The affiliation to an institution provides prestige and identity to researchers and determines access to resources and infrastructure. Institutions in turn seek to affiliate researchers to secure their knowledge and skills, benefiting the research conducted within these institutions and their position in national and international rankings. This study documents the phenomenon of researchers having multiple affiliations and discusses potential causes and consequences. We analyze affiliation information of 8.5M authors from 40 countries, who published 8.9M scientific articles in 14 disciplines since 1996. We find that multiple affiliations occur both within countries as well as across borders, and that more than 60% are within the academic research sector. The share of authors with multiple affiliations increased substantially over the past two decades and particularly since the mid-2000s. The increase is particularly pronounced in countries whose funding structures became more competitive. The rise of multiple affiliations points to fundamental changes in the organisation of science and challenges our measurements of where scientific activity takes place.
A phenomenon that is largely unexplored is that of multiple affiliations, or co-affiliations, where academics are formally engaged with more than one institution at the same time (1). Institutions have an important role in academic research, as the affiliation to them is closely linked to access to resources, networks and research infrastructure. This in turn supports scientific discovery (2). Affiliations moreover determine the value ascribed to individual researchers, as institutional prestige can impact academics’ careers and funding opportunities (3). Given their importance, academics may seek out affiliations to institutions outside their main employment to ensure access to resources and networks. Affiliation information is also used for assigning publications to scientific institutions in research assessments and rankings (4). This may create incentives for institutions to offer side appointments to high-profile researchers who are primarily employed elsewhere in order to increase their ranking. Such practices raise concerns regarding the potential assignment of research discoveries to places where they did not originate (5, 6). A better understanding of the extent and nature of multiple affiliations and how they may relate to research assessments is therefore crucial.

Here we analyze affiliation information of 8,534,248 authors from 40 countries based on 8,893,241 published research articles. We consider every article published between 1996 and 2018 in a representative set of journals [see Supplemental Material (SM), Tables S1 and S2 for details]. Journals are sampled randomly from the top half of the Scimago impact factor distributions in each of 14 disciplines. Our data originates from Scopus, which has three important advantages: Its superior coverage of scientific articles (7), the disambiguation of authors and their affiliations, and the provision of additional information on organisations to which the affiliations relate (see SM for details). An author is considered to have multiple affiliations if she reports at least two distinct affiliations on at least one article in a given year.

Our analysis shows that the increase of authors with multiple affiliations is a global phenomenon. In total, 12.7% of all articles list at least one author with multiple affiliations. The share of authors with multiple affiliations increased from 8% in 1996 to 13% in 2018. This trend is prevalent in all scientific fields, all journal quality groups, and all countries (see Figure 1). Comparing across disciplinary fields shows that the increase is strongest in Neuroscience (8.9% to 16.4%), Chemistry (3.9% to 10.4%) and Medicine (6.6% to 12.7%). Journals with a higher impact factor have on average a higher share of authors with multiple affiliations, although the
share of multiply affiliated authors is rising in journals of all quality groups (see Figure [1], upper right panel). When distinguishing authors by country of their first listed affiliation, we find a substantial variation in the occurrence of multiple affiliations between countries. Whereas in the United States the share of authors with multiple affiliations remained quite constant at about 9%, the shares in other larger economies increased substantially over time (see Figure [1], lower left panel). In Europe, France and Norway stand out with both a steep increase in the share and a high peak level in 2018 with about one in four authors reporting multiple affiliations on their scientific articles (See Figure [1], lower right panel and Figure S4 for all countries). Multiple affiliations became more common in Europe relatively abruptly in the early to mid-2000s. In China however the share started to increase already in the late 1990s, peaked in 2005 and remained relatively constant until 2016.

The vast majority of co-affiliations occur within the academic research sector (see SM for details on classifications of affiliations). More than 50% of all multiple affiliations involve either two universities or a university and a research institute (see Figure [2]). In Medicine, affiliation with a university and a hospital is the most frequent co-affiliation (36%). Multiple affiliations that involve governmental organisations are rare in all disciplines except Biology (6%). Multiple affiliations that involve companies are also rare, except in Computer Sciences and in Engineering where university-company affiliations account for about 6% of multiple affiliations (see Table S5 for details for all disciplines).

Multiple affiliations span national borders too. Figure [3] illustrates the importance of these foreign affiliations, i.e. multiple affiliations where at least one institution is based in another country. The left panel shows the proportion of authors with international co-affiliations in all authors with multiple affiliations in all 40 countries during the 2015-2018 period, and the right panel depicts the three most important "host" countries for international co-affiliation. Colors in the left panel indicate the share of author with multiple affiliations in all authors in a country. The importance of international co-affiliation varies substantially between countries. Forty-two percent of authors based in the United Kingdom have an international co-affiliation and most of these international institutions are located in either the United States, Germany, or China. The share of authors with international co-affiliations is much lower, for instance, in France (12%), or in Norway (18%) which we showed to have some of the highest occurrences of multiple
Figure 1: Authors with multiple affiliations

Notes: The figure depicts the share of authors with multiple affiliations by field, journal quality group, and country. Authors are assigned to fields based on the fields to which their article’s journal is assigned. Authors can occur multiple times if they publish in different years or in different fields resulting in 34,111,267 author-year-field observations. Authors are assigned to a journal quality category based on the octile according to a journal’s field-specific Scimago Impact Factor (in cases where a journal is ranked in multiple fields, the higher octile applies). Authors are assigned to the country of their first listed affiliation per publication. See SM for details on data preparation.

affiliations. Overall, there is a negative correlation between the share of authors with multiple affiliations in all authors and the share of authors with a foreign co-affiliation of $\rho = -0.522$, indicating that multiple affiliations occur mainly within countries. For the majority of countries the most important host of co-affiliations is the United States, with shares ranging from 17% to 53%. For Russia, Germany assumes the role of host for about 25% of researchers with an international co-affiliation. For researchers with a first affiliation in the United States the most important host country is China. Geographical neighbors are typically among the three most important countries of foreign co-affiliation. Comparing the 2015-2018 period to the 1996-1999 period (see Figure S6) reveals a broadened set of host countries as China and several European countries became more prominent.
The increasing prevalence of multiple affiliations suggests that fundamental changes to institutional conditions and the organisation of science are at work. Previous research discussed changes in the complexity of science and increases in team sizes and cross-institutional collaborations on co-authored papers as its consequence and important coping mechanisms (8–10). The rise in multiple affiliations may be the reflection of another coping mechanism.

Science and higher education policies could be a further driver. The increase of authors with multiple affiliations has been particularly pronounced in countries that implemented substantial structural funding reforms over the past two decades (11, 12). Examples include Japan (2002), China (2002), Norway (2003), South Korea (2005), Germany (2006), Singapore (2008), the United Kingdom (2007), France (2008) and Israel (2010). The predominance of within-country co-affiliations in those countries that have a high share of authors with multiple affiliations is moreover remarkable. A shift in national research funding towards a higher concentration of resources and research output in fewer (elite) places (13) may contribute to these incentives. Co-affiliations to well-endowed institutions could provide a means for individual researchers to redress any imbalances in resource access.

The increase in multiple affiliations may also be related to the growing importance of bibliometric indicators for research funding distribution (4). Institutions may have strong incentives

Notes: The figure depicts the different combinations of affiliations (organisation types) as shares in all affiliations at author-article level. See SM for details on the measurement.
Notes: The figure depicts the shares of authors with foreign co-affiliations in all author-article observations with multiple affiliations (left) and the three most common host countries for these affiliations (right). Authors are assigned to the country of their first listed affiliation. A greener bar means a higher share of authors with multiple affiliations within a country. See SM for details on the measurement.

to affiliate prolific researchers in order to increase their chances in funding competitions and to improve their ranking in institutional assessments.

In addition, foreign co-affiliations could reflect traces of increased international mobility (11, 14). They may provide an important source of productivity-enhancing "home country linkages" (15), or make it easier for researchers to stay connected with previous institutions when internationally mobile. Such co-affiliations are likely beneficial for international research networks and knowledge exchange.

We indeed found a higher share of authors with multiple affiliations on articles in top journals compared to lower impact journals, which is indicative of such ranking and mobility mechanisms. Since researchers and institutions may benefit from multiple affiliations, condemning these is thus not a good fix. Yet, the increase in multiple affiliations also implies that counting publications simply based on listed affiliations distorts institutional performance measures.
Multiple affiliations should therefore be taken into account in any bibliometric evaluations. Just as we acknowledge the contribution that multiple authors make to a scientific discovery, we may explicitly acknowledge the contribution of multiple institutions to the scientific work of an author.
Supplemental Materials

A  Data collection

All data originate from Scopus and were downloaded in January and February 2019. Scopus is a large database providing linked and uniquely identified bibliometric information on the level of authors, affiliations, sources (e.g. journals) and documents. We download bibliometric information for 8,893,241 documents. These documents fulfill the following criteria: 1. published during the 1996-2018 period, 2. classified by Scopus as research article (as opposed to editorial, discussion, review, etc.), 3. published in a journal that is part of our sampling procedure (see below), 4. contains valid affiliation information for at least one author and 5. at least one author’s affiliation is located in the set of countries that we look at. The analysis focuses on OECD countries (excluding Latvia, Luxembourg and Iceland) as of 2018 and a group of comparison countries consisting of Argentina, China, Romania, Russia, Singapore, South Korea, South Africa and Taiwan. In total our analysis includes 40 countries (they are listed in table S2).

The set of journals was sampled randomly to represent the following 14 All Science Journal Classification (ASJC) fields: Arts and Humanities (Arts/Humanities); Agriculture and Biological Sciences (for brevity, Biology); Biochemistry, Genetics and Molecular Biology (Biochemistry); Chemistry; Computer Science (Computer Sci.); Earth and Planetary Sciences (Planetary Sci.); Engineering; Immunology and Microbiology (Immunology); Mathematics; Medicine; Neuroscience; Pharmacology, Toxicology and Pharmaceutics (Pharmaceutics); Physics and Astronomy (Physics); Social Sciences. For each field, we use the Scopus list of covered journals as of 2018. We then remove journals with fewer than 3 citations in the previous 3 years and we remove journals with fewer than 4 years of coverage in the 1996-2018 period. This leads us to field-wise lists of journals with sufficient information and relevance per field. As table S1 shows, the largest number of journals is available in the field of Medicine (6,414) and the

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1Due to difficulties in parsing information from title pages, which is sometimes incomplete and missing, a small number of documents regularly lack affiliation information.
2These countries are regularly used as comparison group in Scopus’ own reports.
3These are journals that were either founded close to 2018 or where Scopus does not provide data. We obtain information on yearly coverage from scopus.com/sources during December 2018.
fewest in Neuroscience (494). Using the Scimago Journal Impact Factor (SJR) we partition each list into octiles. From each of the top four octiles, we randomly draw \( x \) journals, where \( x = 0.2 \times \text{Number of journals with sufficient information in that field} \). Thus for each field we obtain a set of 10\% of randomly drawn journals representing the upper half of the Impact Factor distribution (seed equals 0).

Figure S1: Share of articles with usable affiliation information, by field.

Notes: The time series depict the share of articles with usable information. The upper panel depicts the share of articles with existing author and affiliation information in the total number of articles published. The lower panel depicts the share of articles thereof with perfect author and affiliation information, i.e. where the organisation type is available.

We remove observations where further information cannot be provided, because either affiliation information are missing or undefined. Affiliations are missing when, for example, the affiliation reporting follows a non-standard format. We call an article 'usable' if it provides affiliation information for at least one author. The share of articles with usable affiliations is very high in all fields; close to 100\% and increasing over time. The upper panel of Figure S1 shows the share of articles with existing author and affiliation information by field and over
time. Scopus further distinguishes among affiliation profiles with confirmed and corresponding information (affiliation type, country address, etc.) and those without such information (unconfirmed). Thus, we further drop about 3.9M author-affiliation observations that are linked to unconfirmed affiliations. On average, 15% of articles at least partially link to unconfirmed affiliation profiles. For the share by year and field see bottom panel of Figure S1. The increase in the share of articles with unconfirmed affiliations, points to an increase in the variety of affiliations and increased difficulties in automatic parsing of such information. Third, we also remove 10 author-article observations where the author is "Anonymous", and a further 250 author-article observations where the author is a "collaborative unit" rather than a person. We continue with 47,581,417 author-article-field observations, that come down to 34,111,267 author-year-field observations (i.e. ignoring that an author can publish multiple times in a field and per year) or 23,961,829 author-year observations (i.e. ignoring that authors and articles can be assigned to multiple fields).

Table S1 shows summary information for this data, i.e. the selected number of journals, authors and articles. The table lists for each field the number of journals used, the number of authors in the respective field, the total number of documents and the final number of articles used. "Journals Total" is the universe of journals in this field as indexed by Scopus. "Journals Coverage > 5 years" is the number of journals for which Scopus indexed at least 5 years during the 1996-2018 period. "Journals Sampled for Study" is the number of randomly sampled journals from all journals with sufficient coverage. "Authors Total" is the number of authors unique in that field that published in the randomly sampled journals between 1996 and 2018 as identified by the Scopus author-ID. "Articles Total" is the number of articles published in the randomly sampled journals. "Articles Used in Study" is the number of articles with usable information on affiliations and "Articles Share" is the share of used articles over total number of articles.

Articles can appear several times if the journal in which they are published is categorized into two or more different research field. Articles are counted in as many fields as the journal is categorized in, which can be up to seven. The average number of assigned fields for journals with more than one field is 2.29 fields and 76% are counted in just two different fields. Authors

Note that some of the 3.9M observations may be assigned to countries that we do not consider in this study.
Table S1: Number of journals, authors and articles used in the study, by field

| Field            | Journals | Authors | Articles |
|------------------|----------|---------|----------|
|                  | Total    | Coverage > 5 years | Sampled for Study | Total | Used in Study | Share (in %) |
| Biology          | 2,018    | 1,832   | 404      | 1,479,484.0 | 952,820 | 950,228     | 99.73        |
| Arts/Humanities  | 3,451    | 3,026   | 692      | 312,581.0   | 325,740 | 298,905     | 91.76        |
| Biochemistry     | 1,973    | 1,789   | 396      | 2,070,003.0 | 1,112,024 | 1,104,753   | 99.35        |
| Chemistry        | 787      | 747     | 160      | 1,344,345.0 | 924,995 | 923,704     | 99.86        |
| Computer Sci.    | 1,441    | 1,300   | 292      | 531,202.0   | 444,690 | 442,599     | 99.53        |
| Planetary Sci.   | 1,073    | 988     | 216      | 453,188.0   | 511,673 | 510,019     | 99.68        |
| Engineering      | 2,436    | 2,216   | 488      | 1,455,351.0 | 1,208,023 | 1,197,163   | 99.1         |
| Immunology       | 539      | 490     | 108      | 632,938.0   | 274,801 | 272,727     | 99.25        |
| Mathematics      | 1,338    | 1,249   | 268      | 404,637.0   | 474,743 | 471,284     | 99.27        |
| Medicine         | 7,086    | 6,414   | 1,420    | 4,030,900.0 | 3,071,072 | 3,043,218   | 99.09        |
| Neuroscience     | 552      | 494     | 112      | 516,390.0   | 257,696 | 256,501     | 99.54        |
| Pharmaceutics    | 727      | 668     | 148      | 679,884.0   | 312,733 | 311,746     | 99.68        |
| Physics          | 1,010    | 945     | 204      | 1,085,900.0 | 1,113,190 | 1,110,148   | 99.73        |
| Social Sci.      | 5,552    | 4,897   | 1,112    | 668,256.0   | 686,226 | 652,899     | 95.14        |
| Unique           | 21,368   | 19,295  | 5,285    | 8,534,248   | 8,893,241 |             |              |

Notes: The table reports the number of journals attributed to a field, the number of journals with sufficient coverage during the sample period, and the final number of sampled journals. It further reports the number of authors unique to the field during the sample period, and the total number of published and used publications. A publication is used if it contains complete affiliation information.

appear several times if they publish in more than one field. That implies that we capture author-field pairs which avoids assigning an author so a single field based on our own judgement. The final number of unique journals is 5,285 the final number of unique articles is 8,893,241 and the final number of unique authors is 8,534,248.

Table S2 shows the number of authors and the number of articles by country of the author’s first affiliation. Articles can appear multiple times if they have international co-authors. Authors can appear several times if they moved between countries during the data period. Each article can appear as many times as there are authors on that article.
Table S2: Number of authors and articles by country of first affiliation

| Country      | Articles | Authors |
|--------------|----------|---------|
|              | Unique   | Share (in %) | Unique   | Share (in %) |
| Argentina    | 54,445   | 0.50     | 44,107   | 0.48        |
| Australia    | 330,401  | 3.02     | 211,021  | 2.29        |
| Austria      | 86,647   | 0.79     | 59,539   | 0.65        |
| Belgium      | 135,436  | 1.24     | 86,937   | 0.95        |
| Canada       | 448,277  | 4.10     | 322,610  | 3.51        |
| Chile        | 34,517   | 0.32     | 28,847   | 0.31        |
| China        | 1,196,563| 10.94    | 1,581,232| 17.19       |
| Czechia      | 60,378   | 0.55     | 41,860   | 0.46        |
| Denmark      | 108,812  | 1.00     | 66,148   | 0.72        |
| Estonia      | 8,918    | 0.08     | 5,745    | 0.06        |
| Finland      | 91,810   | 0.84     | 56,852   | 0.62        |
| France       | 489,126  | 4.47     | 369,828  | 4.02        |
| Germany      | 680,517  | 6.22     | 532,532  | 5.79        |
| Greece       | 69,658   | 0.64     | 52,317   | 0.57        |
| Hungary      | 39,647   | 0.36     | 27,825   | 0.30        |
| Ireland      | 45,410   | 0.42     | 35,690   | 0.39        |
| Israel       | 106,281  | 0.97     | 71,613   | 0.78        |
| Italy        | 412,628  | 3.77     | 302,823  | 3.29        |
| Japan        | 633,866  | 5.80     | 622,362  | 6.77        |
| Lithuania    | 8,817    | 0.08     | 7,043    | 0.08        |
| Mexico       | 65,733   | 0.60     | 71,367   | 0.78        |
| Netherlands  | 260,587  | 2.38     | 169,002  | 1.84        |
| New Zealand  | 56,112   | 0.51     | 36,319   | 0.39        |
| Norway       | 77,373   | 0.71     | 46,031   | 0.50        |
| Poland       | 119,282  | 1.09     | 84,364   | 0.92        |
| Portugal     | 66,933   | 0.61     | 47,677   | 0.52        |
| Romania      | 18,903   | 0.17     | 14,133   | 0.15        |
| Russia       | 141,351  | 1.29     | 107,599  | 1.17        |
| Singapore    | 67,511   | 0.62     | 51,960   | 0.56        |
| Slovakia     | 18,306   | 0.17     | 13,511   | 0.15        |
| Slovenia     | 19,105   | 0.17     | 10,824   | 0.12        |
| South Africa | 54,350   | 0.50     | 37,324   | 0.41        |
| South Korea  | 268,218  | 2.45     | 270,840  | 2.94        |
| Spain        | 334,553  | 3.06     | 260,407  | 2.83        |
| Sweden       | 180,867  | 1.65     | 110,354  | 1.20        |
| Switzerland  | 173,595  | 1.59     | 124,733  | 1.36        |
| Taiwan       | 170,250  | 1.56     | 162,356  | 1.77        |
| Turkey       | 104,634  | 0.96     | 99,236   | 1.08        |
| United Kingdom| 780,116 | 7.14     | 551,290  | 5.99        |
| United States| 2,913,539| 26.65    | 2,402,202| 26.12       |
B  Identifying multiple affiliations

To identify multiple affiliations we rely on authors’ affiliation information on articles in the Scopus database. Counting affiliations from publications has the advantage of being available at a large scale and with high coverage (as opposed to, e.g. CVs or university websites). Publication data however need to be stratified. The share of articles with affiliation information (‘usable articles’) is about 99% in all fields except Arts/Humanities (92%) and Social Sciences (95%) (see Table S1 and Figure S1). We say an author holds multiple affiliations if Scopus reports at least two distinct affiliation profiles for this author. We undertake two corrections to the Scopus-based org-profile categorisation. First, we clean an author’s list of affiliations such that affiliations of university systems (e.g. University of California) are removed if a member of that system (e.g. University of California at Los Angeles) is also present in the list of affiliations of an author. That is, if an author is both affiliated with the "University of California" and "University of California, Los Angeles", we do not mark this author as having multiple affiliations. This procedure is avoids misallocations on the side of Scopus. Second, we also remove co-affiliations with the IEEE and the IEEE Canada. These are affiliations where authors state their membership when publishing in corresponding journals, but Scopus often confuses them with an affiliation to an organisation.

Authors are identified based on their Scopus Author-ID. We use this ID to aggregate information from a single author with multiple articles in the same field and year. An author-field-year observation is considered to have multiple affiliations if the author listed more than one affiliation on at least one of her articles published in that year and field. Authors are assigned to the country of their first listed affiliation (main affiliation) on an article.

C  Counting multiple affiliations

With $a$ denoting authors and $a^M$ denoting multi-affiliation authors, i.e. authors with at least two different affiliations, in country $c$ in field $f$ and year of publication $t$, we calculate the average country-year share of authors with multiple affiliations as
\begin{equation}
s_{c,t} = \frac{\sum a_{c,t}^M}{\sum a_{c,t}}.
\end{equation}

Likewise, when aggregating over fields, we can calculate the average share of authors with multiple affiliations as by field as

\begin{equation}
s_{f,t} = \frac{\sum a_{f,t}^M}{\sum a_{f,t}}.
\end{equation}

Alternatively to averaging directly across countries or fields, we can average in two steps by first calculating the country-field level average share

\begin{equation}
m_{c,f,t} = \frac{\sum a_{c,f,t}^M}{\sum a_{c,f,t}}.
\end{equation}

and then take the average over these values either by country or field:

\begin{equation}
\overline{s}_{c,t} = \frac{m_{c,f,t}}{\sum_c m_{c,f,t}}.
\end{equation}

\begin{equation}
\overline{s}_{f,t} = \frac{m_{c,f,t}}{\sum_f m_{c,f,t}}.
\end{equation}

Table S3 shows \(s_{f,t}\), i.e. the share of authors with multiple affiliations by field and year (averaging over all countries). The share of authors with multiple affiliation is highest in Neuroscience and Chemistry and lowest in SHH. Observed growth in the occurrence of multiple affiliation authors between 1996 and 2018 was also highest in Chemistry with 167\% and Biochemistry with 79\%. The average growth across fields was 74\%. While the average share is lowest in Social Sciences in 2018, it still increased by 36.5\% compared to 1996.

Figure S2 shows the growth by field using the shares \(\overline{s}_{f,t}\) and illustrates similar patterns as Figure S3 which corresponds to Figure 1 in the main article.

Figure S4 shows the annual share of authors with multiple affiliations for the 40 countries in our data. The overview shows that the share of authors with multiple affiliations increased in most countries, but that the increase had been stronger in some countries than in others. Particularly strong increases can be observed in Argentina, Finland, France, Germany, Russia, Singapore, Spain and Portugal.
Figure S2: Evolution of the share of authors with multiple affiliations by fields

Notes: The time series depict the share of authors with multiple affiliations by fields $\bar{s}_{f,t}$.

Figure S3: Evolution of the share of authors with multiple affiliations, by field

Notes: The time series depict the share of authors with multiple affiliations by fields $s_{f,t}$. 

15
Table S3: Share of unique authors with multiple affiliations (in %).

| Year | Biology | Arts/ Humanities | Biochemistry | Chemistry | Computer Sciences | Planetary Sciences | Engineering | Immunology | Mathematics | Medicine | Neuroscience | Pharma- ceutics | Physics | Social Sciences |
|------|---------|------------------|--------------|-----------|-------------------|-------------------|------------|------------|------------|----------|--------------|----------------|---------|-----------------|
| 1996 | 6.6     | 8.3              | 9.7          | 4.6       | 7.7               | 14.4             | 11.4       | 12.0       | 4.9        | 8.9      | 8.7          | 6.8             | 8.4     | 3.9             |
| 1997 | 6.8     | 8.0              | 9.7          | 5.1       | 8.5               | 14.6             | 11.8       | 10.9       | 5.0        | 9.5      | 8.6          | 6.4             | 7.7     | 3.4             |
| 1998 | 7.7     | 8.8              | 11.5         | 5.2       | 8.1               | 14.2             | 11.7       | 12.3       | 5.4        | 7.6      | 8.8          | 8.2             | 8.2     | 4.1             |
| 1999 | 7.6     | 8.6              | 14.2         | 5.1       | 6.3               | 12.5             | 9.6        | 17.9       | 5.2        | 7.1      | 10.2         | 9.6             | 10.0    | 3.2             |
| 2000 | 7.2     | 8.4              | 13.0         | 5.1       | 6.5               | 12.3             | 9.1        | 16.3       | 4.4        | 7.7      | 11.0         | 8.9             | 7.4     | 3.6             |
| 2001 | 6.6     | 6.6              | 12.4         | 4.9       | 5.2               | 11.9             | 7.3        | 17.6       | 4.7        | 7.0      | 12.6         | 8.2             | 8.0     | 3.5             |
| 2002 | 5.7     | 6.8              | 13.7         | 4.6       | 5.2               | 10.4             | 8.8        | 18.0       | 5.0        | 7.1      | 12.6         | 10.4            | 8.3     | 2.4             |
| 2003 | 8.6     | 9.0              | 14.7         | 5.5       | 5.3               | 10.3             | 8.7        | 19.5       | 4.8        | 7.3      | 13.5         | 9.9             | 9.4     | 2.6             |
| 2004 | 8.9     | 9.1              | 14.9         | 6.0       | 5.5               | 12.0             | 9.8        | 20.6       | 5.4        | 7.3      | 15.2         | 9.8             | 9.6     | 3.5             |
| 2005 | 9.1     | 9.7              | 13.5         | 6.5       | 6.9               | 14.1             | 11.1       | 19.5       | 5.4        | 9.0      | 12.6         | 10.7            | 9.2     | 4.3             |
| 2006 | 9.2     | 8.4              | 12.5         | 6.7       | 6.6               | 13.4             | 11.6       | 18.5       | 5.5        | 9.6      | 11.5         | 11.2            | 9.2     | 3.8             |
| 2007 | 10.4    | 8.0              | 16.9         | 7.1       | 6.9               | 13.7             | 11.1       | 15.6       | 5.5        | 8.2      | 14.8         | 11.5            | 9.5     | 3.6             |
| 2008 | 10.7    | 9.1              | 17.8         | 7.5       | 8.2               | 14.2             | 10.5       | 14.2       | 6.5        | 8.6      | 18.2         | 12.3            | 10.0    | 3.8             |
| 2009 | 11.1    | 7.3              | 17.8         | 8.6       | 9.3               | 15.1             | 10.6       | 13.3       | 6.6        | 9.2      | 17.9         | 12.2            | 9.2     | 3.3             |
| 2010 | 11.1    | 6.3              | 17.9         | 8.7       | 9.7               | 14.5             | 9.6        | 15.3       | 7.1        | 9.9      | 13.6         | 11.4            | 10.4    | 3.0             |
| 2011 | 11.7    | 6.5              | 19.8         | 8.5       | 10.0              | 15.3             | 11.0       | 17.1       | 7.1        | 10.4     | 17.3         | 14.7            | 10.6    | 3.2             |
| 2012 | 11.3    | 8.3              | 18.9         | 10.1      | 11.4              | 16.4             | 11.2       | 18.5       | 7.5        | 10.5     | 26.3         | 16.1            | 10.6    | 3.4             |
| 2013 | 11.7    | 9.6              | 21.9         | 13.5      | 12.5              | 17.3             | 11.0       | 14.5       | 7.3        | 10.1     | 29.6         | 17.2            | 8.4     | 3.9             |
| 2014 | 11.8    | 10.3             | 22.7         | 13.9      | 12.5              | 18.2             | 11.2       | 14.4       | 7.7        | 10.2     | 25.0         | 18.6            | 8.6     | 4.1             |
| 2015 | 12.0    | 10.9             | 18.7         | 15.0      | 13.7              | 18.2             | 12.0       | 14.9       | 7.3        | 11.6     | 28.6         | 13.7            | 8.4     | 4.0             |
| 2016 | 12.2    | 11.4             | 14.5         | 16.0      | 13.9              | 18.9             | 12.3       | 15.6       | 7.8        | 13.1     | 29.8         | 10.4            | 7.4     | 3.9             |
| 2017 | 17.2    | 12.2             | 15.4         | 16.1      | 13.5              | 18.9             | 12.4       | 15.7       | 7.8        | 12.1     | 31.6         | 10.7            | 7.5     | 4.2             |
| 2018 | 26.6    | 11.9             | 15.2         | 16.8      | 13.6              | 19.8             | 12.3       | 15.2       | 8.1        | 11.0     | 21.1         | 10.5            | 7.4     | 4.4             |

Overall Growth: 303.7  44.2  57.0  263.5  76.9  37.6  7.4  26.8  63.5  24.0  143.1  53.3 -12.2  12.2
Average: 10.5  8.9  15.5  8.7  9.0  14.8  10.7  16.0  6.2  9.3  17.3  11.3  8.8  3.6

Notes: The table shows the share $s_{f,t}$ [equation (2)] of authors with multiple affiliations by field and year. In each year we count unique authors based on their Scopus author ID. "Overall Growth" is the percentage increase in the share of authors with multiple affiliations from 1996 to 2018.
Figure S4: Evolution of the share of authors with multiple affiliations, by country

Notes: The time series depict the share of authors with multiple affiliations $\pi_{ct}$.
D Affiliations in multiple countries

An author is marked as having foreign affiliations if we observe a second affiliation in a country that is different from the country of the main affiliation. We assume the first listed affiliation to be the main affiliation, and hence take the country of the first affiliation as home country of the researcher. Figure S5 shows the evolution of the share of authors with foreign affiliations over time. From here it appears that the increase in multiple affiliations is due to increases in within-country affiliations rather than in affiliations abroad. Still, affiliations abroad constitute an overall substantial share in all multiple affiliations.

We depict the share of multiple affiliation authors with co-affiliations abroad for all countries in our data for the period 1996 to 1999 in Figure S6. The figure show the share of foreign affiliations on the left and the share of co-affiliations in the top-3 co-affiliation countries on the right. The color of the bars on the left indicate a country’s share of authors with multiple affiliations during the time period. During the 1996 to 1999 period this share was very low.

In some countries, like Romania, Russia, Chile and Switzerland, most co-affiliations are with institutions abroad. Many European countries also had a relatively high share of international co-affiliations. Popular countries of foreign affiliation are the United States, Germany and the United Kingdom, as well as generally neighbouring countries. Researchers with a main affiliation in the United States, Japan or Canada, had a lower share of co-affiliations abroad. Comparing with Figure 3 (showing the 2015-2018 period), the most remarkable differences is the lower share of foreign co-affiliations in Russia (down from 83 percent to 19 percent) and the increase in the share of foreign affiliations in the United Kingdom (up from 37 percent to 42 percent). Moreover, we see an overall decrease in the concentration in top partner countries: The United States and the United Kingdom remain very prominent, but several European countries, such as Germany, Sweden and Spain, and particularly China emerged as top-3 countries of foreign affiliation.
Figure S5: Evolution of the share of authors with foreign multiple affiliations, by country

Notes: The time series depict the share of authors with multiple affiliations in at least two different countries (similar to equation (3)).
Figure S6: Foreign affiliations by country, 1996-1999 average

Notes: The figure depicts the shares of authors with foreign co-affiliations in all authors with multiple affiliations (left panel) and the respective Top-3 countries of co-affiliation (right panel) for the 1996-1999 period. The colors in the left panel correspond to the share of authors with multiple affiliations, the colors in the right panel identify individual countries.
E  Affiliation combinations by organisation type

We consider author-article pairs to investigate affiliation combinations. Since we do not distinguish between fields in this analysis, each article is counted only once resulting in 8,893,241 author-article pairs for which we observe the affiliation type. The upper panel of Figure S7 shows the different affiliation combinations over time at the author-article level. These numbers exclude affiliation combinations that account for less than 0.3% of the observed affiliation combinations in a given year (extreme rare combinations). From the upper panel we can see that the increase in multiple affiliations can be attributed to an increase in co-affiliations between universities and research institutes, between universities, and between universities and hospitals. The share of co-affiliations with companies declined over time. The lower panel shows the distribution of author-article pairs for single-affiliation authors for comparison.

Table S5 shows affiliation-type combinations by discipline. Co-affiliations between universities are the most common form in Arts and Humanities, Computer Sciences, Mathematics and the Social Sciences. In most other disciplines, dual affiliations between universities and (public) research organisations are the most common combination. University-hospital co-affiliations play an important role in Biochemistry and Medicine, Immunology, Neuroscience and pharmaceutical research. Co-affiliations of university researchers with companies are relatively rare in all disciplines expect for Computer Sciences and Engineering where they account for just over 5% of multiple affiliations.
Figure S7: Affiliation type combinations as share of all author-article observations by year.

Notes: The bars depict the share of author-article observations with each combination of affiliation types in all author-article observations. The upper panel considers only multiple affiliations. The lower panel shows the share of single-affiliation author-article observations for comparison.
### Table S4: Affiliation type combinations as share of all author-article observations by year.

| Year | Univ.-Res. Inst. | Univ.-Univ. | Univ.-Hospital | Res. Inst.-Res. Inst. | Univ.-Governmental | Hospital-Hospital | Univ.-Company | Other |
|------|------------------|-------------|----------------|-----------------------|-------------------|------------------|--------------|-------|
| 1996 | 24.0             | 31.3        | 19.9           | 5.1                   | <3                | <3               | 5.5          | 14.2  |
| 1997 | 24.5             | 31.0        | 19.2           | 5.2                   | <3                | 3.1              | 5.3          | 11.7  |
| 1998 | 25.0             | 30.8        | 19.4           | 5.1                   | <3                | <3               | 3.1          | 11.3  |
| 1999 | 26.9             | 30.3        | 19.0           | 5.6                   | <3                | 3.1              | 4.8          | 10.3  |
| 2000 | 25.8             | 29.4        | 20.7           | 5.3                   | <3                | 3.5              | 4.2          | 11.1  |
| 2001 | 26.1             | 28.6        | 20.5           | 5.3                   | <3                | 3.4              | 3.9          | 12.3  |
| 2002 | 26.6             | 28.5        | 20.7           | 5.1                   | <3                | 3.1              | 3.8          | 12.2  |
| 2003 | 28.6             | 29.7        | 19.8           | 5.4                   | <3                | <3               | 3.6          | 12.9  |
| 2004 | 29.0             | 30.1        | 19.9           | 5.4                   | <3                | <3               | 3.2          | 12.3  |
| 2005 | 29.0             | 30.0        | 19.4           | 5.7                   | <3                | <3               | 3.1          | 12.7  |
| 2006 | 29.7             | 28.7        | 19.4           | 6.2                   | <3                | <3               | <3           | 16.0  |
| 2007 | 31.1             | 27.9        | 19.3           | 6.1                   | <3                | <3               | <3           | 15.6  |
| 2008 | 31.7             | 27.7        | 19.0           | 5.9                   | <3                | <3               | <3           | 15.8  |
| 2009 | 33.1             | 27.6        | 18.9           | 5.8                   | <3                | <3               | <3           | 14.6  |
| 2010 | 34.1             | 27.5        | 18.5           | 5.3                   | <3                | <3               | <3           | 14.6  |
| 2011 | 33.8             | 27.3        | 19.0           | 5.1                   | <3                | <3               | <3           | 14.8  |
| 2012 | 33.8             | 28.0        | 18.9           | 4.9                   | <3                | <3               | <3           | 14.4  |
| 2013 | 34.1             | 28.1        | 19.1           | 4.6                   | <3                | <3               | <3           | 14.2  |
| 2014 | 34.1             | 28.2        | 19.0           | 4.7                   | <3                | <3               | <3           | 14.0  |
| 2015 | 33.8             | 28.9        | 19.2           | 4.2                   | <3                | <3               | <3           | 13.9  |
| 2016 | 33.2             | 28.9        | 19.7           | 4.2                   | <3                | <3               | <3           | 14.1  |
| 2017 | 32.8             | 29.6        | 20.0           | 3.9                   | 3.1               | <3               | <3           | 10.6  |
| 2018 | 32.7             | 30.2        | 19.8           | 3.8                   | 3.2               | <3               | <3           | 10.3  |

**Notes:** The table shows the share of the respective multiple affiliation combination on all author-article observations.
Table S5: Affiliation type combinations as share of all author-article observations with multiple affiliations, by field.

|                      | Biology | Arts/ Humanities | Bio-chemistry | Chemistry | Computer Sciences | Planetary Sciences | Engineering | Immu- nology | Mathematics | Medicine | Neuroscience | Pharma- ceutics | Physics | Social Sciences |
|----------------------|---------|------------------|---------------|-----------|------------------|---------------------|-------------|-------------|------------|----------|--------------|----------------|---------|-----------------|
| Univ.-Univ.          | 36.0    | 51.1             | 26.8          | 36.9      | 44.0             | 25.2                | 38.2        | 26.9        | 53.3       | 22.3     | 27.4         | 28.6           | 29.5    | 56.0            |
| Univ.-Res. Inst.     | 39.6    | 25.4             | 32.0          | 43.5      | 35.5             | 50.7                | 38.4        | 27.9        | 35.3       | 20.9     | 25.8         | 26.7           | 51.2    | 23.4            |
| Univ.-Hospital       | 4.3     | 11.8             | 21.4          | 3.2       | 3.6              | <3                  | 3.8         | 19.2        | <3         | 35.6     | 28.2         | 23.5           | <3      | 8.4             |
| Univ.-Governmental   | 5.8     | <3               | <3            | <3        | <3               | 4.1                 | 3.4         | <3          | <3         | <3       | 3.0          | <3             | <3      | 3.1             |
| Univ.-Company        | <3      | <3               | <3            | <3        | <3               | 3.7                 | 5.6         | <3          | 5.9        | <3       | <3           | <3             | <3      | 4.1             |
| Res. Inst.-Res. Inst.| <3      | 5.8              | 4.9           | 6.3       | 4.5              | 12.3                | 5.7         | 5.4         | 4.3        | <3       | <3           | 9.4             | <3      | <3             |
| Res. Inst.-Hospital  | <3      | 5.8              | <3            | 3.7       | <3               | <3                  | 3.8         | <3          | 4.7        | 4.4      | <3           | <3             | <3      | <3             |
| Hospital-Hospital    | <3      | <3               | <3            | <3        | <3               | <3                  | <3          | <3          | 4.1        | <3       | <3           | <3             | <3      | <3             |
| Other                | <3      | <3               | <3            | <3        | <3               | <3                  | <3          | <3          | <3         | <3       | <3           | <3             | <3      | <3             |

Notes: The table shows the share of the respective multiple affiliation combination on all author-article observations with multiple affiliations. Combinations that occur less than 3% in any discipline are grouped as "Other".
F Instructions for replication of the analysis

The programming code files to replicate the data collection, all calculations and the data analysis are available at github.com/Michael-E-Rose/The-Rise-of-Multiple-Institutional-Affiliations.

We used the Python packages pybliometrics (16) to retrieve the data, pandas (17) to manipulate the data and seaborn (18) for visualization. Note that replication requires access to the Scopus data base.

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