410	0.50	Korea	809	0.64	Poland	797	1.29
18	Korea	1393	0.57	Sweden	772	1.18	Brazil	788	0.75
19	Belgium	1376	1.32	Poland	749	1.23	Korea	771	0.60
20	Poland	1369	1.17	Austria	671	1.69	Austria	700	1.74

Table 6 (continued)

gu.se			ki.se			kth.se			
Sweden—Collaborating countries: number of publications and preference factors									
1	UK	1850	1.15	USA	4067	0.36	USA	1204	0.25
2	USA	1647	0.32	UK	3946	1.12	China	1085	0.33
3	Germany	1001	0.84	Germany	2375	0.91	UK	1036	0.69
4	Norway	727	4.77	Italy	1769	1.04	Germany	843	0.76
5	Italy	685	0.88	Netherlands	1666	1.66	France	596	0.82
6	Denmark	665	3.10	France	1591	0.93	Italy	570	0.79
7	Netherlands	591	1.29	Finland	1564	5.21	Spain	499	0.81
8	France	571	0.73	Spain	1466	1.01	Netherlands	472	1.11
9	Australia	566	0.76	Denmark	1421	3.03	Switzerland	449	1.36
10	Finland	500	3.64	Norway	1343	4.02	Russia	435	1.29
11	Spain	484	0.73	Australia	1200	0.74	Japan	404	0.52
12	Canada	476	0.60	Canada	1079	0.62	Austria	391	2.29
13	Switzerland	441	1.23	Switzerland	990	1.27	Canada	386	0.52
14	Belgium	424	1.68	Belgium	888	1.61	Denmark	386	1.94
15	China	385	0.11	China	838	0.11	Australia	373	0.54
16	Austria	258	1.40	Austria	645	1.60	Norway	354	2.50
17	Japan	205	0.24	Japan	606	0.33	Poland	310	1.18
18	Ireland	187	1.60	Poland	528	0.85	Hungary	294	4.13
19	Brazil	178	0.37	Greece	461	1.74	Portugal	287	1.86
20	Poland	177	0.63	Brazil	385	0.36	Brazil	285	0.63
lu.se			su.se			uu.se			
1	UK	2835	0.94	USA	1841	0.31	USA	2517	0.29
2	USA	2576	0.27	UK	1829	0.99	UK	2460	0.9
3	Germany	1948	0.87	Germany	1414	1.03	Germany	1897	0.93
4	Denmark	1744	4.35	France	792	0.88	France	1238	0.93
5	France	1289	0.88	Italy	727	0.82	Italy	1141	0.86
6	Italy	1275	0.88	Netherlands	726	1.38	Netherlands	1064	1.36
7	Netherlands	1233	1.43	Australia	720	0.85	Switzerland	996	1.64
8	Spain	1011	0.82	Spain	653	0.86	Norway	966	3.72
9	Norway	1005	3.52	Switzerland	649	1.58	Spain	937	0.83
10	China	961	0.15	Canada	647	0.71	China	936	0.16
11	Australia	949	0.68	China	603	0.15	Denmark	923	2.53
12	Finland	874	3.4	Norway	585	3.34	Australia	895	0.71
13	Switzerland	866	1.3	Denmark	575	2.34	Canada	795	0.59
14	Canada	793	0.53	Japan	523	0.54	Japan	628	0.44
15	Poland	661	1.25	Finland	466	2.96	Poland	621	1.29
16	Austria	639	1.85	Russia	444	1.06	Finland	570	2.44
17	Japan	635	0.41	Poland	425	1.31	Austria	561	1.79
18	Russia	509	0.75	Austria	410	1.94	Russia	544	0.88
19	Czech Rep.	502	1.96	South Africa	389	2.33	Brazil	461	0.56
20	Greece	498	2.19	Israel	348	1.92	Czech Rep.	443	1.9

Table 6 (continued)

gu.se				ki.se			kth.se		
Sweden—Citing countries: number of publications and preference factors									
1	USA	12,068	0.79	USA	27,091	0.84	China	7501	0.92
2	UK	6507	1.36	UK	13,445	1.35	USA	6143	0.51
3	Sweden	5455	6.06	Sweden	10,256	5.44	Sweden	3999	5.63
4	China	4789	0.46	China	9820	0.45	UK	3350	0.89
5	Germany	4397	1.24	Germany	9239	1.25	Germany	3154	1.13
6	Italy	3064	1.33	Italy	7353	1.53	Italy	1958	1.08
7	Australia	2670	1.21	France	5453	1.12	France	1935	1.05
8	Canada	2548	1.08	Canada	5362	1.09	Spain	1583	1.02
9	France	2331	1.00	Australia	5258	1.14	Japan	1428	0.73
10	Spain	2152	1.10	Netherlands	5109	1.79	Australia	1266	0.73
11	Netherlands	2136	1.57	Spain	4657	1.14	Switzerland	1266	1.52
12	Switzerland	1799	1.70	Switzerland	3504	1.58	Canada	1214	0.65
13	Denmark	1499	2.36	Japan	3239	0.62	India	1154	0.72
14	Japan	1356	0.55	Denmark	2803	2.11	Russia	1139	1.34
15	Norway	1290	2.85	Belgium	2595	1.66	Netherlands	1099	1.02
16	Belgium	1166	1.56	Norway	2207	2.33	Korea	932	0.68
17	Brazil	1122	0.78	Brazil	2155	0.72	Brazil	865	0.76
18	Finland	1002	2.46	Finland	2052	2.41	Poland	813	1.23
19	Austria	827	1.51	Austria	1783	1.56	Denmark	789	1.57
20	Korea	804	0.46	Korea	1765	0.48	Austria	788	1.83
lu.se				su.se			uu.se		
1	USA	17,735	0.63	USA	10,255	0.62	USA	17,799	0.66
2	UK	10,322	1.18	UK	6326	1.22	UK	9917	1.17
3	China	9012	0.48	Germany	5434	1.41	China	8947	0.49
4	Sweden	8572	5.22	China	5263	0.47	Sweden	8699	5.46
5	Germany	8318	1.29	Sweden	4777	4.89	Germany	8223	1.31
6	Italy	5246	1.25	France	2965	1.17	Italy	5133	1.26
7	France	4922	1.16	Italy	2698	1.08	France	4761	1.16
8	Australia	4112	1.02	Australia	2450	1.02	Spain	3897	1.12
9	Spain	3896	1.09	Spain	2443	1.15	Australia	3868	0.99
10	Canada	3894	0.90	Canada	2373	0.93	Canada	3808	0.91
11	Netherlands	3798	1.53	Netherlands	2162	1.46	Netherlands	3647	1.51
12	Switzerland	3258	1.69	Switzerland	2139	1.86	Switzerland	3511	1.87
13	Denmark	2927	2.52	Japan	1976	0.73	Japan	2754	0.63
14	Japan	2705	0.60	Russia	1400	1.19	Denmark	2239	1.99
15	Brazil	2004	0.76	Denmark	1245	1.80	Brazil	1914	0.75
16	Poland	1893	1.24	Brazil	1222	0.78	Belgium	1867	1.41
17	Norway	1821	2.21	Norway	1118	2.28	Poland	1818	1.23
18	Finland	1746	2.35	India	1117	0.50	India	1729	0.48
19	India	1703	0.46	Finland	1113	2.52	Norway	1726	2.16
20	Austria	1677	1.68	Poland	1045	1.15	Russia	1659	0.87

Table 7 The country distribution of the website visitors of the 18 universities

bme.hu		elte.hu		pte.hu	
Hungary					
Hungary	26,374	Hungary	41,676	Hungary	25,639
United States	2237	Romania	1714	Pakistan	573
India	1948	India	1607	Other countries	1091
Pakistan	613	United States	1125		
Malaysia	325	Pakistan	429		
Philippines	253	Other countries	7017		
Other countries	4330				
semmelweis.hu		unideb.hu		u-szeged.hu	
Hungary	8715	Hungary	34,991	Hungary	25,410
Egypt	517	India	1237	India	1245
India	504	Pakistan	811	Pakistan	486
Other countries	3181	Ethiopia	555	Other countries	3248
		Other countries	5078		
bgu.ac.il		biu.ac.il		huji.ac.il	
Israel					
Israel	10,584	Israel	9688	Israel	18,827
United States	4668	United States	3229	United States	7124
India	4261	India	1544	Germany	5088
Pakistan	570	Malaysia	341	India	3284
Other countries	7083	Other countries	5235	Pakistan	370
				Iran	370
				Russia	278
				Turkey	231
				Other countries	10,593
tau.ac.il		technion.ac.il		weizman.ac.il	
Israel	21,686	Israel	19,373	Israel	13,873
India	5965	India	4033	United States	3303
United States	5575	United States	1752	India	1397
Germany	4739	Other countries	7934	Malaysia	279
Pakistan	446			Other countries	6530
Turkey	279				
Other countries	17,059				
gu.se		ki.se		kth.se	
Sweden					
Sweden	54,361	Sweden	25,777	Sweden	99,452
United States	3240	United States	1945	United States	14,739
India	2054	India	1411	China	5867
Nigeria	1264	Saudi Arabia	458	India	4293
Ethiopia	711	Pakistan	305	Canada	1288
Russia	553	Other countries	8275	Panama	1002

Table 7 (continued)

gu.se		ki.se		kth.se	
Pakistan	553			Australia	715
Iran	474			Other countries	15,741
Philippines	474				
Algeria	474				
Other countries	14,933				
lu.se		su.se		uu.se	
Sweden	56,916	Sweden	42,347	Sweden	75,548
India	4423	India	2843	Japan	7804
United States	2596	United States	1754	United States	4010
Nigeria	2404	Nigeria	847	India	3685
United Kingdom	1923	Ethiopia	847	Pakistan	1084
South Africa	961	Pakistan	726	Nigeria	867
Iran	769	Iran	665	Iran	650
Pakistan	673	Other countries	10,405	Other countries	14,741
Ethiopia	577				
Indonesia	481				
Other countries	24,420				

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