Multi-affiliation: a growing problem of scientific integrity

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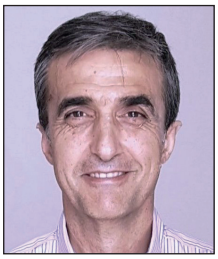

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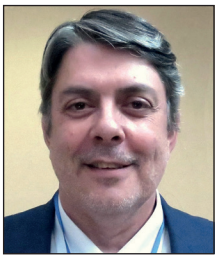

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Abstract

The past decade has witnessed a substantial increase in the number of affiliations listed by individual authors of scientific papers. Some authors now list an astonishing number of institutions, sometimes exceeding 20, 30, or more. This trend raises concerns regarding the genuine scientific contributions these authors make at each institution they claim to be affiliated with. To address this issue, our study conducted a comprehensive regional analysis of the growth of both domestic and international multi-affiliations over the past decade. Our findings reveal certain countries that have experienced an abnormal surge in international multi-affiliation authorships. Coupled with the high numbers of affiliations involved, this emphasizes the need for careful scrutiny of the actual scientific contributions made by these authors and the importance of safeguarding the integrity of scientific output and networks.

Keywords

Multi-affiliation; Authorship; Institutions; Scientific integrity; Scholarly papers; Scientific contributions.

1. Introduction

Multi-affiliation of authors is a phenomenon where authors of a scientific article have multiple affiliations, often from different institutions or organizations. Overall, in recent years there has been a notable increase in the number of authors that have multiple affiliations and in the number of affiliations they hold. A study by Hottenrott *et al.* which covered over 40 million articles and 15 million authors across 40 countries, found that authors with multiple affiliations rose from 10% in 1996 to 16% in 2019 (**Hottenrott**; **Rose**; **Lawson**, 2021).

This phenomenon can be a result of several factors, including the increased complex nature of research which drives collaborations across institutions, whether nationally or internationally (**Gui**; **Liu**; **Du**, 2019; **Sanfilippo**; **Hewitt**; **Mackey**, 2018). A global crisis, such as the COVID-19 pandemic, could also be a driver of large-scale collaborations and as a result an increase in authors having multiple affiliations (**Cai**; **Fry**; **Wagner**, 2021; **Lee**; **Haupt**, 2021). The motivations of authors to belong to more than one affiliation can be driven also for having access to specific networks or funding resources (**Hottenrott**; **Lawson**, 2017; 2022).

While having multiple affiliations is not inherently problematic, it can become an issue when conflicts of interest arise. For example, an author with multiple affiliations may be influenced by the interests of one organization to promote a particular agenda or to downplay certain findings. This can compromise the scientific integrity of the research and raise questions about the accuracy and reliability of the results (**Bachelet** *et al.*, 2019). Another area of concern is compromised ethical behavior especially when authors are paid to be affiliated with an institution to raise its prestige, or when authors try to manipulate the system by adding prestigious affiliations to their name to increase their chances of publication or funding (**Bachelet** *et al.*, 2019; **Bhattacharjee**, 2011).

> "The lack of standardization across publishers and journals of a procedure to require authors to disclose their affiliations and state any conflicts of interest that might arise, has resulted in what has been named "octopus affiliations" where an author lists several affiliations at one time, with which they have insignificant activities"

To address these concerns, both scientific journals and academic institutions are taking practical steps to ensure multiple affiliations are reported ethically and to preserve research integrity. Scientific journals require authors to disclose their affiliations and state any conflicts of interest that might arise from them. This helps increase transparency and accountability in the research process and ensures that readers are aware of any potential conflicts that might influence the research. However, a lack of standardization of this requirement across publishers and journals has resulted in what has been named "octopus affiliations" where an author lists several affiliations at one time, with which they have insignificant activities (**Moustafa**, 2020).

2. Objective

The objective of our study is to draw attention to the increasing trend of authors being affiliated with multiple institutions, both within their country and abroad. Our focus was on the academic affiliations that authors had listed, so that we could demonstrate the extent and scope of this phenomenon within academia.

3. Data and methodology

The data were extracted from *Web of Science Core Collection* on 22nd November 2022, with address unifications from 28th October 2022. The data consists of all editions, including the *Book Citation Indexes* and the *Proceedings Citation Indexes*, but filtered to only include articles and reviews published between 2008 and 2020. Although more than 80% of items in the *Proceedings Indexes* are conference proceedings or meeting abstracts, and so not included in this analysis, many of the rest are articles. In particular, these are predominantly from the physical, chemical and computer sciences. Many items in the *Book Citation Index* include book chapters which are also classified as articles in *Web of Science*, with a particular bias toward the social sciences. This helps to ensure our analysis has applicability to the social sciences as much as to the natural sciences.

Our aim was to tally the affiliations attributed to each author, and extract the highest count for each paper, with a specific emphasis on academic institutions and systems. Although counting the number of addresses linked to each author may appear straightforward, this approach is fraught with several challenges in which a unification of affiliations was needed:

1. Several addresses associated with an author may correspond to a single institution. In this scenario two or more programs or departments in the same institution might be listed. While an author may actually belong to one affiliation, the indexing process for the article may create distinct address entities for each department or program listed.

2. Certain institutions have a hierarchical relationship, such as the campuses of US State universities. Despite an author listing multiple campuses as separate affiliations in their paper, we treated them as a single affiliation due to their shared parent affiliation.

3. Another complication arises when some addresses correspond to multiple independent institutions. This scenario can occur when two academic institutions share a joint institute located at the same address. An illustration of this scenario is the *Harvard-MIT Division of Health Sciences and Technology* in Cambridge, Massachusetts. While this is rightfully affiliated with both *Harvard* and *MIT*, an author listing both it and *Harvard* or *MIT* should be considered as a single affiliation.

4. Conversely, there are cases where an address refers to two distinct unified organizations. One author of a paper listed *Cairo University* and the *German University in Cairo*, both located in Giza, Egypt, in a single address. The author's intention here is unclear. To err on the side of caution, we have adopted a conservative approach where each address is treated as representing a single affiliation.

We addressed these intricate situations with the following algorithm:

1. Each address is represented by a unique identifier based on the given Organization and Country. The rest of the address was ignored, including the city.

2. Each address is also unified to one or more Unified Organizations. These are also represented by a unique identifier linked to the top-most parent in each institutional group. Use of the top-most parent takes care of the parent-child relationship cases.

3. As the Unified Organizations represent the distinct affiliations that we're interested in, we aggregated the unique address IDs associated with each Unified Organization as a set, and then compared these sets to see if they are associated with the same addresses as given by the author. If one such set of address IDs is a subset of another for the same author, we treated them as representing the same affiliation. This takes care of a single address resolving to two distinct Unified Organizations whether through unification, as in case 3 above, or potentially unintentionally, as in case 4.

4. We then count the number of sets of address IDs that remain to give the number of affiliations.

As well as identifying all of the multi-affiliation papers, we also wanted to classify whether the multi-affiliation was international (with affiliations from two or more countries) or intranational (two or more affiliations from the same country). A paper can, of course, be both international and intranational, and, in such cases, be intranational only for some of the countries it is associated with. After processing the data globally, the data were subsequently split by country for further analysis. For this analysis, our final dataset comprised 21 million papers and an aggregate of more than 107 million authors.

4. Findings

Scientific authorship is experiencing a surge in multi-affiliation, particularly on an international scale. The trend is illustrated in Figure 1, which highlights the contrast between intranational and international multiple affiliations among authors. Although there has been a modest increase in intranational multi-affiliations, they have remained relatively consistent compared to international multi-affiliations, which have nearly doubled in just over ten years. Since 2008, intranational multi-affiliations have grown by around 50%, while international multi-affiliations have seen a growth of approximately 100%.

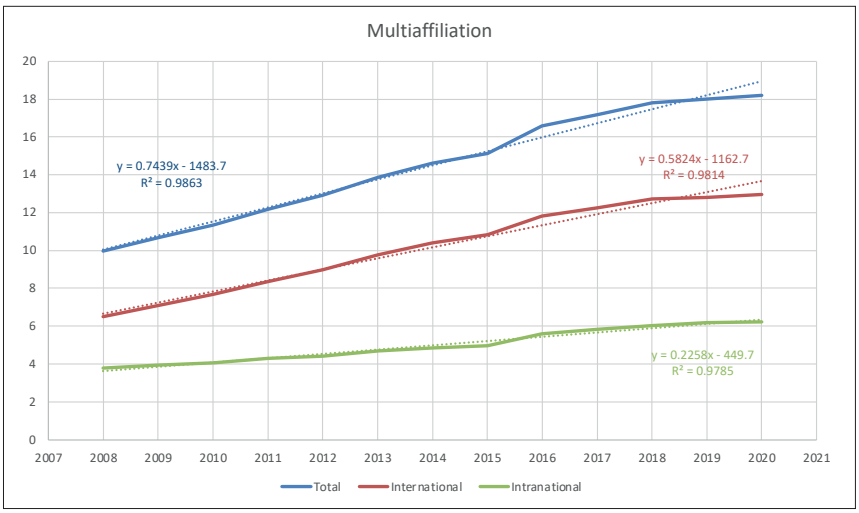

Figure 1. Average weighted by the scientific production of the multi-affiliation percentages of the countries (*WoS* 2008-2020)

These intranational and international multi-affiliation data are not very consistent with those reported by **Hottenrott** *et al.* (2021), in this sense we have to draw attention to the fact that in our study the world production of the University

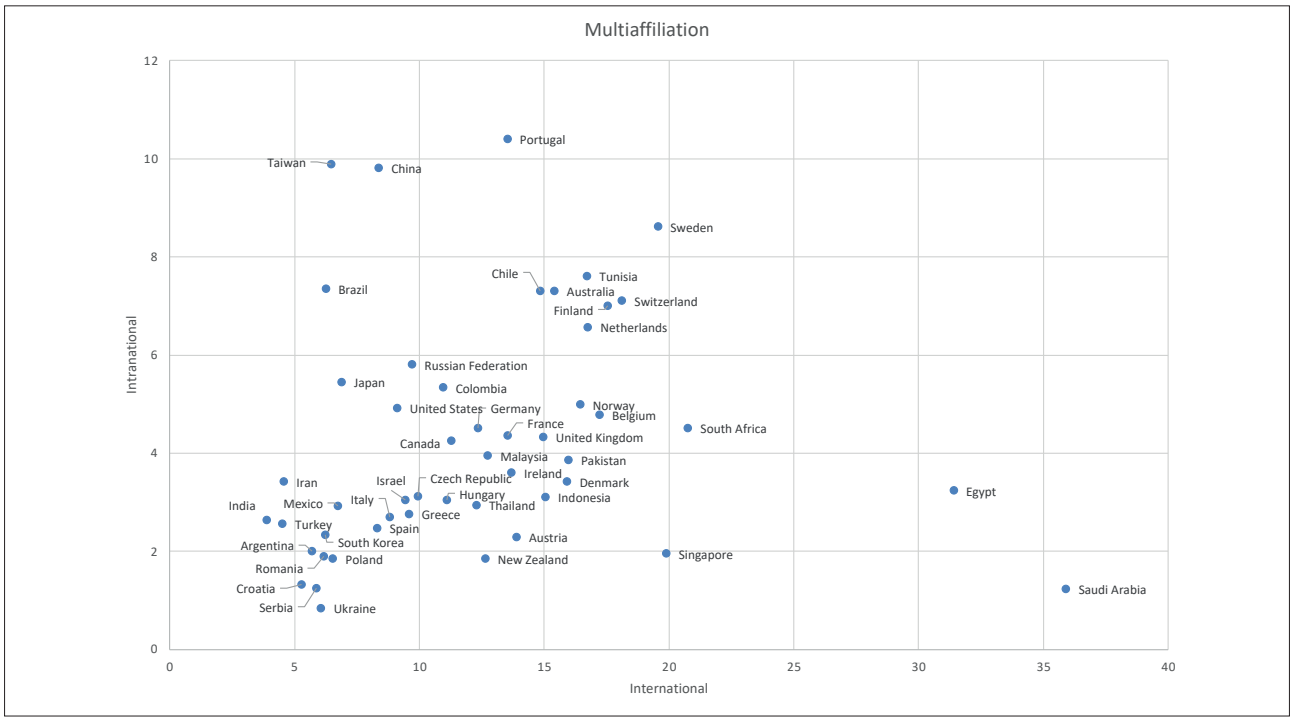

Figure 2. Percentage of international multi-affiliation compared to the percentage of intranational multi-affiliation of the 50 countries with the highest scientific production in the *WoS* in the period 2008-2020

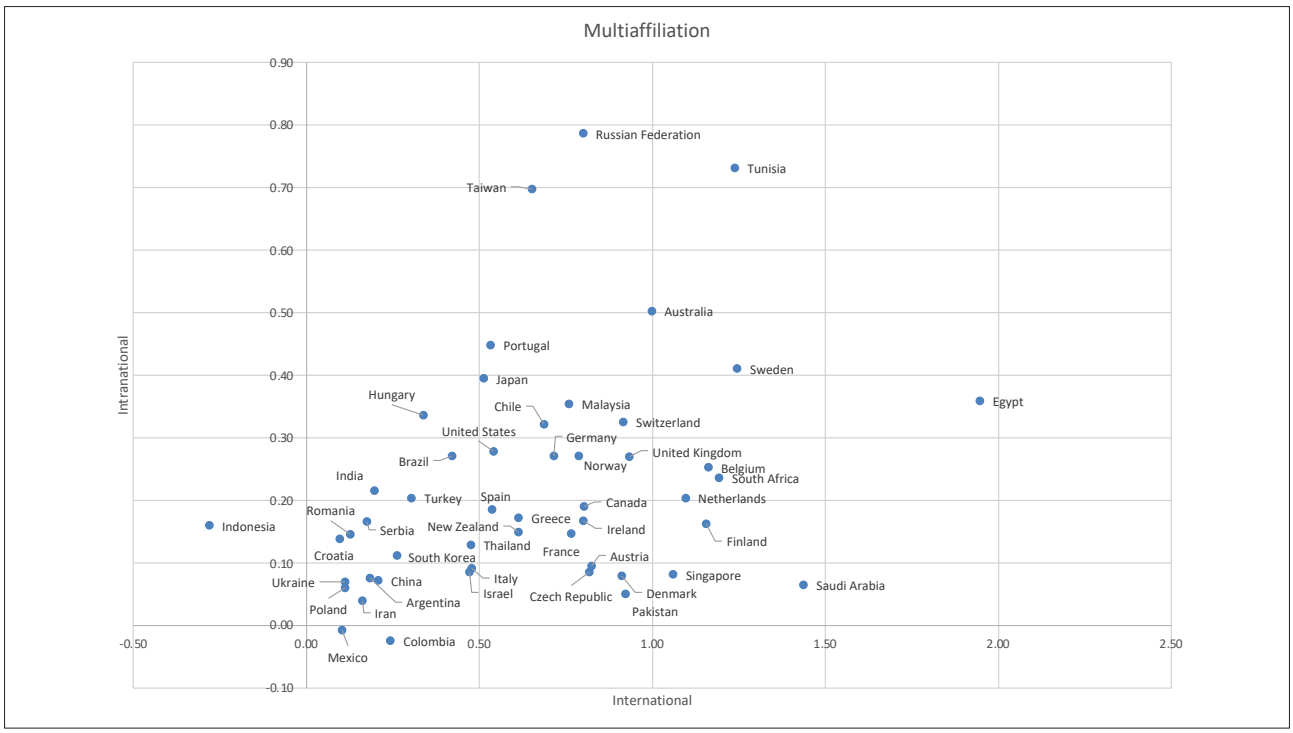

Figure 3. Growth of the percentage of international multi-affiliation (slope of the regression line) compared to the growth of the percentage of intranational multi-affiliation (slope of the regression line) of the 50 countries with the highest scientific production in the *WoS* in the period 2008-2020

sector is analyzed, and above all that, as described in the previous section, a process is carried out to identify affiliations to programs or departments of the same institution or to institutions that share a parent affiliation.

Certain countries such as Egypt and Saudi Arabia exhibit particularly high levels of international multi-affiliation, while Taiwan, China, and Portugal have higher levels of intranational multi-affiliations in comparison. Sweden stands out for having high levels of both international and intranational multi-affiliations (see Figure 2).

Figure 2 also indicates the presence of a distinct group of countries where authors exhibit relatively low levels of both intranational and international multi-affiliations. These include Serbia, Ukraine, Poland, Croatia, Romania, Spain, and South Korea. This could be explained by several reasons. One possibility is that researchers in these countries tend to have a stronger attachment to their primary institutions and may be less likely to establish affiliations with other institutions. Additionally, the funding and incentive structures in these countries may not encourage or reward multi-affiliations, which can result in a lower number of such collaborations. Other factors that may contribute to this pattern could include language barriers, geographic distance, and differences in research culture or priorities between institutions. It's important to note that the reasons for this trend may vary among different countries and would require more specific investigation.

We compared the growth rates of the percentage of international multi-affiliations (based on the slope of the regression line) and the percentage of intranational multi-affiliations (also based on the slope of the regression line) for the period from 2008 to 2020. Figure 3 shows that several countries including Russia, Taiwan and Tunisia demonstrate a high level of growth of intranational multi-affiliations.

This could be attributed to several factors. One possibility is that there has been a greater emphasis on collaboration between institutions within these countries, leading to an increase in intranational multi-affiliations. A good example is Russia which has seen a significant increase in scientific output. Reforms in the science sector and changes to national science policies in Russia have significantly altered the landscape and organization of the country's scientific community, resulting in a notable increase in the number of university faculty members engaged in research and publishing activities nationally and internationally (**Kosyakov**; **Guskov**, 2019). In the case of Taiwan, research has shown that intranational collaboration is relatively more prevalent than international collaboration and that the most common form of collaboration observed is between research institutes and universities (**Liu**; **Chang**; **Chen**, 2012).

Over the next six sections, we provide several examples of countries that exhibit similar trends in terms of both intranational and international multi-affiliations, as well as their overall scientific output.

> For this analysis, our final dataset comprised 21 million papers and an aggregate of more than 107 million authors

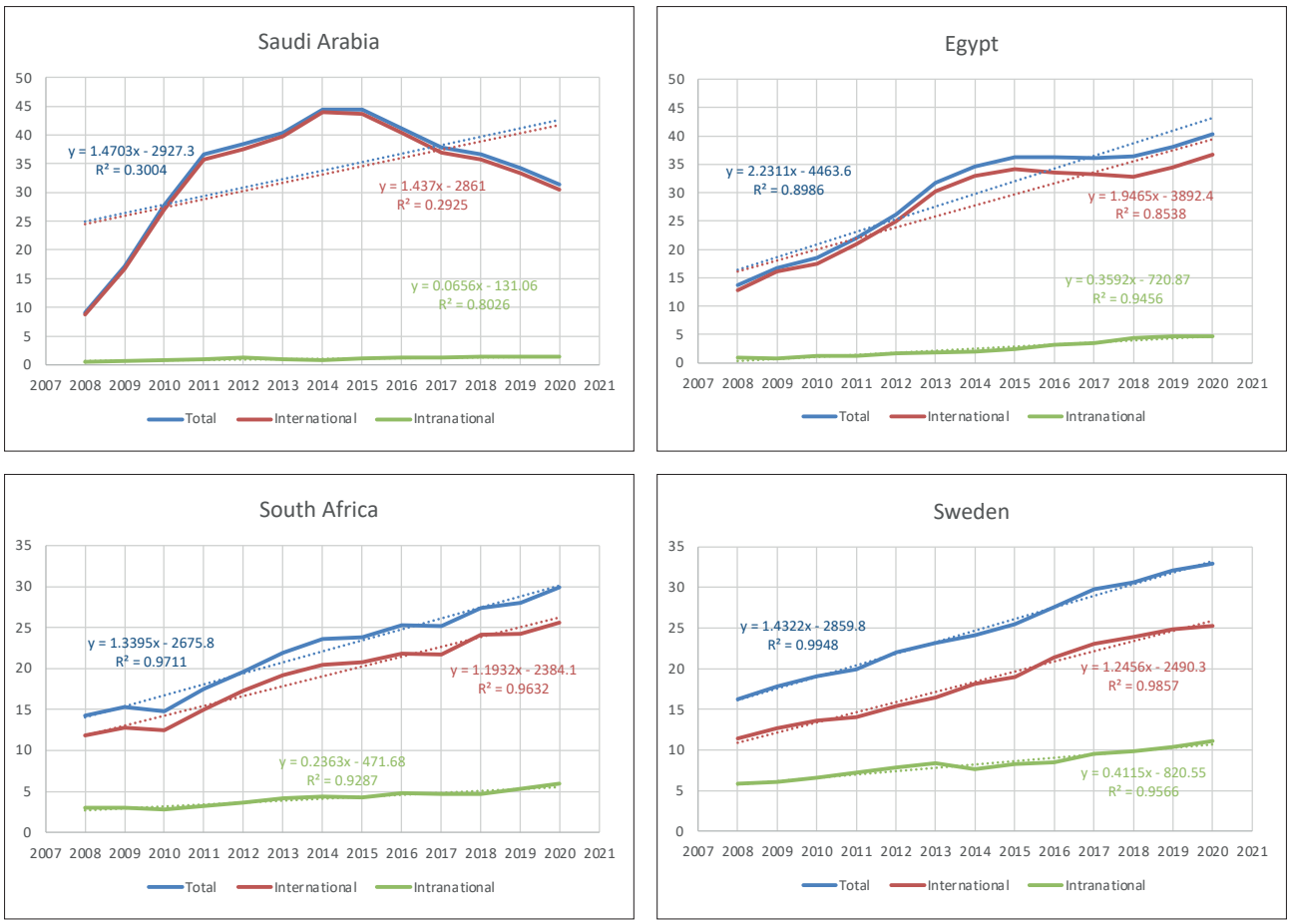

Figure 4. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the countries with the highest percentage (of the 50 countries with the highest scientific production)

4.1. Countries with a high percentage of international multi-affiliations

The first set of countries we examine includes Saudi Arabia, Egypt, South Africa, and Sweden, which display the highest percentage of international multi-affiliations among authors (see Figure 4). Saudi Arabia is particularly noteworthy, as it has experienced a significant growth in its output of international multi-affiliations. In fact, the country experienced an increase by approximately 35 percentage points between 2008 and its peak in 2014, although the percentage has fallen slightly since. Similar trends are observed in Egypt, which has experienced an increase of around 25 percentage points in international multi-affiliations, and South Africa and Sweden, which have both seen increases of around 15 percentage points.

Research conducted by **Landini**, **Malerba** and **Mavilia** (2015) revealed that Northern Africa has experienced an ongoing process of internationalization, leading to an increase in scientific collaborations and research output among international teams. Egypt appears to be the most active country in terms of research output and international collaborations and has become a central hub in the regional research network over time. The increased centrality of Egypt is associated with the growing importance of Saudi Arabia within Egypt's research network, across various research fields and applied science. The study suggests that Northern Africa is undergoing significant changes in the structure and composition of scientific collaborations which could explain the increase in international multi-affiliation authorship. The increase in Saudi international multi-affiliate authorship could also be explained by the finding that some Saudi universities offer cash incentives to faculty members in exchange for academic prestige, such as publishing in high-impact journals or winning prestigious academic awards. This practice has been criticized by some academics and experts who argue that it undermines the integrity of the academic system and creates a culture of incentivized research rather than genuine academic pursuit (**Bhattacharjee**, 2011). In the case of Sweden, a recent article by **Leogrande** *et al.*, shows that Sweden has strong collaborations in Europe where it is a part of a research cluster with Finland, the Netherlands, Austria, Belgium, Cyprus, Norway, Ireland, Luxembourg, United Kingdom, Denmark, and Slovenia which could explain some of the increase in multi-affiliation authorship (**Leogrande** *et al.*, 2022).

> Some Saudi universities offer cash incentives to faculty members in exchange for academic prestige, such as publishing in high-impact journals or winning prestigious academic awards

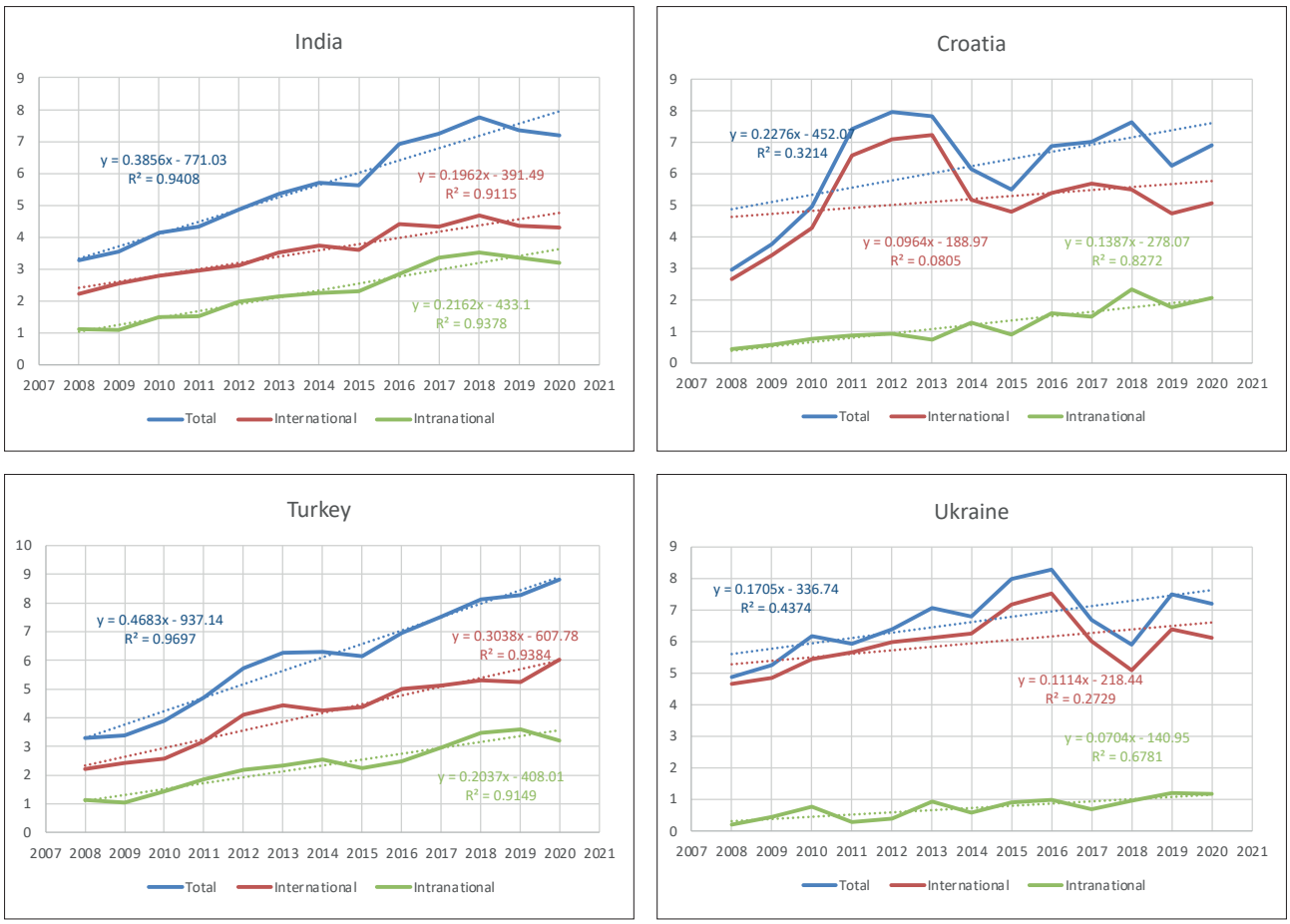

Figure 5. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the countries with the lowest percentage (of the 50 countries with the highest scientific production)

4.2. Countries of low-end multi-affiliation authorships

With the next cluster of countries, we examine instances of low-end multi-affiliation authorships. Figure 5 showcases India, Croatia, Turkey, and Ukraine as the four countries with the lowest total level of multi-affiliation, where we also observe a gradual rise in the number of multi-affiliation authorships. These four countries fall into two main groups, however. Croatia and Ukraine have lower levels of intranational multi-affiliations, a more gradual increase in the growth of such multi-affiliations, and have higher levels of international multi-affiliation authorships compared with Turkey and India. These discrepancies may be attributed to the disparity in the number of scientific institutions within these countries. As per the *Nature Index* (*Institution Tables | Nature Index*, 2017), India is home to 216 scientific institutions, Turkey has 98, while Croatia and Ukraine have 21 and 26 respectively. Due to the relatively limited number of scientific institutions, researchers from Croatia and Ukraine may seek scientific collaborations outside their countries, resulting in a greater number of international multi-affiliations. Compared to Turkey, India demonstrates the least drastic increase in international multi-affiliations authorships.

Despite having a large number of scientific institutions, and an increase in research collaborations with western countries (**Varghese**, 2022), India's relatively less drastic increase in international multi-affiliation authorships could be attributed to several factors. Possible reasons include language barriers, local research priorities, funding limitations, or a preference for working with established local research networks. Additionally, cultural factors, institutional policies, and geographic proximity may also play a role in researchers' inclination to collaborate within the country rather than seeking international affiliations. These factors collectively could contribute to the comparatively slower growth of international multi-affiliation authorships in India.

4.3. Countries that are at the forefront of scientific output

We analyzed the patterns of multi-affiliation authorships in countries that are at the forefront of scientific output. Figure 6 illustrates these trends for the United States, China, United Kingdom, and Germany.

It is noteworthy that China has experienced a slight decline in international multi-affiliations in the last few years, while experiencing an increase in intranational multi-affiliations. In contrast, the United States has been witnessing a gradual rise in international multi-affiliations, which appears to have plateaued over the past four years or so. In contrast to China and the United States, the United Kingdom and Germany are experiencing a significant surge in international multi-affiliations, while their intranational multi-affiliations are increasing more slowly. These findings are in line with previous studies which found similar trends in these countries. **Hottenrott** & **Lawson** (2017; 2022) found that countries and fields with a substan-

Figure 6. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the countries with the highest scientific output

tial non-university research sector tend to have the highest occurrence of cross-sector affiliations. Conversely, countries with a strong international research presence tend to exhibit higher rates of cross-country affiliations.

The occurrence of low cross-sector affiliations combined with limited internationalization, where academic authors primarily affiliate with domestic universities, may be constrained by academic employment contracts that typically impose restrictions on such arrangements (**Hottenrott**; **Lawson**, 2017; 2022).

4.4. Countries with the highest rates of increase in multi-affiliation authorships

Figure 7 presents the countries that exhibit the highest rates of increase in multi-affiliation authorships: Egypt, Tunisia, Russia, and Saudi Arabia. Notably, Saudi Arabia and Egypt both have a substantial disparity between their international and intranational multi-affiliation authorships. While Saudi Arabia's intranational multi-affiliations remain relatively stable, close to 1%, its percentage of international multi-affiliations has undergone a remarkable increase by 35 percentage points between 2008 and 2014. However, a slight downward trend can be observed from 2015 onwards, although the number of international multi-affiliation authorships remains significantly high.

Similar trends to Saudi Arabia are observed in Egypt, where it ranks as the second-largest country in terms of international multi-affiliation authorships, while exhibiting low intranational multi-affiliations. While Tunisia and Russia also demonstrate a large increase in international multi-affiliations, of 15% and 10% respectively over the time period, they also exhibit high levels of growth in their intranational multi-affiliations.

The increase in international multi-affiliations in Tunisia can be attributed to the country's research policies aimed at fostering international research collaborations to enhance its scientific capabilities. Tunisia has signed agreements with several countries to promote scientific cooperation and joint research activities, facilitating the exchange of researchers, knowledge, and resources (*EUR-Lex - 4609295 - EN - EUR-Lex*, n.d.).

In the case of Russia, the rise in international multi-affiliations may be explained by the phenomenon of brain drain. Research by **Subbotin** and **Aref** (2021) indicates that Russia has experienced a significant outflow of specialists across various fields of science between 1996 and 2020. Subfields such as neuroscience, decision sciences, mathematics, biochemistry, pharmacology, chemistry, computer science, chemical engineering, materials science, psychology, medicine, and physics have witnessed a net loss of published researchers (**Subbotin**; **Aref**, 2021).

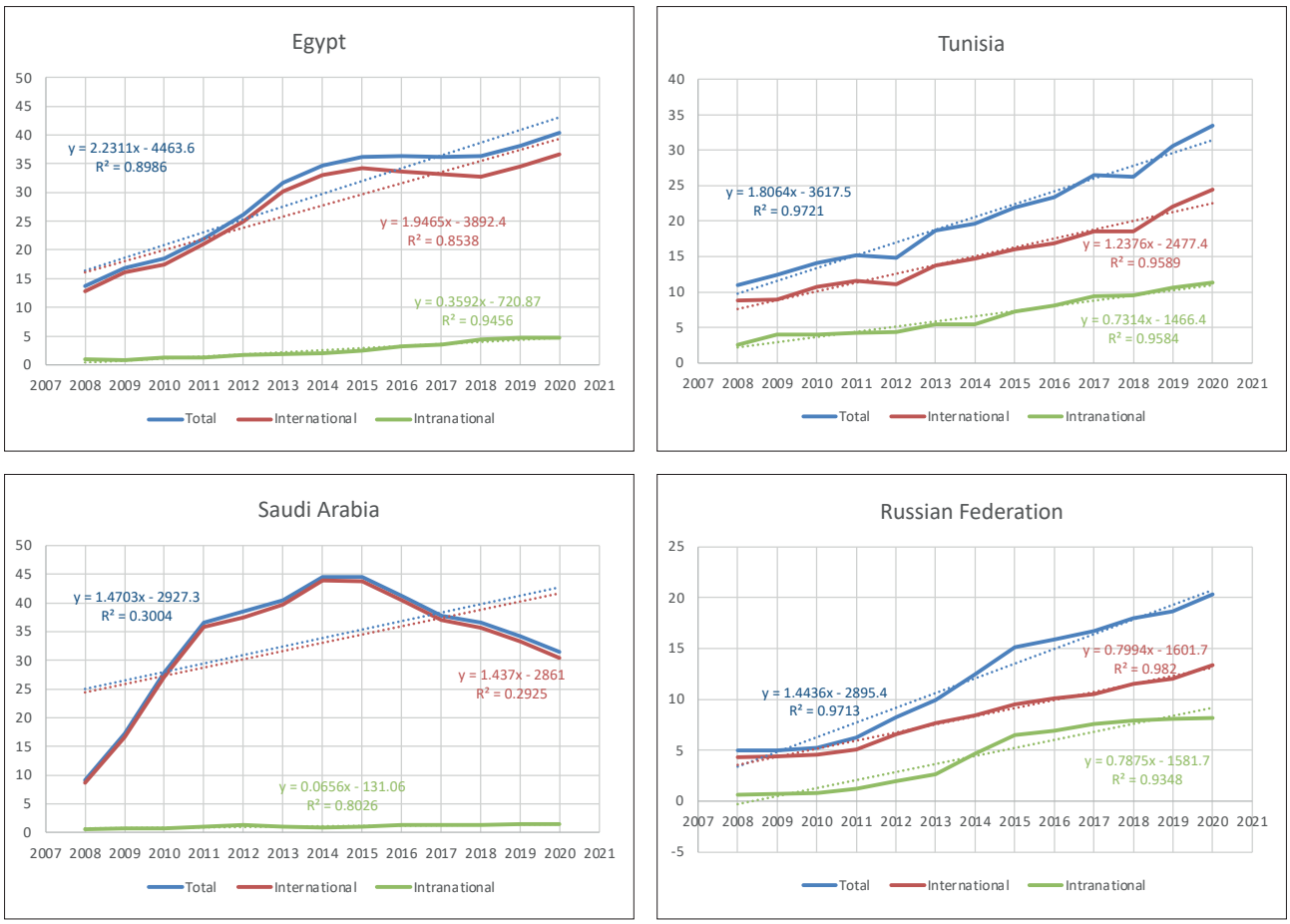

Figure 7. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the countries with the highest multi-affiliation growth (of the 50 countries with the highest scientific production)

4.5. Countries with the lowest growth in multi-affiliate authorships

The four countries with the lowest growth in multi-affiliate authorships are displayed in Figure 8. These include Mexico, Poland, Ukraine, and Iran. A common pattern observed in all four countries is a high proportion of international multi-affiliation authorships coupled with relatively low intranational rates. This is particularly true in the cases of Poland and Ukraine. One possible explanation for this phenomenon could be the relatively lower research output in these countries, which results in a smaller overall number of authors compared to the countries discussed earlier.

In the case of Iran, the relatively low level of international multi-affiliation authorship compared to countries discussed above could be a result of an overall decline in international collaborations. According to a 2019 study by **Sadeh** *et al.* (*The Scientific Output of Iran*, 2019) from 1997 to 2012 there was a continuous decline in the proportion of international collaborations among researchers. However, more recently, starting from 2012 until 2018, there has been a slight upward trend, which can be attributed to the increased presence of Iranians working at universities outside of Iran. Among the papers analyzed, nearly 40% had corresponding authors affiliated with foreign institutions. Half of these authors were scholars who were originally from Iran but are currently employed abroad.

Ukraine is displaying somewhat fluctuating patterns of international multi-affiliations with a peak in 2016 and a dip in 2018 followed by varying numbers of international multi-affiliations since. This could be a result of an overall problematic scientific landscape in the country. According to the *OECD*, in the years leading up to the Russian aggression against Ukraine, the field of science and research in Ukraine underwent a period of transition, characterized by significant structural changes in response to substantial budgetary pressures. The domestic expenditure on research and development (R&D) as a percentage of GDP experienced a decline of approximately one-third between 2013 and 2018. Furthermore, the number of researchers decreased from over 52,000 full-time equivalents in 2013 to 41,000 in 2018. This shift was primarily driven by a sharp decline in the number of researchers employed in business and government institutions (*OECD*, 2022).

The relatively low international multi-affiliations in Poland compared to previously discussed countries could be attributed to the significant scientific brain drain the country experienced in the past decade (**Czerniawska** *et al.*, n. d.). With many highly skilled researchers and scientists leaving the country for better career opportunities abroad, this brain drain has been a cause of concern for the Polish scientific community and the government. According to a report by *OP-Europa*, one of the main factors contributing to this migration is the relatively low salaries and limited career prospects for

Figure 8. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the countries with the lowest growth of multi-affiliation (of the 50 countries with the highest scientific production)

researchers compared to other European countries (*European Commission*, *Directorate General for Education, Youth, Sport and Culture*, 2021). Many Polish scientists, particularly those in the fields of science, technology, engineering, and mathematics (STEM), are attracted to better-funded research institutions and universities in countries such as Germany, the United Kingdom, and the United States.

The same is true for Mexico where limited funding, career prospects and concerns about security, political stability, and quality of life, may influence scientists' decisions to emigrate and thus be affiliated with their country of residence. Another interesting observation made by **Gómez-Flores** *et al.* (2022) while studying the Mexican scientific diaspora was that their surveyed respondents indicated a lack of institutional follow-up on successful collaborations between Mexican and foreign institutions, both in Mexico and abroad. This situation creates challenges for fostering effective collaboration and establishing sustainable community change through coalitions (**Gómez-Flores** *et al.*, 2022).

4.6. The four largest scientific producers in South America

Our last set of observations focuses on the four largest scientific producers in South America, Brazil, Argentina, Chile, and Colombia. In general, there is a noticeable upward trend in international multi-affiliation authorship across all four countries, as depicted in Figure 9. For instance, Chile and Colombia start with around 9% affiliations each, in 2008, and gradually increase to approximately 16% and 12% by 2020. However, the levels of intranational multi-affiliation are much flatter in the four countries, particularly for Argentina and Colombia, with lower levels of growth.

Along with China, Brazil is one of the few countries to display a higher level of intranational multi-affiliation than international. Although the reason behind this trend cannot be revealed by the data, perhaps the language barrier and the large size of these countries may push national multi-affiliation. And in Brazil's case, it could be in part a result of the establishment of the *REAL* scientific collaboration network in 1994 which facilitated more intranational multi-affiliation authorships. The *REAL* scientific collaboration network involves numerous institutions, universities, research centers, and individual researchers across various disciplines. These collaborations contribute to advancing scientific knowledge, promoting innovation, and addressing societal challenges. Within Brazil, scientific collaboration networks are often facilitated by national funding agencies, research organizations, and academic networks. These entities provide support and resources to foster collaborations and promote interdisciplinary research (**Haddad**; **Mena-Chalco**; **Sidone**, 2017).

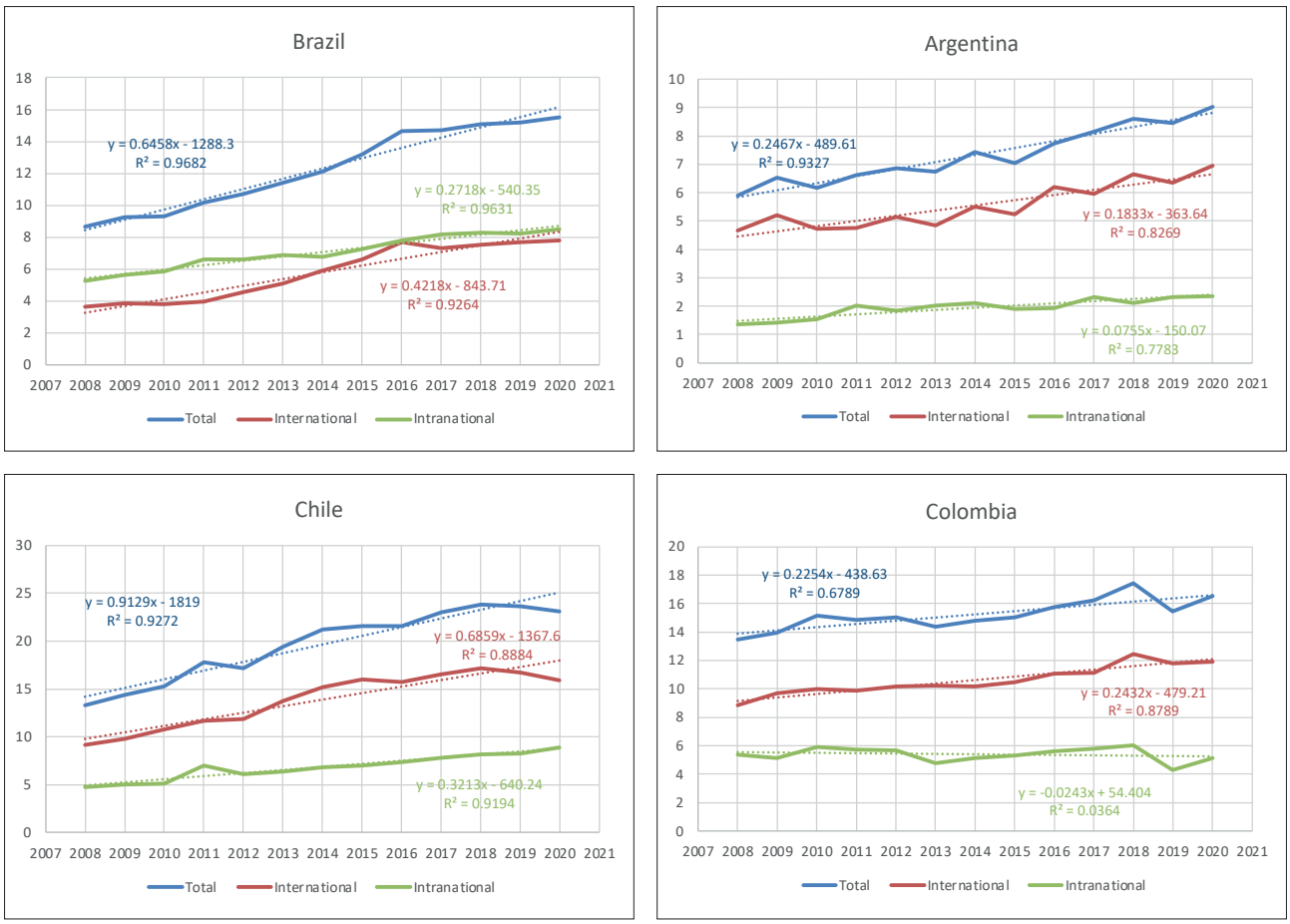

Figure 9. Temporal evolution of the percentages of total, international and intranational multi-affiliation of the 4 South American countries included within the 50 countries with the highest scientific production

5. Discussion and conclusions

The prevalence of authors displaying multi-affiliations has significantly increased over the past decade. Multiple affiliations can be attributed to various factors. One such factor is the implementation of scientific policies by governments that encourage scientists to expand their international presence by establishing foreign affiliations through research collaborations. The growing trend of collaborative research further contributes to researchers forming partnerships with colleagues from diverse institutions or disciplines. By holding multiple affiliations, researchers can foster collaboration and gain access to resources available at different institutions. Another motivating factor for researchers to pursue multiple affiliations is funding. They may seek affiliations with various institutions or organizations to secure funding from different sources, particularly for specific projects or research areas. Such multiple affiliations enable researchers to leverage a broader range of resources, thereby enhancing their research capabilities. Additionally, the desire to broaden professional networks and maintain geographic flexibility can also drive researchers towards adopting multiple affiliations. This enables them to engage with a wider array of collaborators, mentors, and colleagues, fostering professional growth. Lastly, personal reasons may contribute to researchers opting for multiple affiliations, such as accommodating family commitments or aligning with personal preferences. In such cases, researchers may choose affiliations with institutions that cater to their individual needs or resonate with their values.

While the aforementioned reasons and motivations provide valid justifications for researchers having multiple affiliations, it is worth noting that there are also less reputable factors at play. These include instances where institutions offer monetary incentives to renowned researchers as a means to boost their rankings or prestige. Researchers may opt to associate themselves with multiple affiliations to enhance their personal prestige without making substantial contributions to their research or collaborative efforts. This phenomenon, commonly referred to as "octopus affiliations," involves researchers strategically accumulating affiliations primarily for the purpose of bolstering their reputation. Additionally, some researchers may engage in practices where they exploit the funding or resources available through multiple affiliations to advance their own career. This can include gaming the system to secure additional funding or accessing resources from different affiliations without fulfilling the expected level of contribution or collabo-

> "Universities should establish comprehensive policies and procedures to effectively manage situations involving multiple affiliations among faculty members"

ration. Such actions prioritize personal gain and career advancement over the ethical and equitable utilization of funding and resources.

> This study draws attention to various groups of countries, some of which have experienced a concerning rise in the occurrence of multiple affiliations, particularly those involving foreign affiliations

This study draws attention to various groups of countries, some of which have experienced a concerning rise in the occurrence of multiple affiliations, particularly those involving foreign affiliations. It is crucial to closely monitor these trends and take appropriate measures. It is essential to maintain a robust system of checks and balances to safeguard against any potential issues that may arise from such affiliations. Recent news from Spain where one of the country's most prominent scientists was suspended by his university for 13 years comes to mind. In this case the university found that Luque had falsely claimed affiliations with a Russian and a Saudi Arabian university while holding a full-time contract with *Universidad de Córdoba* (**Ansede**, 2023). The suspension raises questions about the integrity of research affiliations and the consequences of such misconduct.

Our recommendation is for universities, where researchers maintain primary affiliations, to conduct rigorous examinations of each researcher's affiliations to ensure that they adhere to legal, ethical, and legitimate standards. Universities should establish comprehensive policies and procedures to effectively manage situations involving multiple affiliations among faculty members. Furthermore, it is essential for universities to enforce the requirement of full disclosure of all affiliations and potential conflicts of interest when researchers publish their work or engage in scholarly activities. This ensures transparency and accountability, preventing the inclusion of institutions without genuine contributions. Moreover, universities should prioritize providing education and training to faculty members on responsible research practices and the proper management of conflicts of interest. By implementing these measures, institutions can uphold the integrity of research and safeguard against unethical practices.

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7. Appendix A

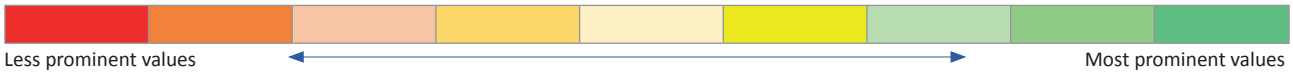
Table 1. Scientific output, percentage, slope and coefficient of determination of the regression line of the percentages of total, international and intranational multi-affiliation, of the countries with more than 2000 documents in the study period (*WoS*, 2008-2020)

Multiaffiliation		Total			International			Intranational		
Country	Output	%	m	R^2	%	m	R^2	%	m	R^2
United States	4,961,301	13.28	0.75	0.96	9.11	0.54	0.96	4.92	0.28	0.89
China	3,483,549	17.48	0.23	0.87	8.37	0.21	0.77	9.82	0.07	0.31
United Kingdom	1,540,631	18.26	1.11	0.99	14.96	0.93	0.99	4.33	0.27	0.97
Germany	1,147,352	16.02	0.91	0.99	12.36	0.71	0.99	4.52	0.27	0.97
Japan	960,595	11.77	0.85	0.97	6.88	0.51	0.98	5.45	0.39	0.94
Canada	898,951	14.86	0.93	0.98	11.29	0.80	0.98	4.26	0.19	0.96
France	832,500	17.24	0.86	0.97	13.55	0.77	0.97	4.36	0.15	0.75
Italy	804,979	11.02	0.53	0.98	8.81	0.48	0.98	2.70	0.09	0.91
Australia	796,558	21.36	1.36	0.99	15.40	1.00	0.99	7.31	0.50	0.98
India	725,060	6.21	0.39	0.94	3.87	0.20	0.91	2.64	0.22	0.94
Spain	709,124	10.37	0.68	0.99	8.31	0.54	0.98	2.47	0.19	0.97
South Korea	699,281	8.32	0.35	0.91	6.23	0.26	0.80	2.35	0.11	0.88
Brazil	633,017	12.98	0.65	0.97	6.24	0.42	0.93	7.35	0.27	0.96
Netherlands	487,077	22.05	1.17	0.99	16.75	1.10	0.99	6.57	0.20	0.94
Iran	422,110	7.76	0.18	0.73	4.57	0.16	0.71	3.42	0.04	0.35
Turkey	401,840	6.64	0.47	0.97	4.52	0.30	0.94	2.57	0.20	0.91
Russian Federation	347,705	14.56	1.44	0.97	9.70	0.80	0.98	5.82	0.79	0.93
Sweden	343,921	26.03	1.43	0.99	19.55	1.25	0.99	8.63	0.41	0.96
Taiwan	329,564	15.54	1.22	0.98	6.47	0.65	0.88	9.89	0.70	0.99
Poland	317,052	8.22	0.15	0.64	6.54	0.11	0.47	1.86	0.06	0.58
Switzerland	315,819	23.57	1.11	0.98	18.11	0.92	0.97	7.11	0.33	0.93
Belgium	259,859	20.98	1.31	0.99	17.22	1.16	0.99	4.78	0.25	0.88
Denmark	220,938	18.72	0.95	0.99	15.92	0.91	0.98	3.43	0.08	0.68
South Africa	188,244	24.02	1.34	0.97	20.76	1.19	0.96	4.51	0.24	0.93
Portugal	186,532	22.68	0.88	0.91	13.52	0.53	0.85	10.40	0.45	0.92
Israel	180,817	12.19	0.54	0.95	9.45	0.47	0.96	3.05	0.09	0.68
Austria	171,450	15.75	0.88	0.99	13.89	0.82	1.00	2.29	0.10	0.74
Malaysia	168,329	16.29	1.06	0.76	12.74	0.76	0.66	3.95	0.35	0.92
Mexico	166,666	9.38	0.09	0.46	6.73	0.10	0.64	2.93	-0.01	0.02
Saudi Arabia	164,493	36.74	1.47	0.30	35.91	1.44	0.29	1.23	0.07	0.80
Finland	161,698	22.93	1.21	0.99	17.55	1.16	0.99	7.01	0.16	0.83
Norway	158,577	20.41	0.96	0.97	16.44	0.79	0.96	5.00	0.27	0.92
Singapore	147,310	21.31	1.08	0.97	19.89	1.06	0.97	1.95	0.08	0.89
Egypt	140,935	34.01	2.23	0.90	31.40	1.95	0.85	3.25	0.36	0.95
Greece	140,459	11.82	0.73	0.92	9.59	0.61	0.89	2.77	0.17	0.86
Czech Republic	130,778	12.73	0.85	0.94	9.94	0.82	0.95	3.13	0.09	0.60
Pakistan	119,863	19.22	0.96	0.63	15.97	0.92	0.71	3.86	0.05	0.06
New Zealand	117,322	14.10	0.73	0.96	12.64	0.61	0.94	1.86	0.15	0.93
Ireland	111,583	16.65	0.90	0.98	13.69	0.80	0.98	3.61	0.17	0.88
Chile	104,938	20.95	0.91	0.93	14.85	0.69	0.89	7.31	0.32	0.92
Thailand	104,211	14.89	0.58	0.87	12.28	0.48	0.88	2.94	0.13	0.63
Argentina	103,180	7.51	0.25	0.93	5.68	0.18	0.83	2.00	0.08	0.78
Romania	95,714	7.93	0.26	0.81	6.16	0.13	0.49	1.90	0.15	0.77
Colombia	76,086	15.56	0.23	0.68	10.95	0.24	0.88	5.35	-0.02	0.04
Hungary	71,872	13.68	0.62	0.90	11.09	0.34	0.85	3.05	0.34	0.93

Multiaffiliation		Total			International			Intranational		
Country	Output	%	m	R^2	%	m	R^2	%	m	R^2
Serbia	63,013	7.01	0.32	0.88	5.87	0.18	0.74	1.24	0.17	0.88
Ukraine	56,693	6.82	0.17	0.44	6.06	0.11	0.27	0.84	0.07	0.68
Tunisia	50,650	23.01	1.81	0.97	16.71	1.24	0.96	7.61	0.73	0.96
Croatia	48,443	6.45	0.23	0.32	5.29	0.10	0.08	1.33	0.14	0.83
Indonesia	48,399	17.97	-0.13	0.03	15.06	-0.28	0.13	3.11	0.16	0.78
Slovakia	42,637	10.28	0.26	0.55	8.82	0.22	0.50	1.61	0.04	0.18
Slovenia	40,561	8.28	0.34	0.79	6.24	0.28	0.76	2.16	0.08	0.36
Viet Nam	39,920	26.14	0.51	0.19	23.92	0.28	0.07	2.62	0.27	0.88
Nigeria	38,951	13.78	1.30	0.96	12.79	1.24	0.96	1.21	0.07	0.55
Bulgaria	37,805	9.76	0.11	0.15	7.10	-0.11	0.26	2.91	0.25	0.77
Algeria	37,430	16.59	0.51	0.84	9.33	-0.08	0.11	8.09	0.64	0.90
Morocco	32,433	14.25	0.38	0.68	10.01	-0.06	0.09	4.79	0.51	0.88
Lithuania	28,419	8.59	0.38	0.85	6.20	0.40	0.79	2.55	-0.01	0.01
United Arab Emirates	26,308	21.36	1.05	0.94	21.11	1.03	0.93	0.33	0.04	0.64
Jordan	24,191	13.06	1.03	0.90	12.19	1.02	0.90	1.04	0.04	0.16
Bangladesh	23,597	25.27	1.18	0.85	23.35	1.00	0.78	2.34	0.22	0.75
Estonia	22,700	19.66	1.35	0.97	17.88	1.45	0.98	2.10	-0.07	0.53
Iraq	22,277	26.43	2.22	0.55	25.41	2.10	0.50	1.18	0.12	0.44
Ethiopia	18,331	21.77	0.34	0.19	19.84	0.24	0.11	2.59	0.13	0.51
Lebanon	17,927	19.93	1.45	0.77	18.71	1.35	0.73	1.62	0.15	0.62
Qatar	17,907	23.56	-0.37	0.20	23.21	-0.42	0.23	0.78	0.10	0.52
Philippines	16,159	18.25	0.48	0.66	15.35	0.32	0.40	3.35	0.18	0.36
Peru	15,828	20.23	0.20	0.13	17.05	0.14	0.07	3.97	0.11	0.19
Cyprus	14,512	13.81	0.55	0.80	12.95	0.46	0.68	1.07	0.10	0.45
Kazakhstan	14,500	15.19	1.07	0.80	12.10	0.67	0.66	3.62	0.48	0.87
Ghana	13,766	16.27	0.59	0.67	15.57	0.51	0.63	0.81	0.09	0.70
Uruguay	12,782	10.46	0.03	0.01	9.95	0.04	0.02	0.61	-0.01	0.00
Iceland	12,227	23.10	0.93	0.68	22.35	0.98	0.71	1.02	-0.05	0.19
Belarus	11,035	7.51	0.70	0.79	7.29	0.67	0.78	0.28	0.03	0.17
Kenya	10,935	19.02	0.39	0.30	17.82	0.28	0.18	1.63	0.14	0.47
Sri Lanka	10,884	22.76	1.04	0.49	21.04	0.83	0.38	2.46	0.25	0.92
Venezuela	10,763	13.43	1.03	0.92	12.51	1.09	0.95	1.16	-0.05	0.18
Ecuador	10,492	23.78	0.59	0.38	22.71	0.54	0.39	1.55	0.09	0.28
Latvia	10,116	10.98	0.37	0.35	8.07	0.35	0.38	3.17	0.07	0.14
Costa Rica	10,020	16.67	1.03	0.89	14.80	0.95	0.88	2.05	0.10	0.29
Uganda	9,712	21.09	0.05	0.01	20.20	0.04	0.00	1.16	-0.02	0.02
Kuwait	9,496	9.53	0.79	0.88	9.48	0.79	0.88	0.07	0.00	0.03
Oman	8,980	16.47	0.95	0.82	16.41	0.95	0.81	0.07	0.01	0.16
Cuba	7,943	12.27	-0.10	0.08	12.07	-0.13	0.11	0.25	0.02	0.22
Armenia	7,636	12.07	-0.12	0.07	10.03	0.00	0.00	2.71	-0.18	0.40
Georgia	6,684	28.65	2.35	0.65	12.75	0.16	0.03	17.09	2.35	0.61
Luxembourg	6,643	21.69	0.33	0.16	21.68	0.32	0.16	0.02	0.00	0.05
Cameroon	6,211	18.26	0.10	0.02	18.16	0.08	0.01	0.13	0.03	0.59
Bosnia And Herzegovina	6,205	6.24	0.11	0.13	6.11	0.10	0.12	0.18	0.00	0.00
Tanzania	6,040	22.48	0.86	0.72	21.56	0.69	0.65	1.36	0.23	0.73
Nepal	4,729	16.60	-0.36	0.14	16.35	-0.39	0.16	0.27	0.03	0.27
Azerbaijan	4,420	14.91	1.03	0.74	13.39	0.80	0.59	1.63	0.25	0.60

Multiaffiliation		Total			International			Intranational		
Country	Output	%	m	R^2	%	m	R^2	%	m	R^2
Macedonia	4,024	8.20	0.07	0.02	6.66	-0.16	0.09	1.59	0.22	0.76
Malta	3,943	14.79	0.49	0.24	14.79	0.49	0.24	0.00	0.00	0.00
Moldova	3,818	18.94	0.02	0.00	16.63	0.11	0.02	3.27	-0.01	0.00
Malawi	3,783	37.91	1.12	0.59	37.75	1.14	0.57	0.24	-0.01	0.02
Zimbabwe	3,555	17.58	0.12	0.02	17.38	0.10	0.01	0.45	0.04	0.12
Trinidad And Tobago	3,146	8.14	-0.11	0.03	8.11	-0.11	0.04	0.03	0.01	0.15
Jamaica	3,077	6.66	0.76	0.76	6.53	0.73	0.78	0.16	0.03	0.12
Montenegro	3,018	4.57	0.41	0.33	4.51	0.41	0.34	0.07	0.00	0.01
Botswana	2,908	16.85	1.11	0.51	16.82	1.10	0.50	0.07	0.01	0.05
Zambia	2,900	30.62	1.34	0.43	30.48	1.33	0.43	0.17	0.02	0.10
Senegal	2,867	18.10	0.67	0.40	17.65	0.64	0.39	0.49	0.03	0.13
Mongolia	2,858	19.07	0.83	0.49	16.66	1.25	0.69	2.59	-0.40	0.37
Bahrain	2,828	14.75	0.02	0.00	14.43	-0.02	0.00	0.32	0.05	0.22
Sudan	2,774	28.05	2.71	0.92	27.97	2.69	0.92	0.18	0.04	0.34
Brunei Darussalam	2,458	21.16	0.87	0.22	20.91	0.84	0.22	0.41	0.05	0.23
Palestine	2,311	23.89	1.74	0.54	23.50	1.69	0.52	0.43	0.05	0.51
Benin	2,297	22.07	0.30	0.18	21.94	0.27	0.15	0.13	0.03	0.27
Fiji	2,132	24.62	0.72	0.43	23.55	0.62	0.32	1.78	0.23	0.61
Uzbekistan	2,074	12.63	0.74	0.41	10.08	0.45	0.21	2.84	0.33	0.34

Note: Color code for each column



Less prominent values ⟷ Most prominent values