



# A bibliometric analysis of the internationalisation of political science in Europe

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## Abstract

Based on data on 67,000 articles published in 100 high-impact journals in the twenty years between 2000 and 2019, I analyse the scientific contribution of European political science scholarly communities in the global context. The scholars contributing to the global scientific production are largely concentrated in a few countries, with the US and UK alone accounting for more than half of the articles published in high-impact journals. However, the tendency is towards increasing diversity in the geographic basis of the international scientific production; and European countries are central to this change. Contributing to international collaborative publications has been a key engine of the increased scientific production of scholars based in Europe. This was a generalised global tendency, and a spectacular one for certain national scholarly communities. The network analysis of international collaborations points to the consolidation of three clusters within a growing and increasingly dense network. The US, followed by the UK, are central to a global cluster of collaborations. European countries are primarily clustered in two groups: a larger and growing cluster; and a smaller but even more integrated, highly productive and connected cluster of scholars based in seven northern European countries. All bibliometric indicators consistently point to a generalised growth in the output and internationalisation of the scientific contribution provided by the European political science community.

**Keywords** Bibliometrics · Europe · Internationalisation · Political science · Publications

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## Introduction

This article uses data on 67,000 articles published in 100 high-impact political science journals in the twenty years between 2000 and 2019 to analyse the publication output of national scholarly communities. Highly regarded journals have a wide readership and international circulation and are commonly referred to as “international journals.” Publishing in such journals means contributing to the international scientific scholarship. For these reasons, patterns of publishing in international journals can be analysed as possible indicators of internationalisation (see Tronconi and Engeli in this symposium) — although clearly just one among many (and see also Engeli et al.).

Bibliographic data permit the analysis of publications at the level of journals, articles, authors, academic institutions, and countries. This article focuses on the country level to provide a bibliometric analysis of the internationalisation of European political science against the background of the global scientific production. For each country, or national scholarly community, I use two simple indicators of internationalisation: articles published in the journals selected for this study; and co-authorship of publications, within the same set of journals, with scholars based in different countries. I analyse both indicators in turn and then look more closely into patterns of international authorships through social network analysis.

This approach has some limitations. First, books and book chapters are excluded from this analysis, but they are still highly cited in political science (Jensen and Moses 2021). Second, the journals selected for analysis are not a random sample of journals in the field, but those with the higher five-year impact factor according to the 2020 Journal Citation Report of the Web of Science. The broader community of scholars that publish primarily in other outlets may pursue different paths to internationalisation. Third, the selected journals publish articles in English, and one may argue that this biases the analysis in favour of scholars working in English-speaking countries. Moreover, other internationalised (or regionalised) communities—for example, those publishing in Spanish—would not be captured by this analysis.

These limitations notwithstanding, publications in high-impact academic journals do provide a relevant perspective to the internationalisation of political science. Publishing in highly regarded international journals is central to academic careers and to the measurement of academic performance (Grossman 2020), and it also means contributing to the international scientific debate. Scholarly communities in English-speaking countries are indeed dominant in these journals. But English is the *lingua franca* of science, so the language bias is probably unavoidable in a study of internationalisation. By focussing on a large sample of leading journals, this study should still “capture the core of the discipline” (Metz and Jäckle 2017, 157)—arguably its most internationalised core.

By mapping a significant part of the international scientific production of a large number of countries over two decades, and describing patterns of international collaboration, this article expands upon the niche of studies using



bibliometric analysis to assess the status of political science. Political scientists have “a tradition of reflecting on the evolution and state of their discipline” (Fisher et al. 1998, 847). Relevant contributions have focussed on the analysis of subdisciplines, such as public administration (Forrester 1996), international relations (Kristensen 2012), or EU studies (Keeler 2005; Jensen and Kristensen 2013). Gender biases (Williams et al. 2015; Closa et al. 2020; Grossman 2020), single national scholarly communities (e.g. Plümper and Radaelli 2004; Leifeld et al. 2017) or regional groupings such as Central and Eastern Europe (Jokić et al. 2019) also have been the object of some important studies (for a more recent, in-depth discussion of the internationalisation of political science in Central and Eastern Europe, see Kapidžić et al. in this symposium).

Recent bibliometric studies include some contributions to a special symposium in this journal, a focus on influential books and articles (Jensen and Moses 2021), long-term analyses of the articles published in the journals of the European scholarly associations (Ghica 2021), and other articles published in this journal since its launch (Mas-Verdu et al. 2021). Indeed, single journals can provide a relevant perspective on patterns of developments within the discipline, factors of success, and biases; also from the side of editorial work (Closa et al. 2020). Contributions taking a bibliographic network analysis approach (Batagelj and Cerinšek 2013) still represent a small, but growing, share of bibliometric studies in political science (Kristensen 2012; Leifeld et al. 2017; Mas-Verdu et al. 2021; Jensen and Kristensen 2013; Russett and Arnold 2010; Metz and Jäckle 2017).

The article proceeds as follows. The next section presents the dataset. In the findings section, I first provide some descriptive indicators of the contributions of national scholarly communities to the analysed scientific production, and of the involvement in international collaborative publications. I then present a network analysis of international collaborations. In both the descriptive and network analysis sections, I slice the data in two decades—2000–2009 and 2010–2019—to observe the change in patterns of publications and collaborations over time.

## Data

My dataset consists of 67,081 articles published between 2000 and 2019 in 100 journals classified as “political science” in the Social Science Citation Index.<sup>1</sup> I selected the top-100 journals that in 2019 had a five-year impact factor greater than one (cf. Metz and Jäckle 2017). Table 4 in the Appendix provides the list of selected journals, and the number of articles published in each journal, in the two decades, covered by this article.

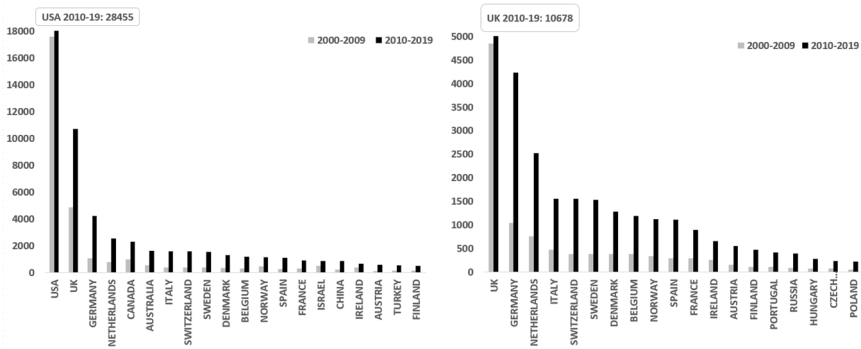
The bibliographic record of each article includes a rich set of information, including author details, institutional affiliation, keywords, or journal. The text of each bibliometric record can then be parsed to extract additional information from existing fields.<sup>2</sup> To

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<sup>1</sup> <https://www.webofscience.com/>, last accessed 26 November 2021.

<sup>2</sup> The complete bibliometric records also include bibliographies, which can be used for mapping, for example, patterns of co-citations or citation couplings among authors or journals.





**Fig. 1** Contribution to international scientific production. World's top-20 (left quadrant) and European top-20 countries (right quadrant)

parse, process and analyse the large number of bibliometric data downloaded, I used the R package Bibliometrix (Aria and Cuccurullo 2017), which permits leverage of the power and richness of bibliographic data at multiple levels.

To analyse the internationalisation of national scholarly communities, the article focuses on countries as a level of aggregation. This information is extracted from each record by taking the country indicated in the authors' affiliation details. The analysis is centred on European countries, but they are discussed in the context of the broader global political science community: between 2000 and 2019, the political scientists that contributed to the scientific production of the selected journals were based in 127 countries.<sup>3</sup>

## Findings

### Contribution to the international scientific production

Our first indicator of internationalisation of national scholarly communities is the contribution given by scholars, affiliated to institutions based in the respective countries, noting the overall number of articles published by the selected international journals.<sup>4</sup> For simplicity, and with the caveats discussed above in mind, let us call this a measure of "international scientific production". This is shown in Fig. 1. The left quadrant includes the world's top-20 countries for scientific production, while the European top-20 are shown in the right quadrant. The grey bars display figures

<sup>3</sup> Replication data and scripts will be made available on the EPS website.

<sup>4</sup> Note that the number of contributions is different from the number of articles. In the case of co-authored articles, the number of contributions for a country is equal to the number of co-authors affiliated to institutions based in that country. For example, one article co-authored by three scholars based in the same country will count as three contributions for that country.



for the decade 2000–2009, while black bars are for 2010–2019. Additional indicators are available in Tables 5 and 6 in the Appendix.

The scientific production of political scientists is highly concentrated in relatively few countries. Indeed in both quadrants, the y-axis is scaled down (truncated) to make the figures for smaller national communities visible; the data for the US and the UK are displayed in a call-out. In the decade 2010–2019, US (41%) and British (15%) institutions together hosted more than half of the (co-)authors of the articles published in the top-100 journals. Just ten countries hosted the authors of 80% of all articles. European countries were largely represented in this highly productive core: seven among the top-10 for scientific production and fourteen among the top-20 were European countries.

Within the general picture of a scientific production concentrated in a relatively small number of countries, however, the data also reveal a tendency towards diversification. In the previous decade (2000–2009), more than 70% of the scholars who published in the top-100 journals were based in the US or the UK. The top-10 countries hosted 87%, and the top-20 hosted 95%, of all authors. Over time, the international scientific production became relatively less concentrated across countries.<sup>5</sup>

European countries were key to the increased diversification of international scientific production, in two ways. On the one hand, the European scientific production increased markedly. On the other hand, the contributions to the international scientific production became much more evenly distributed among European countries themselves (see Table 5). To be sure, even in 2010–2019 the UK still provided an affiliation to a large share—roughly one third—of European contributors to publications in the top-100 political science journals; but down from 45% of Europe’s contributions in the previous decade. And while in the second decade, the British contribution more than doubled in absolute numbers (from less than 5000 to more than 10,000), so did the scientific production of the 20 more productive European countries. Meanwhile, contributions by scholars based in Germany, Ireland, Italy, Austria and Hungary more than tripled.<sup>6</sup>

Clearly, UK-based institutions still provide a large share of the European contributions to publications in leading international political science journals. Yet, the

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<sup>5</sup> Table 4 in the Appendix shows some aggregate indicators, all pointing to a broader and more diverse geographic basis of global political science.

<sup>6</sup> Italy and Hungary host two particularly productive academic institutions, the European University Institute and the Central European University, which will likely contribute substantially to the estimated scientific contribution of these countries. It may be debated whether the articles published by scholars affiliated to these institutions should be counted within Hungary and Italy. I decided to leave the data as they are for two main reasons. First, lacking an obvious alternative option, the output of the scholars affiliated to these institutions should be taken out entirely from the dataset, or else be placed on some kind of ad hoc category. This does not sound like a good option. Second and related, other countries also host highly productive institutions which are either private or enjoy special statutes or larger resources. Clearly this is particularly (but not exclusively) the case of the US, where a few big private universities may have a relatively large impact on the country’s scientific production. I am not sure that the relationship between these institutions and their host countries is fundamentally different from that of the EU and CEE and, respectively, Italy and Hungary. Eventually, I decided to leave it to the reader to interpret the findings of this article in the light of this and other possible caveats.



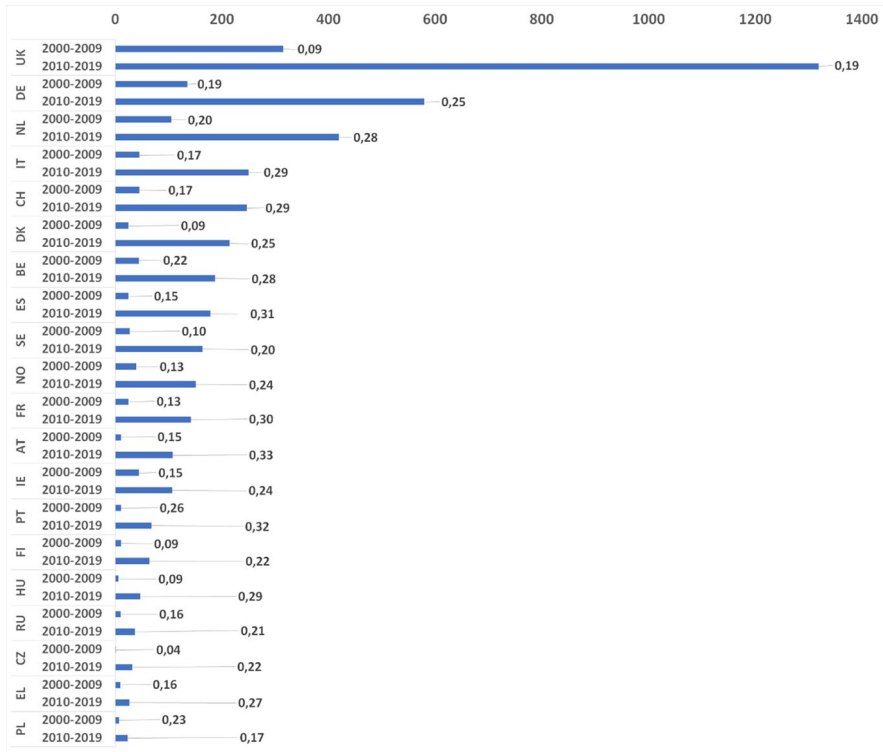


Fig. 2 Involvement in collaborative work by country, European top-20

increase in the amount of contributions from + other European countries has been remarkable.

### Participation in international collaborative publications

Our second indicator of internationalisation of national scholarships is the contribution to collaborative studies co-authored by scholars based in different countries. Multiple country publications (MCP) are shown in Fig. 2, this time only for the 20 European countries with the higher contribution to the international scientific production. For each country, the bars indicate the absolute number of MCP; alongside each bar, the share of MCP on the total number of publications contributed by that country is included. Separate bars for each country show figures for the first and second decades under analysis.

The generalised tendency towards an increased involvement in international collaborative publications outpaced the broader growth of the global scientific production. If we consider the top-35 countries for scientific production (which include the European top-20), single-country publications (SCP) increased by 1.57 (about



150%) between decades; meanwhile, MCP increased by 5.56 (or about 550%) on the average.

This is better appreciated by observing the performance of single countries. In the decade 2000–2009, MCP represented 20% or more of the total scientific production in seven European countries: the Netherlands (20%), Belgium (22%), Portugal (26%), Poland (23%), Romania (25%), Ukraine (20%) and Bulgaria (33%). Except for Belgium and the Netherlands, these were relatively small political science communities producing a limited number of publications. The European average was 17%. In the following decade, MCP grew to 27% of the total production on the average. They were 20% or more of the total scientific production in the large majority of European countries, with just eight exceptions.<sup>7</sup> In relative terms, MCP had increased massively in most European countries. In 2010–2019, they were between four and five times as numerous as in the previous decade in Italy, Switzerland, France and Finland; and between five and eight times more numerous in Denmark, Spain, Sweden, Austria, Portugal and Hungary.

International collaborative publications seem to have been an important component of the general growth of the international scientific production between the two decades. This was a generalised tendency in the large majority of national political science communities. It was certainly so in European countries, where the change was indeed even more marked. These figures complement the description of a growing presence of Europe-based political scientists in the international political science scholarship, with a broader and more diverse geographic basis and a parallel massive increase in collaborative publications. International collaborative research seems to be establishing itself as a key engine for scientific production, in Europe as well as globally. The next section discusses how international collaboration works in practice, and how it has changed along the two decades observed.

## Country collaboration network analysis

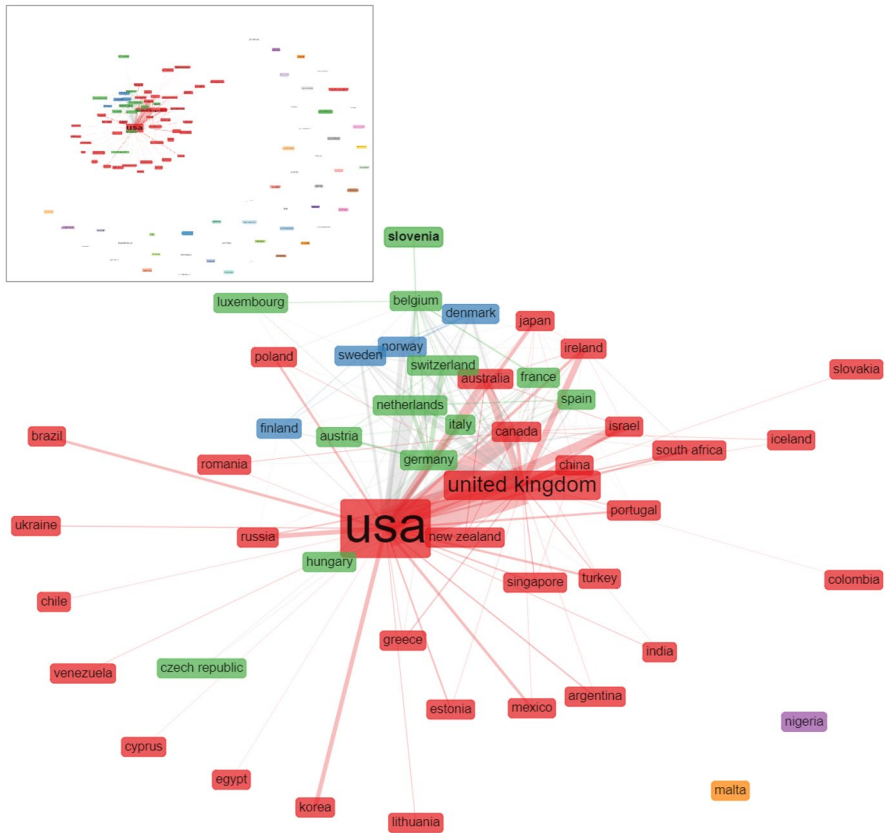
Social network analysis permits to look closely into actual patterns of international cooperation. Single countries can be represented as nodes in a network of country collaborations, as in Figs. 3 and 4. Two countries are connected if at least one article was co-authored by scholars working in institutions based in those countries. The higher the number of co-authorships between scholars based in two countries, the stronger the connection between those countries (and the larger the edge joining the related nodes in the network).

Several indicators of connectedness and centrality can be used to obtain a deeper understanding of the network configuration. Table 1 presents some aggregate network-level indicators describing the internal structure of the network and its development over time. Tables 2 and 3 instead provide core network statistics at the level

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<sup>7</sup> These were the UK (where the rate was 19%, and the relatively smaller involvement in international publications was clearly the result of a very strong internal capacity, as well as established domestic collaborations), Poland, Romania and Latvia (where it was still around 15% or more); and Lithuania, Croatia and Albania where international collaborative publications were almost or entirely absent.





**Fig. 3** Country collaboration network, 2000–2009. Entire network in the inset, and fifty most connected countries zoomed in in the chart

of single countries for the 50 nodes with the higher degree (most connections) in the network. Statistics about all countries are shown in Tables 10 and 11 in the Appendix that also include some additional indicators of centrality.

### Structure and evolution of the network

Aggregate network indicators, shown in Table 1 separately for the two decades, consistently point to a broadening and tightening of the network. While it expanded from 106 to 129 countries from the first to the second decade, the network also became twice as densely connected. Despite the larger network size, communication flows (that is, connections between scholars based in different countries) did not become more difficult; the average length of the shortest path connecting two countries actually decreased slightly.







**Table 2** Country collaboration network. Clustering and centrality of single countries within the network. Fifty most connected countries, 2000–2009

Node	Cluster	Degree	Closeness	Betweenness	Authority
USA	1	26,883	0.055	0.3492	1
UK	1	8928	0.0544	0.1173	0.9121
CANADA	1	1869	0.054	0.093	0.7439
AUSTRALIA	1	1082	0.0537	0.0116	0.6658
ISRAEL	1	876	0.0534	0.0167	0.5259
IRELAND	1	785	0.0536	0.0093	0.6127
CHINA	1	423	0.0534	0.0057	0.4183
JAPAN	1	285	0.0533	0.0003	0.3827
NEW ZEALAND	1	278	0.0533	0.0323	0.3109
TURKEY	1	277	0.0532	0.0022	0.3104
RUSSIA	1	265	0.0533	0.0006	0.4392
SOUTH AFRICA	1	229	0.0533	0.0051	0.409
KOREA	1	188	0.053	0	0.2585
SINGAPORE	1	185	0.0532	0.0049	0.3286
MEXICO	1	183	0.0531	0.0015	0.2263
PORTUGAL	1	148	0.0531	0.0004	0.3134
GREECE	1	148	0.053	0.0004	0.2489
BRAZIL	1	141	0.053	0.0017	0.1877
POLAND	1	128	0.053	0.0004	0.2416
ESTONIA	1	88	0.0529	0	0.1629
INDIA	1	69	0.0529	0.0001	0.1364
ARGENTINA	1	69	0.0528	0	0.1105
ICELAND	1	52	0.0531	0.0001	0.2027
SLOVAKIA	1	48	0.0531	0.0001	0.233
CHILE	1	45	0.0529	0	0.1597
ROMANIA	1	42	0.0529	0	0.132
CYPRUS	1	37	0.0528	0	0.1277
EGYPT	1	33	0.0528	0.0001	0.1288
LITHUANIA	1	33	0.0526	0	0.0517
UKRAINE	1	32	0.0527	0	0.0936
VENEZUELA	1	26	0.0527	0	0.0943
GERMANY	2	2093	0.054	0.0517	0.8114
NETHERLANDS	2	1515	0.0538	0.0079	0.7417
ITALY	2	783	0.0538	0.0098	0.7101
SWITZERLAND	2	762	0.0536	0.003	0.6412
BELGIUM	2	631	0.0537	0.0175	0.6446
FRANCE	2	562	0.0535	0.0191	0.5444
SPAIN	2	493	0.0536	0.0101	0.5995
AUSTRIA	2	257	0.0532	0.0013	0.4568
HUNGARY	2	204	0.0534	0.0017	0.4244
CZECH REPUBLIC	2	76	0.0529	0	0.189



**Table 2** (continued)

Node	Cluster	Degree	Closeness	Betweenness	Authority
SLOVENIA	2	63	0.0514	0.0001	0.0361
LUXEMBOURG	2	57	0.0528	0	0.2324
NORWAY	3	871	0.0537	0.0221	0.657
SWEDEN	3	778	0.0536	0.0036	0.5918
DENMARK	3	692	0.0534	0.002	0.4964
FINLAND	3	300	0.0532	0.0008	0.4297
NIGERIA	4	42	0.0094	0	0
MALTA	5	31	0.0517	0	0.0384

from the first to the second decade, which points to the development of more inclusive clusters in the second decade.

Finally, the network became slightly more centralised. Degree centralisation equals one when all nodes connect to a single one, and not to each other (as in a star); it is zero when all nodes are equal (as in a circle). Higher degree centralisation therefore means that there are relatively less very central nodes. This development is consistent with network theory, which sees centralisation as an indicator of network efficiency and posits that while networks grow in size, they will also become more centralised.<sup>9</sup>

What are these best-connected countries? How did the structure of the collaboration network change over time, and what did it mean for the general organisation of international collaborations? To address these questions, we now turn to the descriptive analysis of the network.

## 2000–2009

Let us begin with the network of international collaboration in the period 2000–2009. For ease of visualisation, Fig. 3 zooms in on the more connected core comprising 50 countries; the entire network is shown in the inset. Nodes (countries) are coloured according to the cluster in which they are placed.<sup>10</sup> Table 2 complements the graphical visualisation of the network with several centrality indices for single nodes: the cluster to which countries belong; their degree (number of connections); normalised closeness (the steps required to access every other node); betweenness (brokerage potential, measured as the normalised number of shortest paths crossing each node); and authority (connection to nodes that link many other nodes).

In the first decade, the network of 106 countries hosting scholars who published in the political science journals selected for this study included three main clusters, comprising overall 57 countries. The remaining 49 countries were isolated nodes in the network (as can be seen in the inset of Fig. 3). The main cluster (red in the figure) included 41 countries and had the US—the country scoring highest on all network indicators by far—at the centre. We may call this the global cluster. The

<sup>9</sup> Because of preferential attachment to degree, new nodes will tend to connect to the more connected existing nodes (Barabasi 2014). Preferential attachment to degree creates networks with a power law degree distribution: many nodes with low degree and few nodes with high degree.

<sup>10</sup> I used the Fruchterman & Reingold clustering algorithm. Add reference/weblink?



**Table 3** Country collaboration network. Clustering and centrality of single countries within the network. Fifty most connected countries, 2010–2019

Node	Cluster	Degree	Closeness	Betweenness	Authority
USA	1	40,197	0.4555	0.2835	1
UK	1	20,072	0.4369	0.1655	0.9731
CANADA	1	4570	0.4	0.0644	0.8427
AUSTRALIA	1	3357	0.3902	0.0464	0.7811
CHINA	1	1688	0.3765	0.0056	0.7232
ISRAEL	1	1599	0.3668	0.0036	0.6368
IRELAND	1	1526	0.3844	0.0137	0.8078
TURKEY	1	1053	0.3678	0.0205	0.6274
RUSSIA	1	848	0.3743	0.0043	0.7043
KOREA	1	847	0.3526	0.0004	0.4245
SOUTH AFRICA	1	834	0.371	0.0196	0.5559
JAPAN	1	603	0.3575	0.0025	0.452
SINGAPORE	1	554	0.3657	0.0062	0.57
NEW ZEALAND	1	497	0.3536	0.0019	0.437
MEXICO	1	488	0.3596	0.0015	0.5242
BRAZIL	1	483	0.3699	0.003	0.6696
CHILE	1	356	0.3606	0.002	0.5994
INDIA	1	317	0.3606	0.0093	0.4496
ARGENTINA	1	217	0.3488	0.0004	0.4185
COLOMBIA	1	204	0.3478	0.0011	0.3563
U ARAB EMIR	1	186	0.3413	0.0002	0.2667
CYPRUS	1	156	0.3596	0.0002	0.572
ESTONIA	1	154	0.345	0.0001	0.327
EGYPT	1	122	0.3316	0.0007	0.1447
UKRAINE	1	102	0.3488	0	0.4291
KAZAKHSTAN	1	100	0.3377	0.0011	0.1835
KENYA	1	92	0.3422	0.0006	0.2345
GERMANY	2	8193	0.4063	0.0419	0.9251
SWITZERLAND	2	3336	0.3855	0.0212	0.794
ITALY	2	3252	0.3926	0.0255	0.8568
SPAIN	2	2209	0.3844	0.014	0.7779
FRANCE	2	1854	0.3938	0.0601	0.8238
AUSTRIA	2	1351	0.3754	0.0031	0.7588
PORTUGAL	2	775	0.3721	0.0198	0.716
HUNGARY	2	672	0.3765	0.0031	0.7693
CZECH REPUBLIC	2	536	0.3743	0.0094	0.7164
POLAND	2	509	0.3787	0.0071	0.7797
GREECE	2	478	0.3754	0.003	0.7591
ROMANIA	2	230	0.3606	0.0004	0.6023
SLOVAKIA	2	151	0.3699	0.001	0.6988
SLOVENIA	2	107	0.3556	0.0024	0.5161



**Table 3** (continued)

Node	Cluster	Degree	Closeness	Betweenness	Authority
LITHUANIA	2	99	0.3636	0.0007	0.6086
BULGARIA	2	93	0.3516	0.0001	0.4842
NETHERLANDS	3	5196	0.4	0.0344	0.8832
SWEDEN	3	2964	0.3844	0.008	0.8198
DENMARK	3	2916	0.381	0.0129	0.7737
BELGIUM	3	2517	0.3821	0.0146	0.7678
NORWAY	3	2339	0.3776	0.0138	0.724
FINLAND	3	976	0.3821	0.0096	0.7909
LUXEMBOURG	3	145	0.3432	0	0.2905

UK was the second most central actor in this cluster (and in the broader network), alongside of other countries to which it is historically connected, such as Canada, Australia, New Zealand—as well as Ireland in the first place. This cluster has a few more well-connected countries, notably Israel, China, and Japan.

Importantly, 12 European countries were part of this cluster. In addition to Ireland and the UK, these were Cyprus, Estonia, Greece, Iceland, Latvia, Lithuania, Poland, Portugal, Romania, Russia, Slovakia and Ukraine. Of these, Greece, Portugal and to some extent Estonia had a relatively high degree compared to other countries within the cluster, but limited network centrality and virtually no brokering potential. The other European countries were part of this collaboration cluster primarily because scholars based there had collaborated with colleagues from the main hubs within the cluster.

Most remaining countries within the global cluster were weakly connected in all respects. These included the larger Latin American countries (Argentina, Brazil, Colombia, Chile, Mexico, Venezuela), as well as several African (Burkina Faso, Egypt, Ethiopia, South Africa, Zimbabwe,) Asian (India, Indonesia, Korea, Kyrgyzstan, Philippines, Singapore, Sri Lanka) and Pacific (Fiji) countries. Such countries had a low degree (number of connections) and no brokering capacity; in general, they scored poorly on all connection indices. Overall, they were peripheral to the global cluster and were part of it because of their collaborations with few countries from its core.

Most European countries were part of the two remaining clusters. One larger European cluster included 12 nodes, with Germany and the Netherlands at the centre. They clearly had a key brokering role within the European cluster, being pivotal to collaborations among scholars from many other European countries; but their degree and centrality scores made them actually quite central to the entire network. To a relatively smaller extent, this was also the case for Italy and Switzerland, and less so for Spain and France.

Belgium was a somehow special country within the European cluster. Its betweenness was extremely high compared to its degree (still relatively high compared to the size of the country). Although limited in mass, scholars based in Belgium were able to place themselves at the centre of a tight web of international collaborations, particularly with other European colleagues. Austria and Hungary were



the remaining European countries with a marked degree and some betweenness in the network. The Czech Republic, Slovenia and Luxembourg had some degree but no brokering capacity.

The second cluster of European countries was composed of the Scandinavian countries: Denmark, Finland, Norway and Sweden. Their relatively high degree, as well as the web of collaboration within and outside the cluster, is what placed these countries in a cluster of their own. Among them, Norway, Sweden and Denmark had the higher degree (comparable to such countries as Italy or Switzerland in the main European cluster, or Ireland and Israel in the global cluster) and also a significant centrality. Sweden was second by degree, but it was by far the main hub, both within the cluster and with other countries.

Finally, the network included a set of 49 individual nodes with no systematic relations with any cluster of countries. Scholars based in these countries either did not publish collaborative work with colleagues based in other countries, or (in a smaller number of instances) their collaborations happened mainly or exclusively with single countries. In short, they were not systematically connected to international networks of collaboration for articles published in the top-100 international journals. This set of countries, that constituted about half of the entire network, included eight European countries: Malta, Bulgaria, Serbia, Croatia, Belarus, Moldova, Monaco and Montenegro (in decreasing order of network degree). None of them had any significant centrality or brokering capacity within the overall network.

## 2010–2019

Figure 4 displays the network of country collaborations in the decade 2010–2019. Again, the figure zooms in on the top-50 countries for degree within the network, while the entire network is shown in the inset; single countries are coloured based on the subgroup to which they belong. Indicators of centrality and connectedness of single countries are shown in Table 3 for the 50 most connected countries within the network. Table 8 in the Appendix provides centrality indicators for all countries in the network.

By 2010–2019, the network had expanded in size, but the isolated nodes had decreased both in relative and absolute terms: less than one third of the countries—37 out of 129 countries—were now excluded from collaboration clusters, compared to almost half of the 106 countries composing the network in the previous decade. International collaborations were still organised around three clusters of scholarly communities, and these groupings maintained their overall identity: one global cluster and two (mainly) European clusters. However, all expanded in size and deepened in terms of interactions.

The global cluster expanded to include 62 nodes. The US and UK maintained their centrality within the cluster (as well as within the broader network): their score on degree and centrality measures actually increased markedly in the second decade. Canada and Australia followed, also part of the top-10 most connected, central, and in-between countries in the broader network. More countries within the global cluster became tightly connected (see Table 3). Canada, Australia, Israel, China, Ireland



and Turkey all had a degree (number of international co-authorships) higher than 1000; Russia, South Africa, Korea, Japan, Singapore, Brazil, Mexico and New Zealand higher than 500.

Although significantly lower in network degree, Ireland and Turkey stood out for their high centrality score and brokering capacity within the network (as shown by the betweenness and hub indicators). The latter in particular was rather well connected to many countries in the European cluster, as was the case for some Latin American countries, such as Brazil and Chile. Korea, Japan and Singapore also were quite well connected within the global cluster; less so with countries in the European cluster.

The global cluster included ten European countries (down from fourteen in the previous decade), four of which were European Union members. In addition to the UK and Ireland, European countries in the global cluster were Russia, Cyprus, Estonia, Ukraine, Serbia, Iceland, Croatia, and Belarus. Russian scholars stood out for the scope of their connections with Europe, having co-published with scholars from 18 (other) European countries — a massive increase from the previous decade, when Russian scholars only published collaborative work with scholars from the UK, Germany and Finland. With the partial exception of Cyprus and Estonia, the remaining European countries within the global cluster had limited connections within, and poor or no connection outside of it.

By 2010–2019, most of the scholars from European countries had tightened their collaboration with European colleagues. As a result, the larger European cluster grew to include 20 nodes; up from 12 in the previous decade, and now also comprising three non-European countries (Qatar, Jordan and Venezuela). The top-three countries for connection, authority and centrality within the main European cluster—Germany, Switzerland and Italy—were also among the top-10 most connected countries of the broader network of international collaborations. France was among the top-10 for most centrality indicators, although not for degree. In general, most countries within the European cluster were well connected within and outside of it; relatively less so were scholars in Slovenia, Lithuania and Bulgaria, as well as the three non-European countries.

The second European cluster also grew in size, from four to nine nodes. The four Scandinavian countries were joined by Belgium, Luxembourg, and the Netherlands—another well-connected and internationalised community of scholars—as well as Malta and Mozambique. While no longer a Scandinavian cluster, this was still a Northern European one. Malta was part of it because of some repeated collaborations between a few productive scholars with colleagues in the Netherlands, and Mozambique because of co-authored publications with scholars in Norway and Denmark.<sup>11</sup>

The Northern European cluster was tightly connected internally as well as externally. Scholars based in the countries that were part of this cluster used to

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<sup>11</sup> These countries had a rather limited presence in the top-100 political science journals, so structured collaborations by one or two productive scholars could effectively determine the positioning of the country in one or the other cluster, which seems to be what happened in these cases.



collaborate systematically with colleagues from other countries of the same group. However, this was also a highly internationalised cluster—and a very successful one in terms of scientific production. Three countries—the Netherlands, Sweden, and Denmark—ranked among the world’s top-10 for degree and on most other indicators of centrality and authority. Belgium and Norway followed shortly after.

The Netherlands can be considered an exceptionally successful case. Despite its small size, it ranked fourth globally on most indicators; after the US, the UK and Germany but before Italy, Canada, Australia, or France. Although to a slightly smaller degree, Switzerland, Sweden, Denmark, Belgium and Norway are comparable cases of relatively small but extremely productive and internationalised political science communities. All of them, except Switzerland, were part of the Northern European cluster.

## Conclusions

Based on an original dataset of more than 67,000 articles published in high-impact political science journals between 2000 and 2019, this article has provided a bibliometric analysis of the internationalisation of European political science against the broader context of the global scholarship.

The contribution to the international scientific production, as defined for the purposes of this article, is highly concentrated in relatively few countries. In the decade 2010–2019, scholars based in the US contributed more than 40%, and British scholars 15%, of the total production. However, their combined share of the total production was much smaller than in the previous decade. This was to a large extent a consequence of the growth in the output of European political science communities.

The scientific production grew massively between decades, and it became relatively more evenly distributed among countries. This was especially the case in Europe. In 2010–2019, the UK contributed by about one third to the European scientific production; still a large share, but down from 45% in the previous decade. The publication output more than doubled in all but one of the top-20 European countries, and tripled in five of them.

International collaborative research—in the form of co-authorships between scholars based in different countries—is establishing itself as a key engine of scientific production. This is a generalised global trend, and a sustained one in Europe where publications co-authored by scholars based in different countries accounted for more than one-fourth of the entire output. They were between four and five times as numerous in 2010–2019 as in the previous decade in Italy, Switzerland, France and Finland; and between five and eight times more in Denmark, Spain, Sweden, Austria, Portugal and Hungary.

Over the past two decades, the global political science scholarship has multiplied its output, broadened its geographic basis, and tightened international





collaborations. European political scientists have been central to this development. This is nicely illustrated by the analysis of the international network of country collaborations, which became larger, denser, better connected, and more centralised over time. Three clusters of closer country collaborations were already present in the first observed decade. They all consolidated and increased in size in the second decade. Meanwhile, isolated countries in the network—that is, national scholarly communities publishing in high-ranking journals but with limited or no collaboration with scholars from other countries—went down from almost half to less than one third of the network.

The US and the UK are still central to the global cluster, which comprises almost half of the entire network. European political scientists cluster around two sub-communities: a larger group of scholars based in seventeen countries; and an even more integrated, highly productive and connected core of scholars based in seven Northern European countries.

Against the context of a massively growing scholarly production, and a tightening network of international collaborations, some European countries had an exceptional performance. But all bibliometric indicators consistently point to a generalised growth in the output and internationalisation of the scientific contribution of the European political science community.

## **Appendix**

### **A bibliometric analysis of the internationalisation of political science in Europe**

#### **Sources**

See [Table 4](#)



**Table 4** List of journals included in the analysis, and number of articles by journal in the first and second decade

Journal	2010–19	2000–09
PUBLIC CHOICE	994	898
PS-POLITICAL SCIENCE & POLITICS	957	802
JOURNAL OF POLITICS	954	625
SOCIAL SCIENCE QUARTERLY	925	717
ELECTORAL STUDIES	883	430
JCMS-JOURNAL OF COMMON MARKET STUDIES	882	240
JOURNAL OF EUROPEAN PUBLIC POLICY	867	547
ANNALS OF THE AMER ACAD OF POL AND SOC SCIENCE	753	712
GLOBAL POLICY	711	–
POLITICAL QUARTERLY	707	491
EUROPE-ASIA STUDIES	697	516
POLITICAL RESEARCH QUARTERLY	692	486
WEST EUROPEAN POLITICS	686	461
AMERICAN JOURNAL OF POLITICAL SCIENCE	685	573
EUROPEAN JOURNAL OF POLITICAL ECONOMY	652	99
INTERNATIONAL STUDIES QUARTERLY	637	305
POLITICAL STUDIES	623	392
PUBLIC ADMINISTRATION	608	423
JOURNAL OF CONFLICT RESOLUTION	607	372
DEMOCRATIZATION	604	96
COMPARATIVE POLITICAL STUDIES	602	437
PARTY POLITICS	597	314
SURVIVAL	584	395
POLITICAL PSYCHOLOGY	580	339
CITIZENSHIP STUDIES	569	33
JOURNAL OF PEACE RESEARCH	556	362
POLITICAL GEOGRAPHY	544	355
ENVIRONMENTAL POLITICS	531	283
JOURNAL OF DEMOCRACY	529	540
EUROPEAN JOURNAL OF POLITICAL RESEARCH	506	602
AMERICAN POLITICAL SCIENCE REVIEW	498	412
TERRORISM AND POLITICAL VIOLENCE	485	277
PARLIAMENTARY AFFAIRS	477	425
NATIONS AND NATIONALISM	464	55
LOCAL GOVERNMENT STUDIES	463	298
BRITISH JOURNAL OF POLITICAL SCIENCE	446	326
REVIEW OF AFRICAN POLITICAL ECONOMY	442	45
GEOPOLITICS	436	88
REVIEW OF INTERNATIONAL POLITICAL ECONOMY	436	274
JOURNAL OF PUBL ADMIN RES AND THEORY	430	236
AMERICAN POLITICS RESEARCH	421	297



**Table 4** (continued)

Journal	2010–19	2000–09
PUBLIC OPINION QUARTERLY	417	323
JOURNAL OF EUROPEAN INTEGRATION	416	–
NEW POLITICAL ECONOMY	401	161
BRIT JOURNAL OF POLITICS & INTERNAT RELAT	392	77
INTERNATIONAL POLITICAL SCIENCE REVIEW	381	198
POLITICAL BEHAVIOR	378	179
JOURNAL OF STRATEGIC STUDIES	374	288
ARMED FORCES & SOCIETY	370	261
COMPARATIVE EUROPEAN POLITICS	366	38
CAMBRIDGE REVIEW OF INTERNATIONAL AFFAIRS	362	58
SOCIAL MOVEMENT STUDIES	352	–
POLICY STUDIES JOURNAL	347	383
POLICY AND POLITICS	337	309
COMMUNIST AND POST-COMMUNIST STUDIES	332	251
NEW LEFT REVIEW	328	341
GOVERNANCE-INT J OF POLICY ADMIN AND INSTITS	327	125
EUROPEAN POLITICAL SCIENCE	326	63
HUMAN RIGHTS QUARTERLY	319	298
EUROPEAN UNION POLITICS	306	155
POLITICAL ANALYSIS	303	161
PROBLEMS OF POST-COMMUNISM	302	296
POLITICS	299	51
SOCIO-ECONOMIC REVIEW	299	21
CONTEMPORARY POLITICS	298	–
PERSPECTIVES ON POLITICS	298	72
INTERN JOURNAL OF PUBL OP RES	296	244
INTERN ENVIRONM AGREEMNTS-POL LAW AND EC	294	38
AFRICAN AFFAIRS	288	226
JOURNAL OF HUMAN RIGHTS	287	44
POLITICAL COMMUNICATION	286	225
REGULATION & GOVERNANCE	281	59
INTERNATIONAL ORGANIZATION	278	241
SOUTH EUROPEAN SOCIETY AND POLITICS	272	75
PUBLIUS-THE JOURNAL OF FEDERALISM	271	261
JOURNAL OF INTERN RELAT AND DEVELOPM	268	47
POLITICAL THEORY	264	245
GLOBAL ENVIRONMENTAL POLITICS	260	90
MEDITERRANEAN POLITICS	257	46
POLITICAL STUDIES REVIEW	257	26
INTERNATIONAL JOURNAL OF PRESS-POLITICS	254	40
COOPERATION AND CONFLICT	253	71
COMPARATIVE POLITICS	248	202



**Table 4** (continued)

Journal	2010–19	2000–09
INTERNATIONAL STUDIES REVIEW	247	49
GOVERNMENT AND OPPOSITION	245	224
INTERN J OF TRANSITIONAL JUSTICE	243	65
LATIN AMERICAN POLITICS AND SOCIETY	242	170
JOURNAL OF POLITICAL PHILOSOPHY	241	229
POLITICS & GENDER	241	70
ACTA POLITICA	236	98
LEGISLATIVE STUDIES QUARTERLY	236	240
SWISS POLITICAL SCIENCE REVIEW	235	103
ANNUAL REVIEW OF POLITICAL SCIENCE	222	134
STATE POLITICS & POLICY QUARTERLY	221	97
POST-SOVIET AFFAIRS	209	136
POLITICAL SCIENCE QUARTERLY	202	192
STUDIES IN COMPARAT INTERNAT DEVELOPMENT	202	164
POLITICS & SOCIETY	200	171
SCANDINAVIAN POLITICAL STUDIES	185	180
WORLD POLITICS	185	136

### Contribution to the international scientific production

See Tables 5 and 6

The Shannon index has been developed in information theory and is used across disciplines (including in political science, [Boydston et al. 2014](#)) to measure diversity in distributions. Shannon's index is normalised in Table 4 so that it would take the value of one in case of equal distribution (that is, if authors were spread in equal number across countries), while a value of zero would indicate full concentration (if all authors were based in a single country). As can be seen, Shannon is markedly higher in the second than in the first decade; and this is even more the case when we look at scientific production in the European subset of countries.



**Table 5** Global scientific production, top-20 countries

2010–2019			2000–2009		
Country	<i>n</i>	Share	Country	<i>n</i>	Share
USA	28,455	0.41	USA	17,577	0.55
UNITED KINGDOM	10,678	0.15	UNITED KINGDOM	4850	0.15
GERMANY	4231	0.06	GERMANY	1042	0.03
NETHERLANDS	2522	0.04	NETHERLANDS	763	0.02
CANADA	2284	0.03	CANADA	955	0.03
AUSTRALIA	1622	0.02	AUSTRALIA	533	0.02
ITALY	1559	0.02	ITALY	383	0.01
SWITZERLAND	1559	0.02	SWITZERLAND	381	0.01
SWEDEN	1535	0.02	SWEDEN	379	0.01
DENMARK	1279	0.02	DENMARK	343	0.01
BELGIUM	1193	0.02	BELGIUM	298	0.01
NORWAY	1122	0.02	NORWAY	474	0.01
SPAIN	1113	0.02	SPAIN	256	0.01
FRANCE	896	0.01	FRANCE	298	0.01
ISRAEL	870	0.01	ISRAEL	475	0.01
CHINA	846	0.01	CHINA	204	0.01
IRELAND	662	0.01	IRELAND	387	0.01
AUSTRIA	558	0.01	AUSTRIA	114	0.00
TURKEY	517	0.01	TURKEY	142	0.00
FINLAND	477	0.01	FINLAND	154	0.00



**Table 6** European scientific production, top-20 countries

2010–2019 eur			2000–2009 eur		
Country	<i>n</i>	Share	Country	<i>n</i>	Share
UNITED KINGDOM	10,678	0.34	UNITED KINGDOM	4850	0.45
GERMANY	4231	0.13	GERMANY	1042	0.10
NETHERLANDS	2522	0.08	NETHERLANDS	763	0.07
ITALY	1559	0.05	NORWAY	474	0.04
SWITZERLAND	1559	0.05	IRELAND	387	0.04
SWEDEN	1535	0.05	ITALY	383	0.04
DENMARK	1279	0.04	SWITZERLAND	381	0.04
BELGIUM	1193	0.04	SWEDEN	379	0.04
NORWAY	1122	0.04	DENMARK	343	0.03
SPAIN	1113	0.04	BELGIUM	298	0.03
FRANCE	896	0.03	FRANCE	298	0.03
IRELAND	662	0.02	SPAIN	256	0.02
AUSTRIA	558	0.02	FINLAND	154	0.01
FINLAND	477	0.02	AUSTRIA	114	0.01
PORTUGAL	417	0.01	RUSSIA	111	0.01
RUSSIA	398	0.01	HUNGARY	91	0.01
HUNGARY	285	0.01	GREECE	77	0.01
CZECH REPUBLIC	231	0.01	PORTUGAL	73	0.01
POLAND	222	0.01	POLAND	58	0.01
GREECE	174	0.01	CZECH REPUBLIC	38	0.00

See Tables 7 and 8

**Table 7** Indicators of concentration of the international scientific production in the two decades

	2000–2009	2010–2019
Number of countries—all	106	129
Number of countries—European	38	40
Shannon index—all countries	0.42	0.51
Shannon index—European countries	0.50	0.67

**Table 8** International publications. Average country collaborations indices and change

	2010–2019	2000–2009	Growth
All	0.25	0.19	5.26
Europe	0.20	0.25	5.19
All top-10	0.15	0.26	4.10
European top-10	1.60	0.26	5.65



## **Participation in international collaborative publications**

Comparing MCP publications among countries is not straightforward. On the one hand, big scholarly communities tend to be integrated in the international community; the scholars based there may have more resources and opportunities to collaborate internationally. On the other hand, relatively smaller and/or less internationally productive scientific communities have stronger incentives to pursue international collaborations, also in order to get access to more opportunities and resources. For several small scholarly communities, MCP represents most or all of their entire scholarly production.

For the same reasons, comparing MCP between European and non-European countries should be done with caution. Several European countries tend to be large contributors to the international scientific production. Therefore, national political science communities in Europe are on the average much larger than scholarly communities in non-European countries, which may bias the comparison. The difference between European and non-European averages should be read against this background. Although rather high in absolute numbers and as a proportion of total publications, in 2010–2019, the average share of MCP was smaller in European countries than in the rest of the world—but it had increased massively from the previous decade. The extent and increase of MCP in Europe can be better appreciated if we compare the top-10 European and the top-10 non-European countries, as in Table 5.

See Table 9



**Table 9** Single-country publications (SCP) and multiple country publications (MCP), top-35 countries, 2010–2019

Country	SCP	MCP	Tot	MCP/Tot	SCP change	MCP change	Tot change
USA	14,655	1770	16,425	0.11	0.25	1.71	0.33
UK	5598	1319	6917	0.19	0.66	3.19	0.88
GERMANY	1763	579	2342	0.25	1.97	3.29	2.22
NETHRLNDS	1058	419	1477	0.28	1.56	2.99	1.85
CANADA	1063	342	1405	0.24	0.85	2.08	1.05
AUSTRALIA	745	256	1001	0.26	1.37	2.88	1.63
ITALY	615	250	865	0.29	1.86	4.56	2.33
SWITZERL	612	247	859	0.29	1.81	4.49	2.27
DENMARK	636	214	850	0.25	1.63	7.56	2.18
SWEDEN	675	164	839	0.20	1.67	5.07	2.00
BELGIUM	482	187	669	0.28	2.13	3.25	2.38
NORWAY	469	151	620	0.24	0.81	2.87	1.08
SPAIN	394	178	572	0.31	1.83	6.12	2.49
CHINA	379	136	515	0.26	2.95	3.86	3.15
ISRAEL	386	123	509	0.24	0.42	1.37	0.58
FRANCE	325	142	467	0.30	0.91	4.68	1.39
IRELAND	337	107	444	0.24	0.31	1.43	0.48
TURKEY	269	62	331	0.19	1.72	9.33	2.15
AUSTRIA	216	108	324	0.33	2.38	8.82	3.32
FINLAND	227	64	291	0.22	1.08	4.82	1.43
KOREA	186	68	254	0.27	3.77	6.56	4.29
PORTUGAL	143	68	211	0.32	3.61	5.18	4.02
SOUTH AFR	158	42	200	0.21	1.55	5.00	1.90
RUSSIA	137	37	174	0.21	1.54	2.70	1.72
HUNGARY	115	47	162	0.29	0.92	6.83	1.45
CZECH REP	112	32	144	0.22	3.15	31.00	4.14
SINGAPORE	113	31	144	0.22	1.05	2.44	1.25
JAPAN	112	27	139	0.19	0.38	2.38	0.56
POLAND	114	23	137	0.17	3.75	2.29	3.42
NEW ZEAL	87	44	131	0.34	0.24	1.93	0.54
MEXICO	81	32	113	0.28	0.56	5.40	0.98
BRAZIL	77	29	106	0.27	1.26	2.22	1.47
GREECE	71	26	97	0.27	0.45	1.89	0.67
CHILE	56	30	86	0.35	3.00	29.00	4.73
INDIA	52	19	71	0.27	1.48	5.33	1.96

Countries are ranked by Tot (SCP+ MPC) number of publications

MCP/Tot: share of multiple country publications on total publications

SCP change: relative increment of single-country publications from previous decade

MCP change: relative increment of multiple country publications from previous decade

Tot change: increment of publications from previous decade





## Country collaboration network. Clustering and centrality Indices

See Tables 10 and 11

**Table 10** Country collaboration network. Clustering and centrality of single countries within the network. All countries, 2000–2009

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
USA	1	26,883	0.6667	0.0550	0.3492	0.0979	1.0000
UK	1	8928	0.4667	0.0544	0.1173	0.0585	0.9121
CANADA	1	1869	0.3238	0.0540	0.0930	0.0437	0.7439
AUSTRALIA	1	1082	0.2286	0.0537	0.0116	0.0262	0.6658
ISRAEL	1	876	0.1619	0.0534	0.0167	0.0196	0.5259
IRELAND	1	785	0.2095	0.0536	0.0093	0.0248	0.6127
CHINA	1	423	0.1524	0.0534	0.0057	0.0185	0.4183
JAPAN	1	285	0.1048	0.0533	0.0003	0.0128	0.3827
NEW ZEALAND	1	278	0.1048	0.0533	0.0323	0.0158	0.3109
TURKEY	1	277	0.1048	0.0532	0.0022	0.0134	0.3104
RUSSIA	1	265	0.1238	0.0533	0.0006	0.0145	0.4392
SOUTH AFRICA	1	229	0.1238	0.0533	0.0051	0.0153	0.4090
KOREA	1	188	0.0667	0.0530	0.0000	0.0085	0.2585
SINGAPORE	1	185	0.1048	0.0532	0.0049	0.0138	0.3286
MEXICO	1	183	0.0762	0.0531	0.0015	0.0107	0.2263
PORTUGAL	1	148	0.0857	0.0531	0.0004	0.0108	0.3134
GREECE	1	148	0.0667	0.0530	0.0004	0.0089	0.2489
BRAZIL	1	141	0.0667	0.0530	0.0017	0.0102	0.1877
POLAND	1	128	0.0667	0.0530	0.0004	0.0090	0.2416
ESTONIA	1	88	0.0381	0.0529	0.0000	0.0058	0.1629
INDIA	1	69	0.0381	0.0529	0.0001	0.0060	0.1364
ARGENTINA	1	69	0.0286	0.0528	0.0000	0.0050	0.1105
ICELAND	1	52	0.0476	0.0531	0.0001	0.0069	0.2027
SLOVAKIA	1	48	0.0571	0.0531	0.0001	0.0077	0.2330
CHILE	1	45	0.0476	0.0529	0.0000	0.0070	0.1597
ROMANIA	1	42	0.0286	0.0529	0.0000	0.0049	0.1320
CYPRUS	1	37	0.0381	0.0528	0.0000	0.0060	0.1277
EGYPT	1	33	0.0381	0.0528	0.0001	0.0057	0.1288
LITHUANIA	1	33	0.0095	0.0526	0.0000	0.0028	0.0517
UKRAINE	1	32	0.0190	0.0527	0.0000	0.0038	0.0936
VENEZUELA	1	26	0.0286	0.0527	0.0000	0.0049	0.0943
COLOMBIA	1	24	0.0286	0.0528	0.0000	0.0048	0.1297
LATVIA	1	24	0.0286	0.0527	0.0000	0.0047	0.1083
PHILIPPINES	1	16	0.0095	0.0510	0.0000	0.0029	0.0161
KYRGYZSTAN	1	15	0.0476	0.0529	0.0000	0.0070	0.1597
ETHIOPIA	1	13	0.0190	0.0527	0.0000	0.0041	0.0614
ZIMBABWE	1	12	0.0095	0.0526	0.0000	0.0028	0.0517



Table 10 (continued)

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
SRI LANKA	1	11	0.0190	0.0528	0.0000	0.0039	0.0901
INDONESIA	1	10	0.0286	0.0527	0.0012	0.0054	0.0721
BURK FASO	1	6	0.0095	0.0517	0.0000	0.0027	0.0384
FIJI	1	6	0.0095	0.0526	0.0000	0.0028	0.0517
GERMANY	2	2093	0.3333	0.0540	0.0517	0.0405	0.8114
NETHERLANDS	2	1515	0.2571	0.0538	0.0079	0.0287	0.7417
ITALY	2	783	0.2571	0.0538	0.0098	0.0290	0.7101
SWITZERLAND	2	762	0.2000	0.0536	0.0030	0.0225	0.6412
BELGIUM	2	631	0.2190	0.0537	0.0175	0.0256	0.6446
FRANCE	2	562	0.1714	0.0535	0.0191	0.0212	0.5444
SPAIN	2	493	0.2095	0.0536	0.0101	0.0249	0.5995
AUSTRIA	2	257	0.1429	0.0532	0.0013	0.0166	0.4568
HUNGARY	2	204	0.1238	0.0534	0.0017	0.0149	0.4244
CZECH REP	2	76	0.0476	0.0529	0.0000	0.0067	0.1890
SLOVENIA	2	63	0.0190	0.0514	0.0001	0.0046	0.0361
LUXEMBOURG	2	57	0.0571	0.0528	0.0000	0.0075	0.2324
NORWAY	3	871	0.2286	0.0537	0.0221	0.0272	0.6570
SWEDEN	3	778	0.1905	0.0536	0.0036	0.0217	0.5918
DENMARK	3	692	0.1429	0.0534	0.0020	0.0168	0.4964
FINLAND	3	300	0.1238	0.0532	0.0008	0.0145	0.4297
NIGERIA	4	42	0.0000	0.0094	0.0000	0.0016	0.0000
MALTA	5	31	0.0095	0.0517	0.0000	0.0027	0.0384
BULGARIA	6	22	0.0381	0.0529	0.0000	0.0058	0.1464
GEORGIA	7	17	0.0095	0.0526	0.0000	0.0028	0.0517
BOTSWANA	8	16	0.0190	0.0521	0.0000	0.0037	0.0682
GHANA	9	13	0.0095	0.0526	0.0000	0.0028	0.0517
UGANDA	10	14	0.0190	0.0527	0.0000	0.0038	0.0856
KENYA	11	12	0.0190	0.0527	0.0000	0.0038	0.0798
MOROCCO	12	12	0.0000	0.0094	0.0000	0.0016	0.0000
THAILAND	13	15	0.0286	0.0522	0.0003	0.0052	0.0678
LEBANON	14	11	0.0095	0.0512	0.0000	0.0026	0.0281
SERBIA	15	12	0.0190	0.0527	0.0027	0.0048	0.0535
BANGLADESH	16	9	0.0286	0.0522	0.0000	0.0046	0.1031
MALAYSIA	17	9	0.0095	0.0526	0.0000	0.0028	0.0517
IRAN	18	6	0.0000	0.0094	0.0000	0.0016	0.0000
KAZAKHSTAN	19	8	0.0190	0.0528	0.0000	0.0038	0.0988
MALAWI	20	7	0.0095	0.0514	0.0000	0.0026	0.0339
U ARAB EMIR	21	6	0.0000	0.0094	0.0000	0.0016	0.0000
COSTA RICA	22	5	0.0095	0.0526	0.0000	0.0028	0.0517
CROATIA	23	4	0.0000	0.0094	0.0000	0.0016	0.0000
KUWAIT	24	4	0.0000	0.0094	0.0000	0.0016	0.0000
OMAN	25	6	0.0190	0.0527	0.0000	0.0038	0.0833
PAKISTAN	26	5	0.0095	0.0517	0.0000	0.0026	0.0419



**Table 10** (continued)

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
SENEGAL	27	5	0.0095	0.0517	0.0000	0.0027	0.0384
SUDAN	28	6	0.0190	0.0527	0.0000	0.0038	0.0833
URUGUAY	29	7	0.0286	0.0528	0.0000	0.0048	0.1297
UZBEKISTAN	30	7	0.0286	0.0528	0.0000	0.0049	0.1113
BELARUS	31	3	0.0095	0.0517	0.0000	0.0027	0.0384
BOLIVIA	32	3	0.0095	0.0526	0.0000	0.0028	0.0517
CAMBODIA	33	2	0.0000	0.0094	0.0000	0.0016	0.0000
CAMEROON	34	2	0.0000	0.0094	0.0000	0.0016	0.0000
ECUADOR	35	3	0.0095	0.0517	0.0000	0.0027	0.0384
GAMBIA	36	2	0.0000	0.0094	0.0000	0.0016	0.0000
GUATEMALA	37	3	0.0095	0.0517	0.0000	0.0026	0.0419
IRAQ	38	3	0.0095	0.0526	0.0000	0.0028	0.0517
JAMAICA	39	2	0.0000	0.0094	0.0000	0.0016	0.0000
LESOTHO	40	2	0.0000	0.0094	0.0000	0.0016	0.0000
LIBERIA	41	2	0.0000	0.0094	0.0000	0.0016	0.0000
MADAGASCAR	42	2	0.0000	0.0094	0.0000	0.0016	0.0000
MOLDOVA	43	3	0.0095	0.0512	0.0000	0.0026	0.0272
MONACO	44	3	0.0095	0.0526	0.0000	0.0028	0.0517
MONTENEGRO	45	2	0.0000	0.0094	0.0000	0.0016	0.0000
MOZAMBIQUE	46	4	0.0190	0.0527	0.0000	0.0041	0.0614
NEPAL	47	2	0.0000	0.0094	0.0000	0.0016	0.0000
NICARAGUA	48	3	0.0095	0.0510	0.0000	0.0029	0.0161
NIGER	49	2	0.0000	0.0094	0.0000	0.0016	0.0000
QATAR	50	2	0.0000	0.0094	0.0000	0.0016	0.0000
TANZANIA	51	3	0.0095	0.0521	0.0000	0.0027	0.0471
ZAMBIA	52	3	0.0095	0.0521	0.0000	0.0027	0.0471



**Table 11** Country collaboration network. Clustering and centrality of single countries within the network. All countries, 2010–2019

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
USA	1	40,197	0.7969	0.4555	0.2835	0.0502	1.0000
UK	1	20,072	0.7031	0.4369	0.1655	0.0388	0.9731
CANADA	1	4570	0.4922	0.4000	0.0644	0.0256	0.8427
AUSTRALIA	1	3357	0.4297	0.3902	0.0464	0.0217	0.7811
CHINA	1	1688	0.3359	0.3765	0.0056	0.0153	0.7232
ISRAEL	1	1599	0.2656	0.3668	0.0036	0.0123	0.6368
IRELAND	1	1526	0.3906	0.3844	0.0137	0.0181	0.8078
TURKEY	1	1053	0.2813	0.3678	0.0205	0.0141	0.6274
RUSSIA	1	848	0.3203	0.3743	0.0043	0.0147	0.7043
KOREA	1	847	0.1719	0.3526	0.0004	0.0084	0.4245
SOUTH AFRICA	1	834	0.3047	0.3710	0.0196	0.0159	0.5559
JAPAN	1	603	0.2109	0.3575	0.0025	0.0104	0.4520
SINGAPORE	1	554	0.2734	0.3657	0.0062	0.0131	0.5700
NEW ZEALAND	1	497	0.1953	0.3536	0.0019	0.0096	0.4370
MEXICO	1	488	0.2188	0.3596	0.0015	0.0103	0.5242
BRAZIL	1	483	0.2891	0.3699	0.0030	0.0132	0.6696
CHILE	1	356	0.2578	0.3606	0.0020	0.0119	0.5994
INDIA	1	317	0.2344	0.3606	0.0093	0.0121	0.4496
ARGENTINA	1	217	0.1641	0.3488	0.0004	0.0079	0.4185
COLOMBIA	1	204	0.1484	0.3478	0.0011	0.0076	0.3563
U ARAB EMIR	1	186	0.1094	0.3413	0.0002	0.0059	0.2667
CYPRUS	1	156	0.2266	0.3596	0.0002	0.0104	0.5720
ESTONIA	1	154	0.1250	0.3450	0.0001	0.0064	0.3270
EGYPT	1	122	0.0625	0.3316	0.0007	0.0045	0.1447
UKRAINE	1	102	0.1641	0.3488	0.0000	0.0079	0.4291
KAZAKHSTAN	1	100	0.0781	0.3377	0.0011	0.0049	0.1835
KENYA	1	92	0.1016	0.3422	0.0006	0.0059	0.2345
CROATIA	1	82	0.2109	0.3565	0.0008	0.0099	0.5049
MALAYSIA	1	82	0.1016	0.3413	0.0008	0.0058	0.2238
NIGERIA	1	82	0.0547	0.3290	0.0008	0.0040	0.1083
ICELAND	1	81	0.0859	0.3368	0.0000	0.0048	0.2480
INDONESIA	1	74	0.0703	0.3360	0.0000	0.0042	0.1926
THAILAND	1	73	0.1250	0.3422	0.0008	0.0067	0.2787
PAKISTAN	1	72	0.1016	0.3422	0.0013	0.0060	0.1953
SERBIA	1	66	0.0938	0.3368	0.0038	0.0059	0.1898
PERU	1	63	0.0547	0.3224	0.0001	0.0037	0.1062
LEBANON	1	62	0.0625	0.3342	0.0000	0.0039	0.1842
TANZANIA	1	51	0.0547	0.3307	0.0000	0.0038	0.1211
URUGUAY	1	49	0.0469	0.3282	0.0000	0.0032	0.1254
GEORGIA	1	48	0.0469	0.3274	0.0000	0.0033	0.1211
BANGLADESH	1	47	0.1094	0.3351	0.0011	0.0063	0.1899



**Table 11** (continued)

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
GHANA	1	47	0.0391	0.3299	0.0000	0.0029	0.1121
ECUADOR	1	43	0.0469	0.3257	0.0000	0.0032	0.1357
SRI LANKA	1	37	0.1250	0.3422	0.0020	0.0070	0.2294
UGANDA	1	35	0.0625	0.3325	0.0028	0.0048	0.1098
PHILIPPINES	1	35	0.0469	0.3224	0.0000	0.0032	0.1115
COSTA RICA	1	33	0.0391	0.3290	0.0000	0.0029	0.1178
CAMBODIA	1	28	0.0859	0.3377	0.0004	0.0050	0.2009
NEPAL	1	28	0.1016	0.3333	0.0009	0.0059	0.1813
ZIMBABWE	1	25	0.0391	0.3274	0.0000	0.0032	0.0821
AZERBAIJAN	1	24	0.0156	0.3160	0.0000	0.0019	0.0459
SIERRA LEONE	1	23	0.0469	0.3333	0.0000	0.0033	0.1346
BELARUS	1	21	0.0469	0.3316	0.0000	0.0032	0.1375
RWANDA	1	20	0.0547	0.3307	0.0003	0.0038	0.1095
VIETNAM	1	19	0.0391	0.3325	0.0000	0.0030	0.1185
MALAWI	1	19	0.0469	0.3290	0.0001	0.0037	0.0921
TUNISIA	1	18	0.0313	0.3200	0.0000	0.0027	0.0782
IRAQ	1	14	0.0391	0.3122	0.0000	0.0029	0.0843
SENEGAL	1	11	0.0156	0.3241	0.0000	0.0020	0.0527
GUATEMALA	1	11	0.0078	0.3145	0.0000	0.0016	0.0267
CONGO	1	10	0.0156	0.3160	0.0000	0.0019	0.0461
JAMAICA	1	9	0.0313	0.3282	0.0000	0.0026	0.0945
KUWAIT	1	8	0.0078	0.3145	0.0000	0.0016	0.0267
GERMANY	2	8193	0.5313	0.4063	0.0419	0.0255	0.9251
SWITZERLAND	2	3336	0.3984	0.3855	0.0212	0.0191	0.7940
ITALY	2	3252	0.4453	0.3926	0.0255	0.0212	0.8568
SPAIN	2	2209	0.3906	0.3844	0.0140	0.0183	0.7779
FRANCE	2	1854	0.4531	0.3938	0.0601	0.0237	0.8238
AUSTRIA	2	1351	0.3281	0.3754	0.0031	0.0147	0.7588
PORTUGAL	2	775	0.3125	0.3721	0.0198	0.0150	0.7160
HUNGARY	2	672	0.3359	0.3765	0.0031	0.0149	0.7693
CZECH REP	2	536	0.3203	0.3743	0.0094	0.0150	0.7164
POLAND	2	509	0.3516	0.3787	0.0071	0.0159	0.7797
GREECE	2	478	0.3281	0.3754	0.0030	0.0146	0.7591
ROMANIA	2	230	0.2422	0.3606	0.0004	0.0110	0.6023
SLOVAKIA	2	151	0.2891	0.3699	0.0010	0.0129	0.6988
SLOVENIA	2	107	0.2266	0.3556	0.0024	0.0107	0.5161
LITHUANIA	2	99	0.2500	0.3636	0.0007	0.0114	0.6086
BULGARIA	2	93	0.1953	0.3516	0.0001	0.0091	0.4842
QATAR	2	66	0.0313	0.3274	0.0000	0.0026	0.0982
LATVIA	2	53	0.1875	0.3507	0.0000	0.0087	0.4728
VENEZUELA	2	20	0.0469	0.3316	0.0000	0.0033	0.1256
JORDAN	2	17	0.0234	0.3176	0.0000	0.0024	0.0553



**Table 11** (continued)

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
NETHERLANDS	3	5196	0.4922	0.4000	0.0344	0.0238	0.8832
SWEDEN	3	2964	0.3906	0.3844	0.0080	0.0177	0.8198
DENMARK	3	2916	0.3672	0.3810	0.0129	0.0171	0.7737
BELGIUM	3	2517	0.3750	0.3821	0.0146	0.0178	0.7678
NORWAY	3	2339	0.3438	0.3776	0.0138	0.0165	0.7240
FINLAND	3	976	0.3750	0.3821	0.0096	0.0171	0.7909
LUXEMBOURG	3	145	0.1016	0.3432	0.0000	0.0055	0.2905
MALTA	3	76	0.2188	0.3575	0.0001	0.0100	0.5538
MOZAMBIQUE	3	22	0.0313	0.2922	0.0000	0.0025	0.0740
ARMENIA	4	19	0.0234	0.2889	0.0000	0.0021	0.0626
ETHIOPIA	5	19	0.0234	0.3216	0.0000	0.0023	0.0705
IRAN	6	14	0.0156	0.3160	0.0000	0.0019	0.0503
BAHRAIN	7	14	0.0156	0.3241	0.0000	0.0020	0.0527
MACEDONIA	8	12	0.0156	0.3084	0.0000	0.0019	0.0489
SAUDI ARABIA	9	15	0.0234	0.3114	0.0000	0.0022	0.0548
ALBANIA	10	11	0.0078	0.2700	0.0000	0.0015	0.0168
KOSOVO	11	14	0.0469	0.3114	0.0000	0.0034	0.0835
MOROCCO	12	10	0.0156	0.3099	0.0000	0.0019	0.0480
AFGHANISTAN	13	17	0.0703	0.3325	0.0006	0.0046	0.1107
CAMEROON	14	11	0.0234	0.3122	0.0000	0.0022	0.0687
LAOS	15	14	0.0469	0.3216	0.0000	0.0033	0.0877
SUDAN	16	11	0.0234	0.3168	0.0000	0.0022	0.0705
UZBEKISTAN	17	10	0.0313	0.3160	0.0000	0.0025	0.0846
LIBYA	18	7	0.0078	0.3145	0.0000	0.0016	0.0267
MAURITIUS	19	5	0.0078	0.3145	0.0000	0.0016	0.0267
MOLDOVA	20	7	0.0078	0.2870	0.0000	0.0015	0.0225
ANGOLA	21	5	0.0078	0.2723	0.0000	0.0015	0.0191
BHUTAN	22	12	0.0625	0.3005	0.0001	0.0042	0.0796
BOLIVIA	23	9	0.0391	0.3249	0.0001	0.0030	0.0844
BURK FASO	24	5	0.0078	0.2838	0.0000	0.0015	0.0220
KYRGYZSTAN	25	5	0.0078	0.3145	0.0000	0.0016	0.0267
MONTENEGRO	26	6	0.0156	0.2864	0.0000	0.0019	0.0271
ZAMBIA	27	6	0.0156	0.3084	0.0000	0.0018	0.0476
ALGERIA	28	7	0.0391	0.3249	0.0000	0.0029	0.1176
BELIZE	29	3	0.0078	0.3055	0.0000	0.0015	0.0260
BOTSWANA	30	5	0.0234	0.3077	0.0000	0.0024	0.0438
CUBA	31	16	0.1094	0.3122	0.0000	0.0055	0.2625
FIJI	32	3	0.0078	0.2819	0.0000	0.0015	0.0209
MALI	33	2	0.0000	0.0078	0.0000	0.0012	0.0000
MAURITANIA	34	4	0.0156	0.2922	0.0000	0.0018	0.0432
NICARAGUA	35	3	0.0078	0.3145	0.0000	0.0016	0.0267
OMAN	36	3	0.0078	0.3145	0.0000	0.0016	0.0267



**Table 11** (continued)

Node	Cluster	Degree	Norm degree	Closeness	Betweenness	PageRank	Authority
SAN MARINO	37	3	0.0078	0.2870	0.0000	0.0015	0.0225
SOMALIA	38	3	0.0078	0.3145	0.0000	0.0016	0.0267
SWAZILAND	39	4	0.0156	0.2838	0.0000	0.0020	0.0238
SYRIA	40	4	0.0156	0.2970	0.0000	0.0018	0.0483

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