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International collaboration and high citation impact – A case analysis of immunology

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Bibliometricians emphasize on international collaboration to enhance the citation impact of research publications. However, Mathew Effect for Countries brings out that the citation impact is not uniformly distributed to all country affiliations. The present study explores whether international collaboration helps in neutralizing the origin of country bias. The study explores this with productivity, author affiliation and citation data from Scopus for the immunology papers for the year 2018. The data considered pertain to India and four comparator countries which are high on international collaboration, namely Denmark, Sweden, Switzerland, and the Netherlands. The results point to playout of Mathew Effect and possible confirmation of social constructivist argument of citation practices.

Keywords: International collaboration; Citation Impact; Immunology

Introduction

International collaborative research has engaged bibliometricians and in the recent years a lot of emphasis is laid on output from such collaborations. In fact, Adams[1] argues that the 4th age of research is driven by international collaboration between elite research groups. He felt that institutions that do not form international collaboration risk progressive disenfranchisement. Coccia & Wang[2] in their analysis of long run patterns of international research collaboration across scientific fields find a convergence of collaborative patterns between applied and basic sciences and see collaborator as one of the contributing factors that suggests the evolution of modern scientific fields.

Scientists collaborate internationally as it is seen to enhance their academic prestige, scientific recognition, visibility, and access to research funding, resulting from collaboration with renowned research groups[3-7]. Scholars also have the potential to gain academic capital by engaging in collaboration. Studies have shown a citation advantage for articles co-authored across institutions and nations[8,9,10] do not endorse beneficial effect of collaboration of any type – local, domestic, or international. This point to the Mathew Effect for Countries in citation terms put forth by Bonitz, Bruckner, and Scharnhorst[11], who argue that Mathew Effect for Countries is observable in all main scientific fields that were investigated. Over fifteen years the Mathew Effect for Countries has been relatively stable. Matthew Effect in short refers to the rich getting richer and the poor poorer.

For universities international links bring esteem, demonstrate wider engagement and enhance status of an institution. This, in turn, helps to attract students and staff from an international catchment. At national level an important motivation is cost sharing. Research collaboration opportunities are also pursued as a form of diplomacy[12].

International collaboration is one of the major factors driving the surge in publication activity over the period and is specially so in the US and European countries[13]. In quantitative terms Europe is the global international collaboration leader. It is also argued that such collaboration pays off in terms of citation premium in European systems[14].

Research also suggests that the positive spinoffs of international collaboration may vary across disciplines and the countries[15]. Because of that not all international collaborations are beneficial. Though collaborative research indicates a citation advantage, the reason why collaboration papers tend to be more cited is not clear[16]. As collaborative research is more likely to be funded, they tend to be better resourced[16,7]. It could also be because there are more authors to cite themselves.

Nevertheless, not all international collaboration is beneficial. International collaboration with some countries seems to increase impact. In contrast, collaboration with some other nations seems to decrease impact. In biochemistry, for instance, international collaboration may not be beneficial unless the collaboration is from the USA[16.]

It is also noted in the literature that international collaboration stands out to be generally beneficial when we adopt simpler statistical methods[16,6]. Given these observations it is important to consider specific countries and the related data examined at depth. It is also observed that in some fields, team authored work may not be of higher quality[16] or produce more novel research[18]. In addition, collaboration complicates notions of contribution and responsibility in publication[19].

Indian bibliometric studies generally approach international collaboration optimistically for their relative better citation impact. Analysis by Prakasan *et al*[20] register that India from 1991-2010 had collaborated with 180 countries with publications ranging from one to several thousand. Garg and Tripathi[21] in their review of bibliometrics and scientometrics in India list a host of studies dealing with different aspects of collaboration.

A report by NSTMIS, Dept. of Science & Technology[22] indicates that 16.0% of Indian S&T output were products of international collaboration and these papers were cited 39% more than the world average across collaboration types. The report also notes that the proportion of such collaboration decreased between 2009 and 2013.

Against this background, the current study examines the impact of international collaboration for India, along with four European countries – Denmark, the Netherlands, Sweden, and Switzerland – as comparators which have shown a high rate of collaboration. Denmark, the Netherlands, Sweden, and Switzerland in 2018 had 64.19%, 62.23%, 64.31% and 69.18% [27] of their respective total additions to Scopus as output through international collaboration.

Objectives of the study

Most of the studies on collaboration benefits examine the citation count, and do not take into account extent of author involvement from different countries and whether such benefits accrue generally across international collaborative publications for all countries.

The objectives of the current analysis are:

- To understand whether Indian publications obtain positive impact of collaboration, when compared with four European countries – Denmark, Netherlands, Sweden, and Switzerland - which are very high in such collaborations (Dept. of Science and Technology[23]);
- To examine whether the impact varies with the source of publication and the extent of authorial (human resource) involvement;
- To explore the citation accretion for local and collaborating papers, and how they vary when a given collaborating country leads the collaboration (as the first author in publication) or figures as joint author; and finally,
- To understand the possible variations in citation accretion for the select countries when the publications fall in journals of overlapping SCImago Journal Ranking (SJR).

The analysis focuses on citable documents indexed in Scopus under immunology for the year 2018. For computing author and citation related information the entire set of listed articles were downloaded from Scopus. All the relevant data were collected in June of 2020 from Scopus database.

ANOVA statistics (with Tukey HSD Post-hoc Test when F Ratio was found significant) along with frequency distributions was used in the analysis. ANOVA helps to find out whether the differences between groups of data are statistically significant. Tukey's HSD (Honestly Significant Difference) is the least amount that the means must vary from each other to be truly different. The value of the Tukey test is obtained by taking the absolute value of the difference between pairs of means and dividing it by the standard error of the mean as determined by a one-way ANOVA test. Whenever the means differ by more than the HSD value it is taken that they are honestly significantly different. SPSS was used for the statistical analysis.

Analysis and discussion

Table 1 presents document-type wise distribution of citable documents on immunology for the year 2018 indexed in Scopus for the selected countries. As could be seen total Indian publications in the database is more than twice that of the Netherlands and Switzerland; thrice as much as Sweden; almost four folds that of Denmark. Total citation yield for Indian contributions compares favourably with the other countries in the context. The average citation yield, however, is approximately one-third of the other countries. Indian contributions are several times more than the others in document types—articles, book, book chapter, review, and also editorials.

The first noticeable indicator of the possible difference in content could be noticed in mean number of authors per publication (Table 2). Maximum and minimum number of authors remains the same for all the five countries because the same extensive multi-country study figures against all of

Table 1 — Distribution of citable immunology documents (2018)

	Denmark	Netherlands	Switzerland	Sweden	India
Article	358	653	605	458	1307
Book		1			14
Book Chapter	1	8	10	2	257
Conference Paper	3	9	12	2	1
Editorial	5	9	7	4	13
Erratum	6	11	8	9	6
Letter		39	10	27	7
Note	8	9	20	7	6
Review	53	92	72	56	153
Short Survey		1	3	1	2
Unclassified	3	10	0	6	3
Total Citable Documents	437	842	747	572	1769
Total Citations	4728	7961	6657	5157	5924
Mean Citations	10.82	9.45	8.91	9.02	3.35

Table 2 — Authorship pattern of citable immunology documents (2018)

	Denmark	Switzerland	Sweden	Netherlands	India
Total documents	437	747	572	842	1769
Total authorships	4847	7001	5353	8305	8370
Mean authors	11.09	9.37	9.36	9.86	4.73
Minimum authors	1	1	1	1	1
Maximum authors	184	184	184	184	184

Table 3 — Country affiliation of authors of Citable Documents in Immunology (2018)

	Total authors	Distinct authors*	Country affiliation of collaborating foreign authors				
			The Netherlands	Switzerland	Denmark	Sweden	Total Collaborating authors
Netherlands	8305	7193	-	1494	1277	1374	4145
Switzerland	7000	6321	1494	-	1175	1068	3737
Denmark	4848	4315	1277	1175	-	1297	3749
Sweden	5354	4813	1374	1068	1068	-	3510
India	8369	7328					

**Author is counted only once irrespective of number of citable documents he/she has authored*

them. However, the citation intensity for Denmark, Switzerland, Sweden, and Netherlands is twice as much or more than that of Indian publications, indicating the extensive acceptance of the studies. Possibly Indian publications are narrowly focused. Despite the variation in number of total publications, total extent of authorial involvement remains more or less the same for India and Netherlands. The number is not far behind for Switzerland.

As we understand, researchers may publish more than one article in a year, and Table 3 captures this information. Distinct author (that is, the author is counted only once irrespective of number of Citable Documents he/she has authored) information was processed using Scopus Author Id associated with the publications. Distinct authors figuring in Indian publication were more than that of the Netherlands. As we know international collaboration is generally high among Denmark, Sweden, Switzerland, and the Netherlands. The author data for these comparator countries in the context were processed to understand how many were local to the country and how many came from one of the other three countries in the analysis (Table 3). The Netherlands had almost 50.0% of the authorial presence in their publication from the other three countries; Switzerland 53.39%; Denmark 77.33%; and Sweden 65.59%, as could be seen. In fact, major proportion of authorial contribution in publication comes from outsiders and in the case of Denmark it is considerably high, being more than three-fourths of the total.

The four European countries in the context are getting the benefit of contribution from the same number of author entities as that of India because of collaboration. The analysis also shows that because of this collaboration they get the benefit of the same articles counted against multiple countries in the context as also the citations accrued to them. The

Distribution of author occurrence among immunology articles (2018) pertaining to Netherlands, Switzerland, Denmark, Sweden

No. of occurrence (Same names appearing in different articles)	Authors
1	13859
2	2264
3	549
4	629
Total	17301

- Total articles on immunology in 2018 by Switzerland, Denmark, Netherlands, Sweden: 2343
- Total citations: 24503
- Average citation per publication: 10.46
- Same article appearing against more than one country (among the four) 290
- Cumulative citation score for those 290 articles: 6236
- Collaboration benefit: 24503/6236

Table 4 — Grouping of citable documents in immunology (2018) based on citation intensity

Cited by	Denmark Citable Documents (Percent)	Switzerland Citable Documents (Percent)	Sweden Citable Documents (Percent)	Netherlands Citable Documents (Percent)	India Citable Documents (Percent)
0	26 (1.5%)	67 (3.8%)	60 (3.4%)	75 (4.2%)	653 (36.9%)
1	45 (2.5%)	65 (3.7%)	64 (3.6%)	88 (5.0%)	311 (17.6%)
2	33 (1.9%)	68 (3.8%)	59 (3.3%)	64 (3.6%)	185 (10.5%)
3	33 (1.9%)	68 (3.8%)	48 (2.7%)	82 (4.6%)	145 (8.2%)
4	44 (2.5%)	64 (3.6%)	36 (2.0%)	60 (3.4%)	106 (6.0%)
5	29 (1.6%)	59 (3.3%)	37 (2.1%)	54 (3.1%)	75 (4.2%)
6	28 (1.6%)	35 (2.0%)	35 (2.0%)	48 (2.7%)	51 (2.9%)
7	30 (1.7%)	38 (2.1%)	34 (1.9%)	42 (2.4%)	59 (3.3%)
8	18 (1.0%)	37 (2.1%)	21 (1.2%	43 (2.4%)	36 (2.0%)
9	11 (0.6%)	28 (1.6%)	25 (1.4%)	37 (2.1%)	17 (1.0%)
10 or more	140 (83.2%)	218 (70.1%)	153 (76.3%)	249 (66.5%)	131 (7.4%)

associated citation impact benefit for the four countries is to the extent of 25.5%. Of the 24,503 total citations, the publications common to these countries were calculated to yield 6236 citations as given Table 3.

Analysis was taken further to consider citation distribution among the respective country publication. For the purposes of better appreciation of the trends, the citation categories were collapsed to 11 groups, ranging from 0 citations to 10 or more. As we can notice in Table 4 more than one-third of Indian publications have received no citation, compared to smaller proportion of articles in that category for the other four. At the other end considerable proportion of their publication (ranging from 66.5% to 83.2%) falls in the category of 10 or more citations for the four European countries in the context, whereas it was only 7.4% of the total for India. In 10 or more citations category Indian publications are less than the others even in absolute numbers. Most of our cited publications have secured 1 to 4 citations, and only a few of them (7.4% of the total) on the higher end.

Apart from the international collaboration bonus (same citation getting posted against many countries) enjoyed by comparator countries in the context the variation could be an indication of topics chosen to research by Indian researchers, or their perceived depth or cutting-edge nature in the research information in the publication.

The analysis was taken ahead to understand the role in international collaboration. For the purpose lead position (first author) in the publication was tabulated and also the citation yield as consequence of that.

Table 5 presents data on citable documents with international collaboration and the local authors in

Table 5 — International collaboration and citation accretion

(Figures in brackets are % of the total in the citation category for the respective countries)

Cited by	Denmark		Switzerland		Sweden		Netherlands		India	
	Domestic	International Collab	Domestic	International Collab	Domestic	International Collab	Domestic	International Collab	Domestic	International Collab
0	12 (46.15%)	14 (53.85%)	24 (35.82%)	43 (64.18%)	1 (1.67%)	59 (98.33%)	24 (32.00%)	51 (68.00%)	572 (87.60%)	81 (12.40%)
1	13 (28.89%)	32 (71.11%)	17 (26.15%)	48 (73.85%)	38 (59.38%)	26 (40.63%)	31 (35.23%)	57 (64.77%)	257 (82.64%)	54 (17.36%)
2	8 (24.24%)	25 (75.76%)	25 (36.76%)	43 (63.24%)	15 (25.42%)	44 (74.58%)	19 (29.69%)	45 (70.31%)	140 (75.68%)	45 (24.32%)
3	7 (21.21%)	26 (78.79%)	13 (19.12%)	55 (80.88%)	16 (33.33%)	32 (66.67%)	25 (30.49%)	57 (69.51%)	108 (74.48%)	37 (25.52%)
4	11 (25.00%)	33 (75.00%)	15 (23.44%)	49 (76.56%)	11 (30.56%)	25 (69.44%)	18 (30.00%)	42 (70.00%)	82 (77.36%)	24 (22.64%)
5	10 (34.48%)	19 (65.52%)	13 (22.03%)	46 (77.97%)	11 (29.73%)	26 (70.27%)	13 (24.07%)	41 (75.93%)	55 (73.33%)	20 (26.67%)
6	9 (32.14%)	19 (67.86%)	13 (37.14%)	22 (62.86%)	8 (22.86%)	27 (77.14%)	10 (20.83%)	38 (79.17%)	33 (64.71%)	18 (35.29%)
7	4 (13.33%)	26 (86.67%)	6 (15.79%)	32 (84.21%)	13 (38.24%)	21 (61.76%)	6 (14.29%)	36 (85.71%)	34 (57.63%)	25 (42.37%)
8	3 (16.67%)	15 (83.33%)	8 (21.62%)	29 (78.38%)	3 (14.29%)	18 (85.71%)	11 (25.58%)	32 (74.42%)	25 (69.44%)	11 (30.56%)
9	1 (9.09%)	10 (90.91%)	7 (25.00%)	21 (75.00%)	6 (24.00%)	19 (76.00%)	12 (32.43%)	25 (67.57%)	11 (64.71%)	6 (35.29%)
10 >	20 (14.29%)	120 (85.71%)	47 (21.56%)	171 (78.90%)	44 (28.76%)	109 (71.24%)	46 (18.47%)	203 (81.53%)	72 (54.96%)	59 (45.04%)
Total	98 (22.43%)	339 (77.57%)	188 (25.17%)	559 (74.97%)	166 (29.02%)	406 (70.98%)	215 (25.53%)	627 (74.47%)	1389 (78.52%)	380 (21.48%)

different citation categories ranging from 0 to 10 or more.

As could be seen 21.48% of Indian contributions had international collaboration compared to 77.57% for Denmark; 74.97% for Switzerland; 70.98% for Sweden and 74.47% for Netherlands.

Data from Table 5 also reveals that only 15% of Indian publications with international collaboration fall in 10 or more citation category (59 out of 380), whereas it is 27% in case of Sweden (109 out of 406). Such collaborations range from 30% to 35% for the other three countries. About 20% of Indian papers with international collaboration yield 0 citations. So, the international collaboration does not seem to be the decisive factor in citation yield as borne out by the data, at least for India.

Lead author in collaboration

The analysis also explored whether being in lead in publications of international collaboration (as indicated by first author country affiliation) makes a difference in citation yield (Table 6). In 56.05% (213 of total 380) of the international collaborations from India, Indian researcher was the first author, whereas it was 24.26% for Denmark (106 of 339); 33.57% for Switzerland (188 of 559); 33.74% for Sweden (137 of 406); and 36.52% for Netherlands (229 of 627). In Indian international collaborative research projects, the local contributors have been the first authors in more than half the cases. The data shows that when Indian researchers were in the lead, almost in 25% of those collaborative publications the citation yield was 0 and only in 10.8% of the cases it was 10 or more citations per citable documents. The comparative figure for the other four countries, when they were in the lead, was around 30.0% in 10 or more citations yield category. The distribution points to factors other than publication quality in play in citation yield. Considering these contributions are from Scopus indexed journals, perhaps mere dependence on citations to determine the quality of the article may not seem appropriate.

Citation yield Vs SJR

The analysis was taken one step further to understand whether the publications of the five countries yield overlapping number of citations when they are published in similar SJR category journals. SJR expresses the average number of weighted citations received in the selected year by the documents published in the selected journal in the three previous years, --i.e. weighted citations received

Table 6 — Grouping of articles with international collaboration in Immunology (2018) based on citation yield vis-à-vis First / Co-author details
(*Figures in brackets are % of the total in the citation category for the respective countries*)

	Denmark		Switzerland		Sweden		Netherlands		India	
Citations	Lead Author	Co-author	Lead Author	Co-author	Lead Author	Co-author	Lead Author	Co-author	Lead Author	Co-author
0	3 (21.43)	11 (78.57)	17 (39.53)	26 (60.47)	11 (18.64)	48 81.36)	23 (45.10)	28 (54.90)	53 (65.43)	28 (34.57)
1	13 (40.63)	19 (59.38)	22 (45.83)	26 (54.17)	13 (50.00)	13 (50.00)	17 (29.82)	40 (70.18)	35 (64.81)	19 (35.19)
2	9 (36.00)	16 (64.00)	15 (34.88)	28 (65.12)	16 (36.36)	28 (63.64)	15 (33.33)	30 (66.67)	32 (71.11)	13 (28.89)
3	9 (34.62)	17 (65.38)	15 (27.27)	40 (72.73)	12 (37.50)	20 (62.50)	25 (43.86)	32 (56.14)	18 (48.65)	19 (51.35)
4	8 (24.24)	25 (75.76)	15 (30.61)	34 (69.39)	9 (36.00)	16 (64.00)	16 (38.10)	26 (61.90)	11 (45.83)	13 (54.17)
5	5 (26.32)	14 (73.68)	14 (30.43)	32 (69.57)	4 (15.38)	22 (84.62)	17 (41.46)	24 (58.54)	9 (45.00)	11 (55.00)
6	7 (36.84)	12 (63.16)	7 (31.82)	15 (68.18)	10 (37.04)	17 (62.96)	12 (31.58)	26 (68.42)	7 (38.89)	11 (61.11)
7	10 (38.46)	16 (61.54)	12 (37.50)	20 (62.50)	9 (42.86)	12 (57.14)	13 (36.11)	23 (63.89)	15 (60.00)	10 (40.00)
8	7 (46.67)	8 (53.33)	13 (44.83)	16 (55.17)	8 (44.44)	10 (55.56)	14 (43.75)	18 (56.25)	8 (72.73)	3 (27.27)
9	2 (20.00)	8 (80.00)	4 (19.05)	17 80.95)	4 (21.05)	15 (78.95)	11 (44.00)	14 (56.00)	2 (33.33)	4 (66.67)
10 or more	33 (27.50	87 (72.50)	54 (31.76)	117 (68.24)	41 (37.61)	68 (62.39)	66 (32.51)	137 (67.49)	23 (25.84)	36 (74.16)
Total	106 (31.27)	233 (68.73)	188 (33.69)	371 (66.31)	137 (33.74)	269 (66.26)	229 (36.52)	398 (63.48)	213 (56.05)	167 (43.95)

in year X to documents published in the journal in years X-1, X-2 and X-3[28].

SJR is represented in decimal places based on a complex formula developed by SCImago Research Group. For this analysis the SJR for the journals were rounded off to the base integer. Publications of five countries were grouped into seven categories namely, 0 or less than 1 SJR; between 1 and <2; 2-<3; 3-<4; 6 or more. There was no publication for the select countries in SJR 5 (and its fraction) category journals. In effect we had six categories.

Seven one-way Anova were computed to understand the mean difference among country publications for each of the SJR category. This was followed by Tukey HSD post hoc test when F Ratio was found to be significant. The purpose was to know whether the citation yield distribution is statistically the same in the broad band of SJR for different countries in the context. The Tukey HSD (Honestly Significant Difference) test is a statistical test used to determine if the relationship between two sets of data is statistically significant – that is, whether there's a strong chance that an observed numerical change in one value is causally related to an observed change in another value.

The results indicate that four of the seven Anovas are significant (Table 7), implying statistically significant difference in citation yields for citable documents of these five different countries, despite being published in the same broad group of SJR.

The analyses using Tukey HSD post hoc test, which compares each country in the context with the others, show that there is a significant mean difference in citation yield in three of the six categories of SJR for immunology publications of the countries considered in the context. The post hoc analysis shows that Indian publications, compared to those of other countries in the analysis, accrue significantly lesser citations even when they are published in journals of overlapping SJR. This could be noted in SJR category less than 1; between 1 and 2; and 3 and 4. The Anova for the total country-wise Citable Documents (irrespective of the SJR Categories of the journal where they were published) also returns a significant F Ratio (F= (4,4362) 61.53, MSE = 162.74 P<.000) for the overall distribution. Indian publications get significantly less citation yield compared with each one of the other four countries, whereas no such difference is present for Denmark, Netherlands, Sweden and Switzerland.

Table 7 — n, mean citations, and Anova details vis-à-vis SJR categories of Citable Documents

	India		Denmark		Switzerland		Sweden		Netherlands		Anova results
SJR	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	
.00 -< 1.00	280	.84	280	12.17	33	4.82	11	6.64	20	4.90	F (4,619) = 18.85, MSE = 240.15 P< .000
1.00 -<2.00	1386	3.38	246	6.17	353	5.53	301	5.51	398	5.31	F (4,2679) = 16.04, MSE = 52.35 P <.000
2.00 - <3.00	44	6.07	50	8.78	109	6.88	81	8.60	84	7.88	F (4,363) = 1.22, MSE = 64.83 NS
3.00 - <4.00	27	11.19	30	20.07	59	9.80	30	10.80	45	9.71	F (4,186) = 2.95, MSE = 214.20 P<.000
4.00 - <5.00	5	14.60	8	11.50	27	11.44	11	22.91	23	11.70	F (4,69) = 1.41, MSE = 209.76 NS
6.00 and above	27	13.37	97	20.67	166	17.52	138	15.59	272	16.11	F (4, 695) = .94, MSE = 583.85 NS
Total	1769	3.35	437	10.82	747	8.91	572	9.02	842	9.45	F (4,4362) = 61.53,MSE = 162.74 P<.000

Anova Summary - Citation Yield for Select Countries * SJR <1

	Sum of Squares	df	Variance	F	p	
Between Groups	18105.1481		4	4526.2870	18.8482	0.0000
Within Groups:	148649.6750		619	240.1449		
Total	166754.8231			623		

Tukey HSD Post-hoc Test...

	Mean Difference	95% CI		Significance
		Lower Bound	Upper Bound	
India vs Denmark	11.3300	7.7481	14.9119	p=0.0000
India vs Switzerland	3.9800	-3.8203	11.7803	p=0.6308 (NS)
India vs Sweden	5.8000	-7.2271	18.8271	p=0.7411 (NS)
India vs Netherlands	4.0600	-5.7494	13.8694	p=0.7895 (NS)
Denmark vs Switzerland	-7.3500	-15.1503	0.4503	p=0.0758 (NS)
Denmark vs Sweden	-5.5300	-18.5571	7.4971	p=0.7736 (NS)
Denmark vs Netherlands	-7.2700	-17.0794	2.5394	p=0.2542 (NS)
Switzerland vs Sweden	1.8200	-12.9354	16.5754	p=0.9972 (NS)
Switzerland vs Netherlands	0.0800	-11.9300	12.0900	p=1.0000 (NS)
Sweden vs Netherlands	-1.7400	-17.6491	14.1691	p=0.9983 (NS)

Anova Summary - Citation Yield for Select Countries * SJR between 1 and <2

	Sum of Squares	df	Variance	F	p	
Between Groups	3358.7896		4	839.6974	16.0393	0.0000
Within Groups:	140252.3827		2679	52.3525		
Total	143611.1723			2683		

Tukey HSD Post-hoc Test...

Comparison	Mean Difference	95% CI		Significance
		Lower Bound	Upper Bound	
India vs Denmark	2.7900	1.4242	4.1558	p=0.0000
India vs Switzerland	2.1500	0.9730	3.3270	p=0.0000
India vs Sweden	2.1300	0.8746	3.3854	p=0.0000
India vs Netherlands	1.9300	0.8073	3.0527	p=0.0000
Denmark vs Switzerland	-0.6400	-2.2796	0.9996	p=0.8245 (NS)
Denmark vs Sweden	-0.6600	-2.3568	1.0368	p=0.8263 (NS)
Denmark vs Netherlands	-0.8600	-2.4611	0.7411	p=0.5851 (NS)
Switzerland vs Sweden	-0.0200	-1.5688	1.5288	p=1.0000 (NS)
Switzerland vs Netherlands	-0.2200	-1.6634	1.2234	p=0.9937 (NS)
Sweden vs Netherlands	-0.2000	-1.7080	1.3080	p=0.9963 (NS)

Anova Summary - Citation Yield for Select Countries * SJR between 2 and < 3

	Sum of Squares	df	Variance	F	p
Between Groups	315.8575	4	78.9644	1.2180	0.3027 (NS)
Within Groups:	23533.5699	363	64.8308		
Total	23849.4275	367			

Anova Summary - Citation Yield for Select Countries * SJR between 3 and < 4

	Sum of Squares	df	Variance	F	p
Between Groups	2523.8297	4	630.9574	2.9457	0.0216
Within Groups:	39840.8153	186	214.1979		
Total	42364.6450	190			

Tukey HSD Post-hoc Test...

Comparison	Mean Difference	95% CI		Significance
		Lower Bound	Upper Bound	
India vs Denmark	8.8800	-1.8134	19.5734	p=0.1536 (NS)
India vs Switzerland	-1.3900	-10.7562	7.9762	p=0.9941 (NS)
India vs Sweden	-0.3900	-11.0834	10.3034	p=0.9999 (NS)
India vs Netherlands	-1.4800	-11.2929	8.3329	p=0.9937 (NS)
Denmark vs Switzerland	-10.2700	-19.3092	-1.2308	p=0.0171
Denmark vs Sweden	-9.2700	-19.6782	1.1382	p=0.1061 (NS)
Denmark vs Netherlands	-10.3600	-19.8613	- 0.8587	p=0.0250
Switzerland vs Sweden	1.0000	-8.0392	10.0392	p=0.9981 (NS)
Switzerland vs Netherlands	-0.0900	-8.0682	7.8882	p=1.0000 (NS)
Sweden vs Netherlands	-1.0900	-10.5913	8.4113	p=0.9978 (NS)

Anova Summary - Citation Yield for Select Countries * SJR between 4 and < 5

	Sum of Squares	df	Variance	F	p	
Between Groups	1200.9590	4	300.2398	1.4314		1.4314 (NS)
Within Groups:	14473.3976	69	209.7594			
Total	15674.3566	73				

Anova Summary - Citation Yield for Select Countries * SJR 6 >

	Sum of Squares	df	Variance	F	p	
Between Groups	2184.7688	4	546.1922	0.9355		0.4427 (NS)
Within Groups:	405776.8299	695	583.8516			
Total	407961.5987	699				

Anova Summary - Citation Yield for Select Countries * SJR

	Sum of Squares	df	Variance	F	p	
Between Groups	40052.9624	4	10013.2406	61.5282		0.0000
Within Groups:	709881.7920	4362	162.7423			
Total	749934.7544	4366				

Tukey HSD Post-hoc Test...

Comparison	Mean Difference	95% CI		Significance
		Lower Bound	Upper Bound	
India vs Denmark	7.4700	5.6111	9.3289	p=0.0000
India vs Switzerland	5.5600	4.0416	7.0784	p=0.0000
India vs Sweden	5.6700	3.9962	7.3438	p=0.0000
India vs Netherlands	6.1000	4.6431	7.5569	p=0.0000
Denmark vs Switzerland	-1.9100	-4.0057	0.1857	p=0.0938 (NS)
Denmark vs Sweden	-1.8000	-4.0108	0.4108	p=0.1720 (NS)
Denmark vs Netherlands	-1.3700	-3.4216	0.6816	p=0.3611 (NS)
Switzerland vs Sweden	0.1100	-1.8234	2.0434	p=0.9997 (NS)
Switzerland vs Netherlands	0.5400	-1.2090	2.2890	p=0.9174 (NS)
Sweden vs Netherlands	0.4300	-1.4555	2.3155	p=0.9716 (NS)

Even when Indian research in the subject area published in higher ranking journals, and even when the outcome is of international collaborative work the citation impact tends to be significantly low. The reasons for this phenomenon cannot be attributed to low quality of research output. Perhaps this could be due to the incorrect perception by the peer group, Mathew Effect for Countries[11] in operation, or plain bias[24] in perception of quality of the output. This would point to the social constructivist view of citing behaviour.

Social constructivists believed that we each construct our view of the world based on our perception of the world. Studies conducted on the scientists as participant observers by Latour & Woolgar[25], Latour[26] have given us the nuanced understanding of how the citations work while writing research papers. Social constructivists believe that there is an external reality, as they accept reality as a construct of human mind. Therefore, reality is perceived to be subjective. This plays out in the citation studies context in terms of choosing 'A' over 'B' to cite. In such a scheme of things Indian publications even with international collaboration do not seem to stand a good chance of being cited.

Conclusion

Indian international collaborative papers do not attract the same citation receptivity that the European countries considered in the context do. Excepting contributions of the Netherlands, the other three European countries considered in the analysis do not figure as the first author in the citable documents often, yet they receive the citation benefit.

In fact, it is in the interest of some of these smaller countries to engage in international collaboration to make their relatively smaller authorial presence as force multipliers in the citation game.

A factor that must be examined in detail is the Mathew Effect for Countries[11], a tendency of certain countries not given due citation credit, possibly because of implicit bias against their research output[24].

International cooperation in research and innovation is a strategic priority for the EU. The policy is intended to access the latest knowledge and the best talent worldwide; business opportunities in new and emerging markets; and science diplomacy to influence and enhance external policy. Though much is made of greater citation impact of international collaborations in publications whether it really helps countries like India is still to be understood.

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References

1 Adams J, Collaborations: The fourth age of research, *Nature*, 497 (7451) (2013) 557-560.

2 Coccia M and Wang L, Evolution and Convergence of the Patterns of International Scientific Collaboration, *PNAS*, 113(8) Feb 23 (2016), 2057-2061.

3 Kwiek M, Internationalists and Locals: International Research Collaboration in a Resource-Poor System. *Scientometrics*, 124 (1) (2020) 57-105.

4 Khor KA and Yu LG, Influence of international co-authorship on the research citation impact of young universities, *Scientometrics,* 107*,* (2016), 1095–1110.

5 Kwiek M, The Internationalization of Research in Europe. A Quantitative Study of 11 National Systems from a Micro-Level Perspective. *Journal of Studies in International Education* 19 (2) (2015), 341–59. doi: 10.1177/1028315315572898

6 Thelwall M and Maflahi N, Academic Collaboration Rates and Citation Associations Vary Substantially Between Countries and Fields. https://arxiv.org/ftp/arxiv/papers/1910/1910.00789.pdf

7 Lee S and Bozeman B, The impact of research collaboration on scientific collaboration on scientific productivity, *Social Study of Science*, 35(3), (2005) 673-702.

8 Larivière V, Gingras Y, Sugimoto C R and Tsou A, Team size matters: Collaboration and scientific impact since 1900, *Journal of the Association for Information Science and Technology*, 66(7), (2015), 1323-1332.

9 Chinchilla-Rodríguez Z, Sugimoto CR and Larivière V, Follow the Leader: On the Relationship between leadership and scholarly impact in international collaborations. *PLOS ONE* (2019) 1-18. https://doi.org/10.1371/journal.pone.0218309

10 Bartneck C and Hu J, The Fruits of Collaboration in a Multidisciplinary Field. *Scientometrics*, 85 (2010) 41-52. DOI 10.1007/s11192-010-0242-4

11 Bonitz M, Bruckner E and Scharnhorst A, Characteristics and impact of the Matthew effect for countries, *Scientometrics*, 40 (1997) 407-422.

12 Flink T and Schreiterer U, Science diplomacy at the intersection of S&T policies and foreign affairs: Toward a typology of national approaches, *Science and Public Policy*, 37(9) (2010) 665–677 DOI: 10.3152/030234210X12778118264530

13 OECD and SCImago Research Group (CSIC) (2016), Compendium of Bibliometric Science Indicators. OECD, Paris. Accessed from http://oe.cd/scientometrics. p20-23.

14 Kwiek M, What large-scale publication and citation data tell us about international research collaboration in Europe: changing national patterns in global contexts, *Studies in Higher Education*, (2020) DOI: 10.1080/03075079. 2020.1749254

15 Grácio MCC, de Oliveira EFT, Chinchilla-Rodríguez Z and Moed HF, Does corresponding authorship influence scientific impact in collaboration: Brazilian institutions as a case of study. *Scientometrics,* 125 (69) (2020) DOI: 10.1007/s11192-020-03655-7

16 Sud P and Thelwall M, Not all international collaboration is beneficial: The Mendeley readership and citation impact of biochemical research collaboration, *Journal of the Association for Information Science and Technology*, 67 (8) (2016) 1849-1857.

17 Bornmann L, Is collaboration among scientists related to the citation impact of papers because their quality increases with collaboration? An analysis based on data from F1000Prime and normalized citation scores *Journal of the Association for Information Science and Technology*, 68 (4) (2017) 1036-1047.

18 Wagner CS and Whetsell TA and Mukherjee S, International research collaboration: Novelty, conventionality, and atypicality in knowledge recombination, *Research Policy*, 48 (5) (2019) 1260-1270.

19 Birnholtz J, What does it mean to be an author? The intersection of credit, contribution, and collaboration in science, *Journal of The American Society For Information Science And Technology*, 57 (2006) 1758-1770.
20 Prakasan ER, Mohan L, Girap P, Surwase G, Kademani BS, Bhanumurthy K, Scientometric facts on international collaborative Indian publications, *Current Science*, 106 (2) (2014) 166-169.
21 Garg, K.C. and Tripathi, H K, Bibliometrics and scientometrics in India: An overview of studies during 1995-2014 – Part II: Contents of the articles in terms of disciplines and their bibliometric aspects, *Annals of Library and Information Science*, 65 (3) (2018) 7-42.
22 NSTMIS, Dept. of Science & Technology: Research and Development Statistics 2019-20, New Delhi, 2020, p. 67.
23 Dept of Science & Technology, Science & Technology Research Impact and the Associated Factors: Analysis of Cross National Data. PI: N G Satish, Institute of Public Enterprise, Hyderabad. New Delhi, (Govt. of India, New Delhi), 2020. P. 221.
24 Harris M, Macinko J, Jimenez G, Mullachery P, Measuring the bias against low-income country research: An Implicit Association Test, *Globalization and Health*, 13 (80) (2017) 1-9. DOI 10.1186/s12992-017-0304-y
25 Latour Bruno and Woolgar S, *Laboratory Life: The Construction of Scientific Facts*. (Sage Publications, Beverly Hills), 1979.
26 Latour B, *Science in action. (*Harvard University Press, Cambridge, MA.) 1987, 274p.
27 SCImago Journal and Country Rank. SCImago Research Group. https://www.scimagojr.com/countryrank.php (Accessed on 17 August 2021)
28 Guerrero-Bote VP, Moya-Anegón F, A further step forward in measuring journals' scientific prestige: The SJR2 indicator, *Journal of Informetrics*, 6 (2012) 674–688