Förderstrukturen in der Grundlagenforschung basierend auf Publikationsoutputs mit Bezug zu DFG-Förderung und Förderung vergleichbarer Förderagenturen in vier Vergleichsländern

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0 Executive Summary

This report analyses the structure (quality, quantity, and focus) of scientific results funded by national research councils. It compares the characteristics and role of DFG funded publications in Germany with those of SNF funded research in Switzerland, NWO funded research in the Netherlands, UKRI funded research in the United Kingdom as well as NSF and NIH funded research in the United States.

The analysis differentiates publications based on research council funding from others by means of acknowledgements made in the papers and transferred into bibliometric databases. Major publishers confirm that such information is available with some reliability from 2009 onwards, a claim supported by the structure of the available data. Technically, the analyses draw on Thomson Reuter's Web of Science, where the extraction of acknowledgement information from full texts into the database proper was found most advanced and the data itself thus most reliable.

In summary, it finds that research council acknowledging publications (RCAP) have experienced absolute growth in recent years, in line with the general growth of publication output of the respective countries. Hence, their relative share in national publications has generally not changed. Across all countries, it is highest in the natural sciences, followed by engineering disciplines while it remains comparatively low in the social sciences and the humanities. This finding is not particular to the Web of Science database and hence not a technical artefact. Instead, it is consistent with known differences in the overall role and character of third-party funding across disciplines. By an analysis of co-publication rates, moreover, the report documents that research council funding seems to spur national while inhibiting international collaboration which may more commonly be funded from transnational agencies (e.g. ERC, H2020). With a view to citation-based academic impact, finally, RCAP reach above average standards, regardless of whether this impact is measured by the Excellence Rate or the Crown-Indicator.

In Germany, the share of RCAP in all publications is remarkably in line with the share of DFG funding in universities' research expenditure, underlining the DFG's central role in the national research system. Furthermore, deviations with regard to national and international co-publication rates, remain in the middle field. With respect to academic impact criteria, however, German RCAP stand out notably less from the national average than those in Anglo-Saxon systems or, with a view to their Excellence Rate, those from the Netherlands. In both cases, there is a notably negative trend in the relation between RCAP impact measures and national averages in these area. For the Crown Indicator, both have come close to convergence.

1 Introduction

This report presents a quantitative analysis of scientific publications funded by the Deutsche Forschungsgemeinschaft (DFG) and relevant funding organizations of four countries – Switzerland (SNF), the Netherlands (NWO), the United Kingdom (UKRI) and the USA (NSF, NIH). Its objective is to answer the following key questions:

What is the structure of the scientific outcome (quality, quantity, focus) that can be associated with a DFG funding in comparison to relevant funding organizations in the other four countries?

How has the scientific outcome of the DFG and the other funding organizations developed over the period studied?

In order to perform a detailed analysis of the scientific publication output associated with the funding organizations, we examine the following indicators: Number of publications, thematic focus of the publications, distribution of the publications across types of research performing institutions in Germany, national and international co-publications, Excellence Rate, and the Crown Indicator.

With the aim of investigating the detailed distribution of the DFG funding, the main funding programs of the DFG are analyzed individually as far as possible.

The analyses are performed based on the database Web of Science (WoS) on citadel publications (articles, reviews, letters, and notes). Publication-based indicators are presented for the period 2010 to 2017 and citation-based indicators for the period 2010 to 2015. For citation-based indicators we employ a three-year citation window, which means that we count all citations that a publication receives in the year of the publication and the two subsequent years. A detailed description of the methods provides Michels et al. (2013).

WoS provides information about the acknowledgements included in a publication. We use these acknowledgements in order to identify the publications funded by a particular organization. However, acknowledgements are not mandatory. While the existence of an acknowledging reference in a document thus proves that the publication was funded by the mentioned organization, its absence does not allow any robust conclusions about the publication's funding status. Hence, some the following figures should not be considered as precisely accurate in an absolute sense. For the purpose of international comparisons, however, it is entirely adequate to perform analyses on publications clearly identified as funded. To the authors' knowledge, there is no reason to believe that academics' tendency to avoid or omit funding acknowledgements would be higher in particular countries or disproportionately pronounced for particular funding organizations.

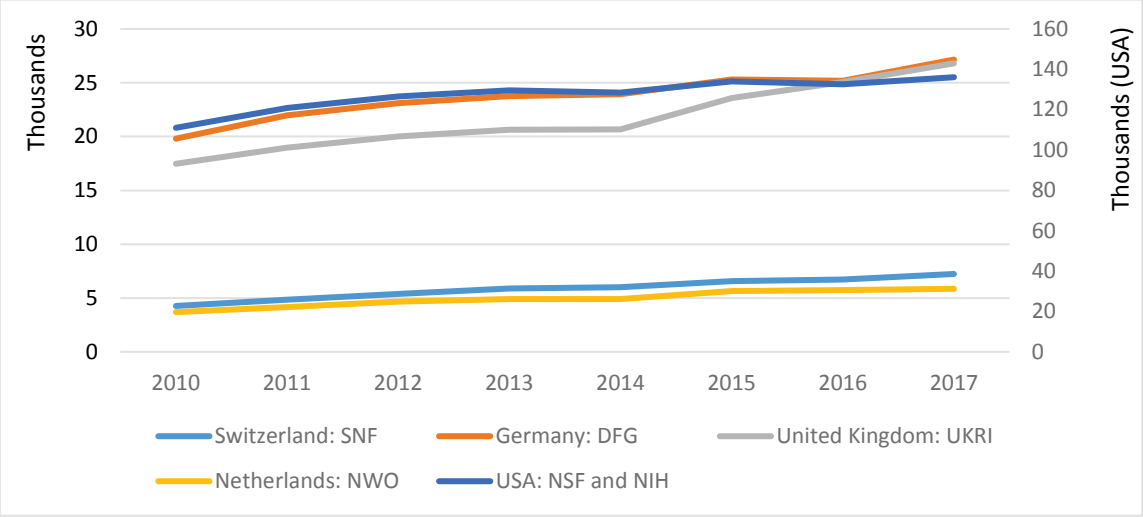
2 Methodological Note

Despite longstanding legal obligations to do so in some cases (even if not in all), the practice of acknowledging funders explicitly and systematically in publications is a comparatively novel phenomenon. While, following legal disputes, close to all reputable journals now expressly ask about affiliation with the US or UK government, express reference to other funders remains - on the part of the publishers - by and large optional. However, more and more national and European level funding agencies have come to require such acknowledgements legally in recent years.

As a result, the practice of acknowledging funders has become more commonplace since the mid-2000s, reaching stable levels around 2009. Naturally, this differs across disciplines and journals so that neither Thomson Reuters nor Elsevier would give a definite year from which onwards funding acknowledgement are systematically reported in their datasets. However, representatives from both database providers suggested in personal conversations that acknowledgements could become a robust point of analytical reference since around 2009. In line with this, Springer Nature confirmed on request that, among their journals, a documentation of research funding in acknowledgements is common "since at least 2009". Accordingly, Fraunhofer ISI's own analyses see figures going up gradually from 2000 until they reach a comparatively stable level around 2009 in both Web of Science and SCOPUS. In parallel, the technical integration of many journals' submission systems under Manuscriptcentral and Inderscience has contributed to a more organized reporting process and, hence, more systematic coverage. Thus, the robustness of acknowledgement data from about 2009 is confirmed from different angles - not ruling out, of course, that some journals still pursue sloppy policies in this regard.

At the current point in time, however, only Thomson Reuters' Web of Science database has satisfactorily extracted and aggregated all information available from full texts or other relevant data generated during the submission process. Overall figures in SCOPUS remain substantially lower to an extent that cannot be explained by the two databases' differences in disciplinary coverage alone. Upon request, Elsevier confirmed that while they were confident about the validity of the available information as such, they remain working on integrating different sources into the main SCOPUS database (including the backend of the online version). Consequently, this study chose to analyze the currently more robust information available in Web of Science, starting 2010. Nonetheless, the authors maintain that the use of SCOPUS would eventually be preferable given its broader disciplinary coverage which would further minimize field-specific distortions. However, this option was unfortunately not yet available during the drafting of this study.

Figure 1: Numbers of research council acknowledging publications (RCAP)



Source: Web of Science, queries and calculations by Fraunhofer ISI

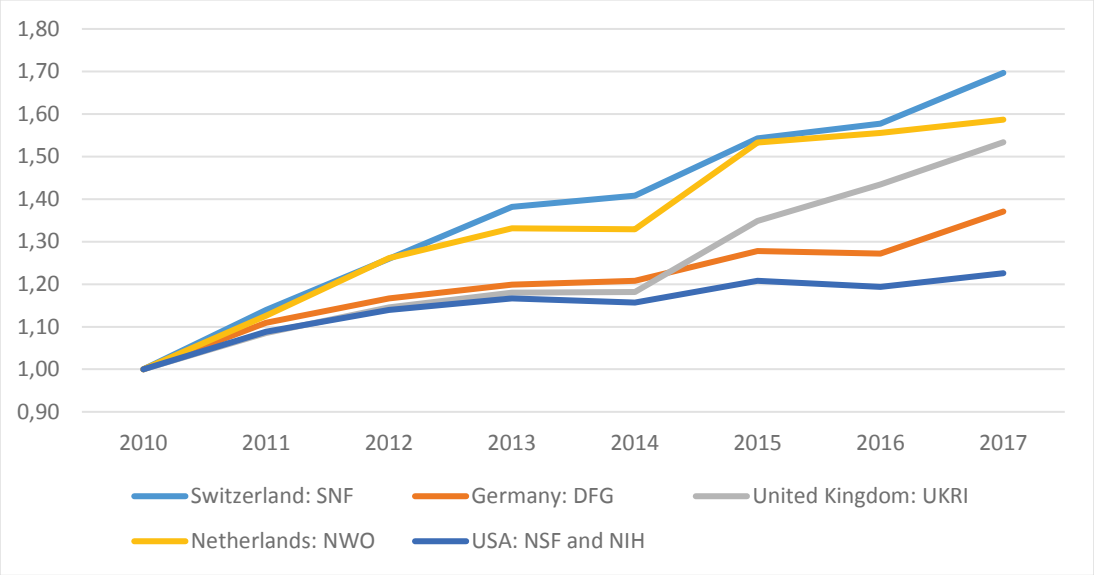
3 Number and share of publications by countries

The number and share of publications provide a first comparison among the different funding organizations and their scientific publication output over the time. Figure 1 shows the number of publications by at least one author from the respective country which acknowledge funding from that country's research council: the DFG in Germany, the SNF in Switzerland, the UKRI in the United Kingdom, the NWO in the Netherlands and the NSF and the NIH in the United States (both exclusive and partial funding).

Due to the different levels of overall publication output in the countries under study, the absolute number of U.S. publications acknowledging the NSF or NIH (USA) is far higher (about 136,000 in 2017) than those acknowledging funding in other countries. While the number of U.K. publications acknowledging UKRI funding (about 17,500 in 2010) is below the number of DFG acknowledging publications from Germany (almost 20,000) in the earlier parts of the period studied, they experience marked growth since 2014. As a result, the total number of UKRI and DFG acknowledging publications converged by 2016 and in parallel increased to about 27,000 for both in 2017.

In comparison, the output of research council acknowledging publications (RCAP) from the Netherlands and Switzerland remains on a lower level. About 5,900 Dutch publications acknowledged the NWO and about 7,200 Swiss publications acknowledge the SNF in 2017. These lower figures in absolute terms reflect a natural size effect in line with the smaller populations, smaller research systems and hence lower publication output of these two countries.

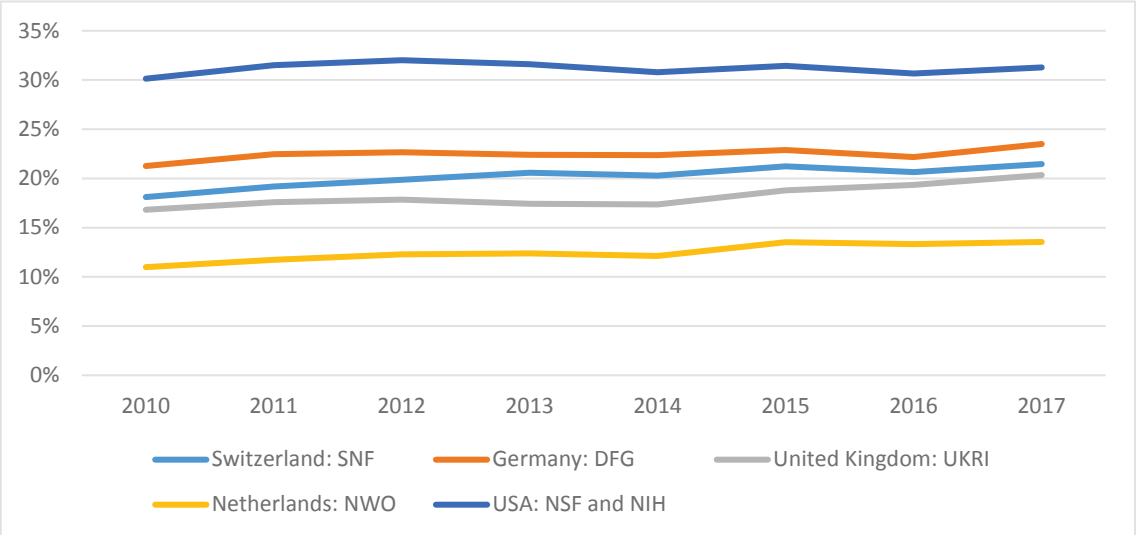
Figure 2: Development of the numbers of RCAP (Index 2010=1)



Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 2 displays the relative growth trend of RCAP in the five countries under study, setting the point of reference at 1 in 2010. The most dynamic development can be observed for the publications acknowledging the SNF (70% increase 2010-17) and those acknowledging the NWO (59% increase 2010-17). The relative number of publications acknowledging the UKRI has increased by 53% since 2010, with particular dynamism since 2014. IN contrast, Germany and the United States display lower relative increases in the number of RCAP (37% and 23% respectively). With a view to DFG RCAP, it is noteworthy that the seeming break in trend during 2015-16 has proven temporary, with growth resuming since 2016.

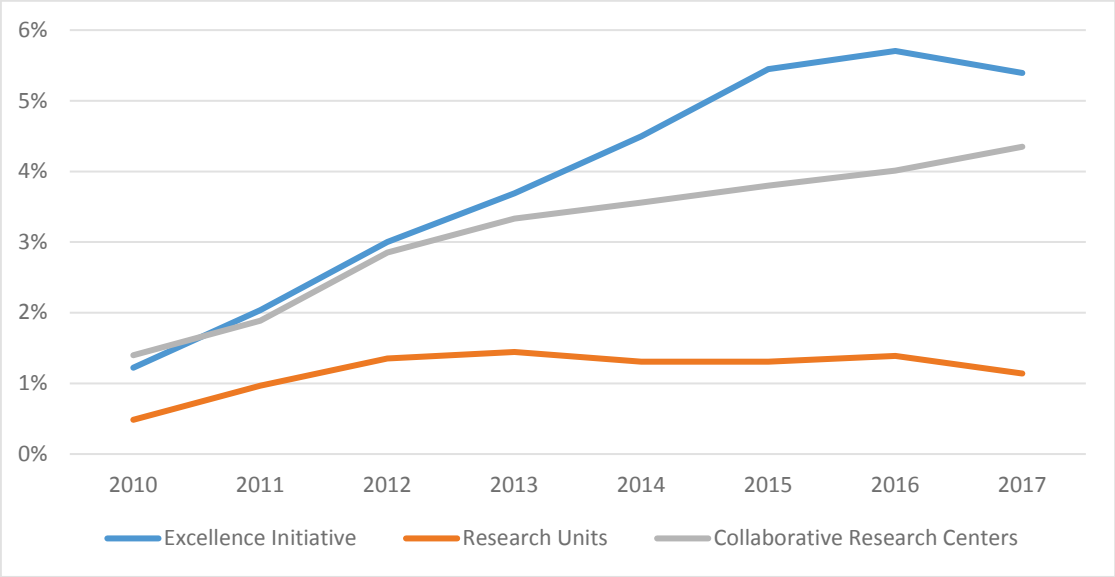
Figure 3: Shares of RCAP in all national publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 3 illustrates the share of RCAP in relation to the total publication output of the respective country to compare the relevance of RCAP independent of total numbers. Overall, the shares of RCAP in all national publications have remained stable, despite significant changes in overall volume (Figure 1). Continuously, the United States does not only display the highest RCAP output in absolute numbers (which is to be expected, given its population) but also the by far highest share of RCAP in all national publications - of about 30-32% during the period studied. In 2017, Germany, UK and Switzerland reach shares of about 20-23% while only 14% of all Dutch publications acknowledge the NWO. Overall, the share of German RCAP in all publications is thus remarkably in line with the share of DFG funding in universities' research expenditure. With a view to changes in relative terms, the UK and Switzerland report the highest increases of about 3.5 percentage points between 2010 and 2017. The Netherlands increases its share by 2.6 percentage points and Germany by 2.2 percentage points, while the shares of RCAP in the USA (1.1 percentage points) remain close to entirely stable.

Figure 4: Share of RCAP from DFG funding programs in all DFG RCAP



Source: Web of Science, queries and calculations by Fraunhofer ISI

In addition to analysing the total number of publications acknowledging the German DFG (DFG RCAP), we take a closer look at selected high-profile DFG funding programs: the Excellence Initiative, Research Units, Collaborative Research Centers. Figure 4 displays the distribution of publications acknowledging that expressly acknowledge on of these high-profile programs. Arguably, this analysis has to be treated with caution, since the number of publications expressly mentioning particular DFG programs remains low and the resulting figures most likely less complete than those for DFG RCAP. Nonetheless, it conveys a number of interesting, indicative findings.

While in 2010, the share of publications acknowledging the Excellence Initiative (1.2%) and that of publications acknowledging funding for Collaborative Research Centers (1.4%) are similar, the share of those acknowledging the Excellence Initiative increased by more than 4 percentage points to 5.7% in 2016, the share of those acknowledging Collaborative Research Centers merely reached 4.0%. In 2017, the latter share increased further to 4.3% while the former decrease to 5.4% Nonetheless, both shares increased notably in relative terms, in contrast to that of publications acknowledging Research Units (1.1% in 2017). Although the limitations of the data do not support final conclusions, it thus seems that the observed dynamic development of RCAP from high-profile programs may be limited to the Excellence Initiative and to Collaborative Research Centers.

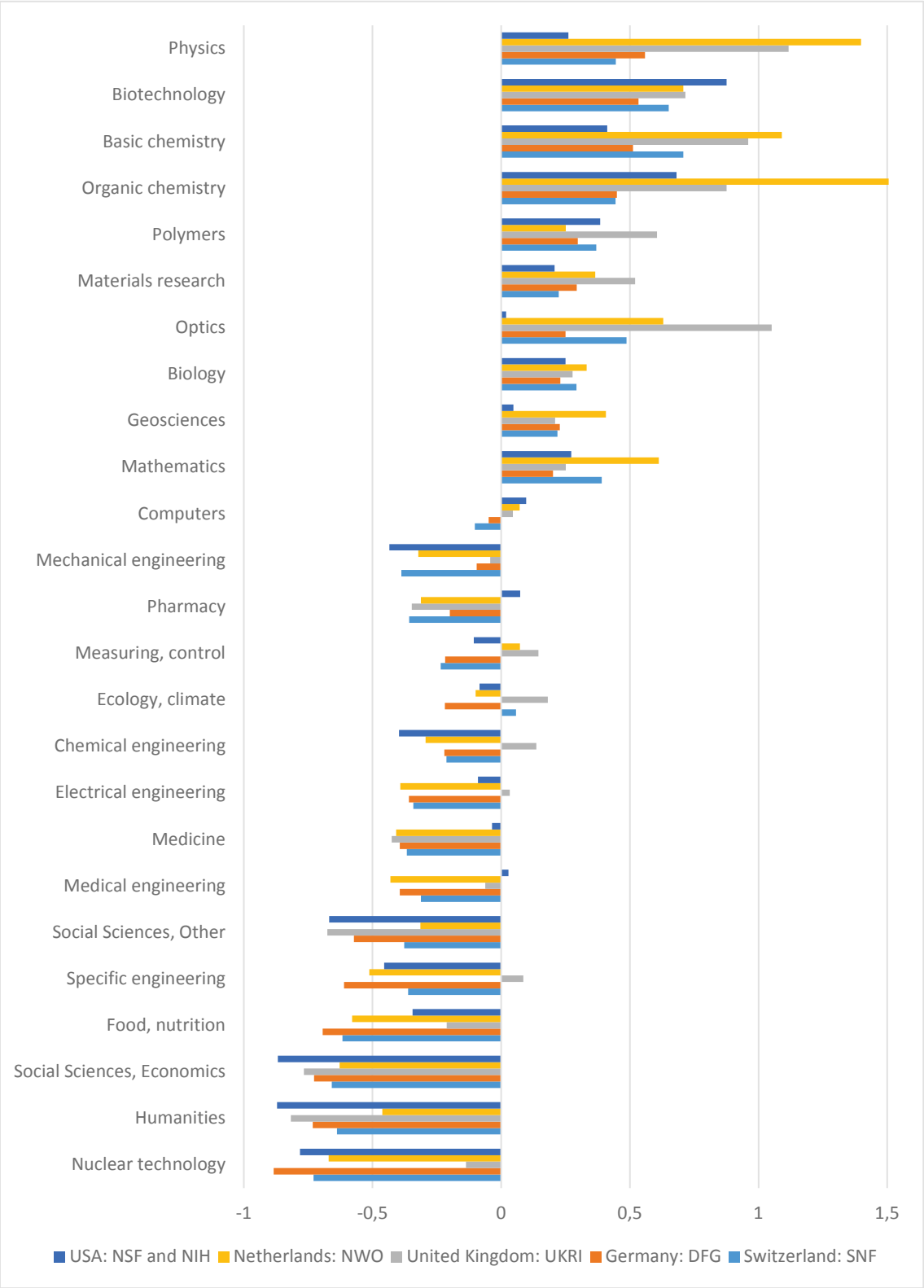
4 Share of publications by disciplines and countries

This section describes the distribution of the shares of RCAP across different disciplines. For each country and discipline, Figure 5 displays the deviation of the share of RCAP of all national publications in a certain field from the country's average share of RCAP of all national publications (for the period 2013-17). For purposes of this report, the analysis was structured based on the common classification into 27 disciplines.

Across all countries, the highest share of RCAP in all publications can be found in fields of natural sciences, followed by engineering disciplines. In the area of socio-economic sciences and the humanities, in contrast, the share of RCAP remains systematically below country average in all cases. Physics is the discipline with the highest share of RCAP in Germany and the United Kingdom, while it ranks second in the Netherlands, fourth in Switzerland and sixth in the USA (cf. Table 1). Biotechnology and Organic Chemistry are within the top five in all countries, Biotechnology ranks first in the USA while Organic Chemistry ranks first in the Netherlands. In Switzerland, the highest share of RCAP is found in Basic Chemistry, which ranks third in all other countries. Generally, the lowest shares of RCAP in all publications are found in the disciplines Humanities, Economics, Nuclear Technology (a small field), Food/Nutrition and other Social Sciences. Further, it is noteworthy that Food/Nutrition, Specific Engineering and Chemical Engineering rank higher in the UK than in the other countries.

Overall, however, the 'ranking' of disciplines with respect to the share of their publications that acknowledge research councils appears as remarkably similar across all countries. To ascertain that this is not an effect of the Web of Science databases' disciplinary bias, the analysis has been repeated with the - still incomplete - data available from Elsevier SCOPUS. The results are close to identical, indicating that there are genuine differences between disciplines in substance - either with a view to third-party funding as such or with a view to the authors' inclination to report it in their publications.

Figure 5: Share of RCAP in all national publications by disciplines, deviation from the country's average (2013-17)



Source: Web of Science, queries and calculations by Fraunhofer ISI

Table 1: Share of RCAP in all national publications by disciplines, Top 5 vs. Lowest 5 (2013-17)

Switzerland: SNF	Germany: DFG	United Kingdom: UKRI	Netherlands: NWO	USA: NSF and NIH
Basic chemistry	Physics	Physics	Organic chemistry	Biotechnology
Biotechnology	Biotechnology	Optics	Physics	Organic chemistry
Optics	Basic chemistry	Basic chemistry	Basic chemistry	Basic chemistry
Physics	Organic chemistry	Organic chemistry	Biotechnology	Polymers
Organic chemistry	Polymers	Biotechnology	Optics	Mathematics
...	...	...	...	...
Mechanical engineering	Specific engineering	Pharmacy	Humanities	Specific engineering
Food, nutrition	Food, nutrition	Medicine	Specific engineering	Social Sciences, Other
Humanities	Social Sciences, Economics	Social Sciences, Other	Food, nutrition	Nuclear technology
Social Sciences, Economics	Humanities	Social Sciences, Economics	Social Sciences, Economics	Social Sciences, Economics
Nuclear technology	Nuclear technology	Humanities	Nuclear technology	Humanities

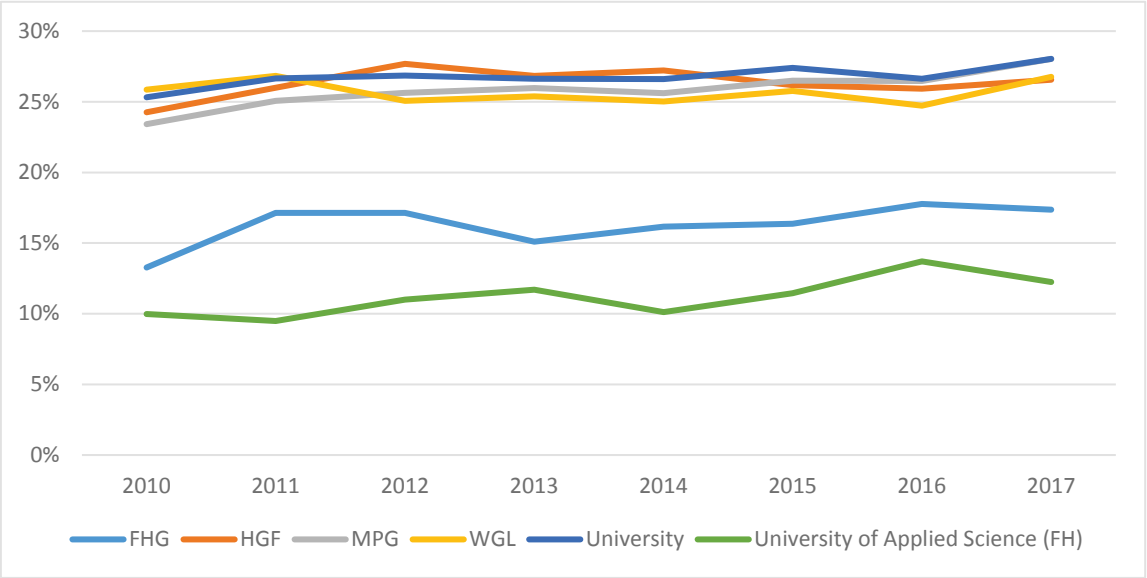
Source: Web of Science, queries and calculations by Fraunhofer ISI

5 Share of publications by German institutions

This section analyzes the structure of DFG acknowledging publications with a view to their origin in different types of German research institutions. Figure 6 documents the share of RCAP for Universities, Universities of Applied Sciences (Fachhochschulen, FH) as well as for public research organizations of the Max-Planck-Gesellschaft (MPG), Fraunhofer (FHG), Helmholtz-Gemeinschaft (HGF) and Leibniz Gemeinschaft (WGL).

As the main recipients of DFG funding, the Universities but also HGF, MPG and WGL report high shares of RCAP between 27-28% in 2017. In contrast, only about 17% of all FHG publications and 12% of all FH publications in 2017 acknowledge the DFG - which is to be expected given the low share of DFG funding that both groups of organisations receive. Since 2010, the shares of RCAP of all institutions have increased, especially those of the MPG (5 percentage points), the FHG (4 percentage points), and the Universities (3 percentage points).

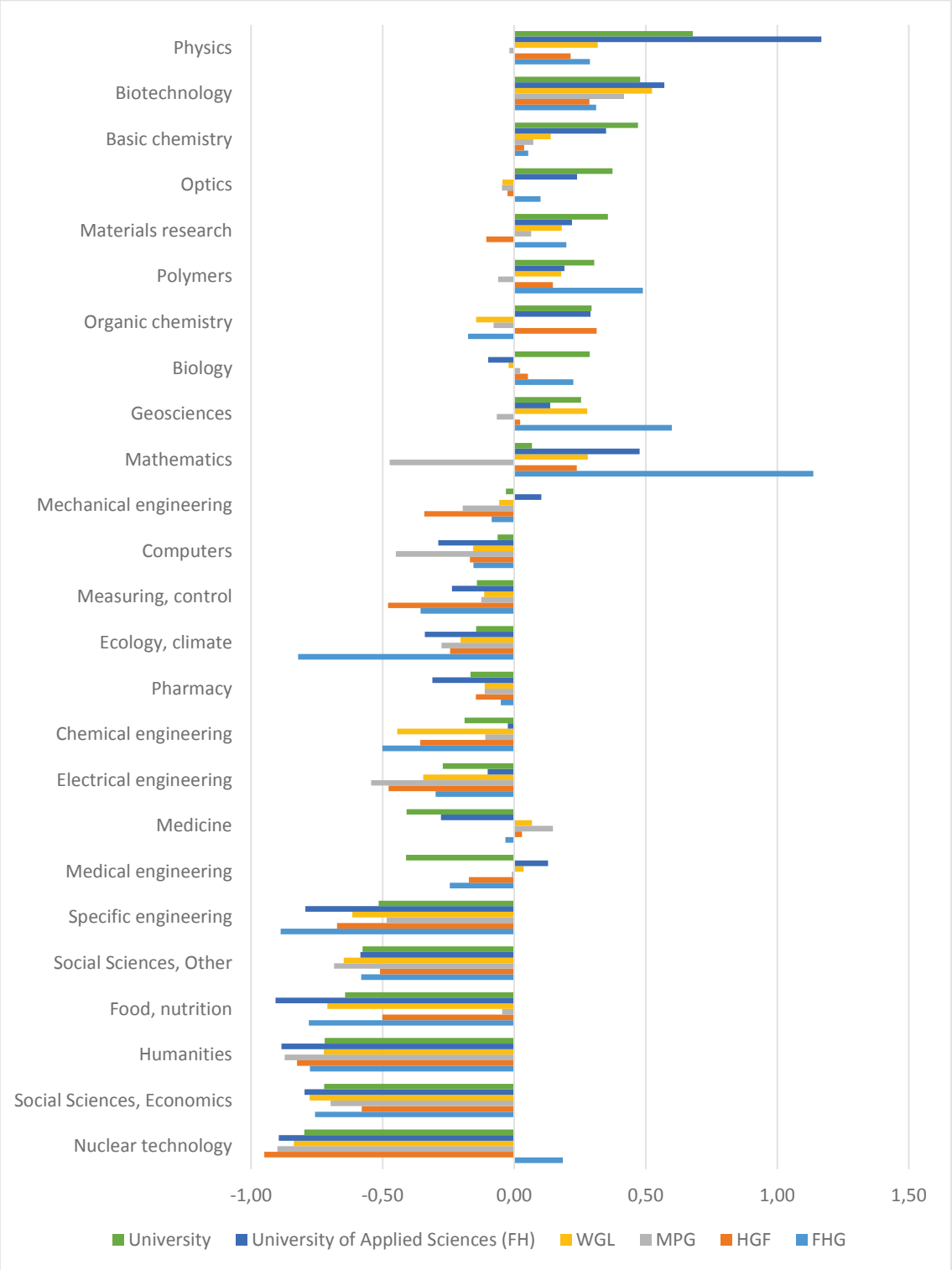
Figure 6: Share of RCAP (DFG) in all publications of German Universities and non-university research institutions



Source: Web of Science, queries and calculations by Fraunhofer ISI

A differentiation of these findings by disciplines (Figure 7) yields limited added value due to the small absolute numbers of RCAP found in each of the many sub-sections thus created. To a certain extent, differences between types of research organizations reflect differences in their disciplinary orientation. In the end, however, none of them deviates too substantially from the overall disciplinary ranking identified in section 1.4.

Figure 7: Share of RCAP of all publications of German Universities and non-university research institutions by disciplines, deviation from the institution's average (2013-17)

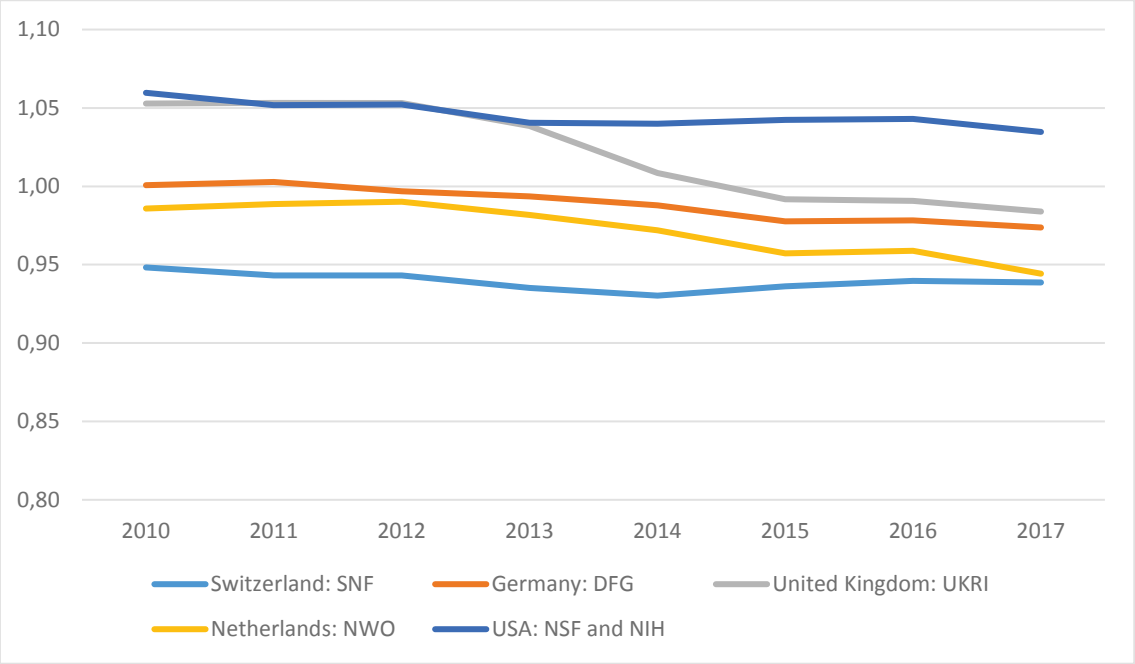


Source: Web of Science, queries and calculations by Fraunhofer ISI

6 Co-Publications

Co-publications are an indicator for scientific collaborations between different organizations that can be divided into international and national co-publications. International co-publications are defined as publications that have at least one partner from abroad, including those that may additionally have national co-authors. In contrast, purely national co-publications are defined as publications with at least one cooperation partner from the same country (but from a different organization), excluding publications that involve co-authors from other countries.

Figure 8: Share of co-publications in all publications: RCAP in relation to all national publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

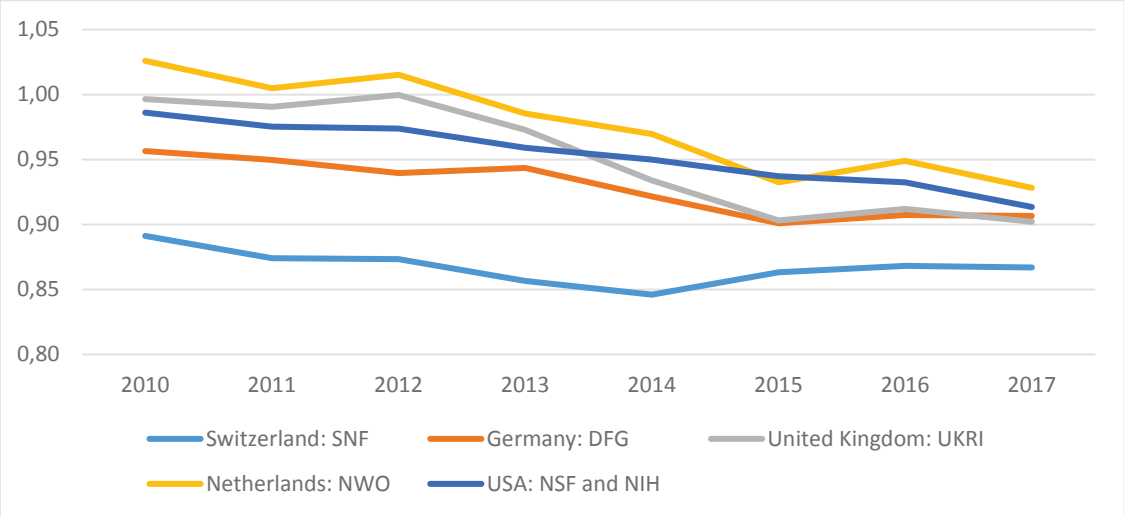
Figure 8 shows the development of the relations between the share of all research council acknowledging co-publications in all RCAP of a country and the share of the total number of all co-publications in all publications of a country. In short, it indicates whether research council acknowledging publications are more commonly drafted in collaboration with co-authors than others, i.e., whether there are indications that research council funding triggers any additional collaboration at all.

We find that the authors of RCAP publications tend to collaborate less with authors of other institutions compared to the national average. Only the USA shows a co-publication rate among RCAP (75% in 2017) that is marginally higher than the national average (73% in 2017). In contrast, publications acknowledging the Swiss SNF display a lower co-publication rate than the average (81% vs. 86% in 2017). In 2010, we find a higher collaboration rate among RCAP (69%) than among all national publications (66%) the UK while

the shares of co-publications among German (70%) and Dutch (74%) RCAP are close to the national average. Since then, however, the shares of co-publications in RCAP have decreased in relative terms and fallen behind the national average in all three countries, to 77% versus a 79% average in Germany, to 79% versus a 84% average in the Netherlands and to 77% versus a 78% average in the UK.

In summary, we find that, with the exception of the US, publications funded by national research councils are less commonly drafted in collaboration than other publications that do not acknowledge any such funding. However, the deviations are in most cases not substantive. In the following, we will examine the relation of the co-publication rate of RCAP to the national average for international as well as purely national collaboration in order to investigate differences among the two types of cooperation.

Figure 9: Share of international co-publications in all publications: RCAP in relation to all national publications

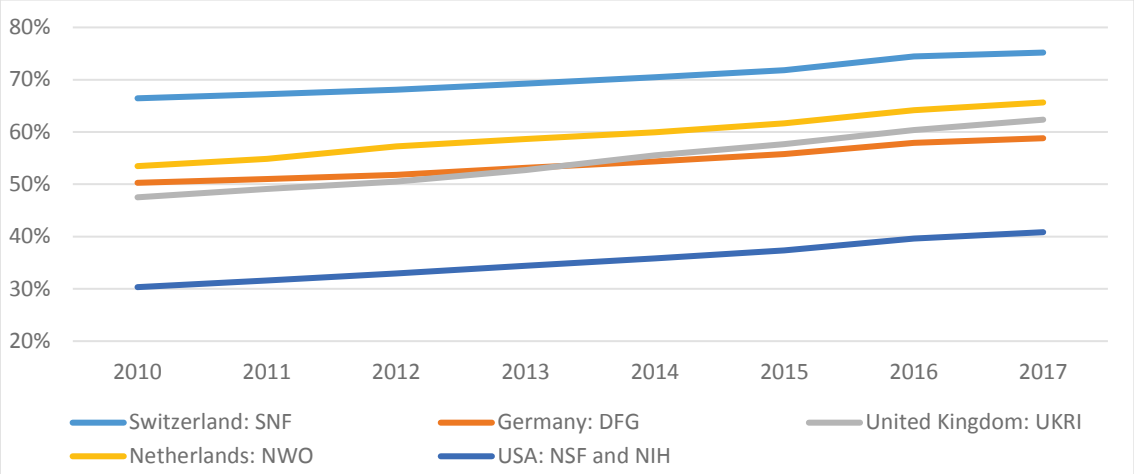


Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 9 shows the development of the relations between the share of international research council acknowledging co-publications in all RCAP of a country and the share of the total number of international co-publications in all publications of a country. In short, it indicates whether research council acknowledging publications are more commonly drafted in collaboration with international co-authors than others.

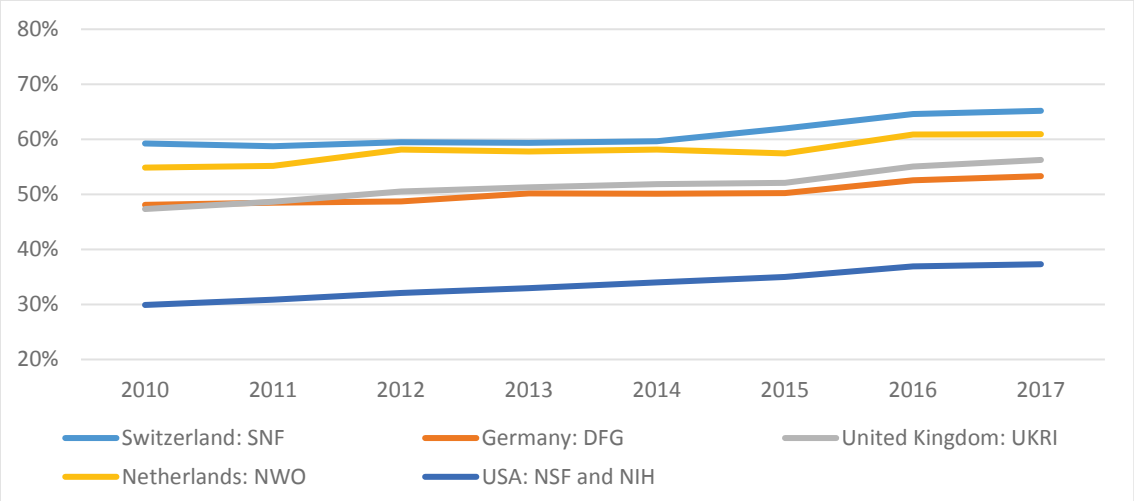
In practice, our findings indicate that the opposite is the case. The international co-publication rate among RCAP is notably below average and decreases markedly since 2012. This negative trend that has only very recently slightly abated, when, after 2015, most international co-publication rates began to increase again. However, after 2016 the decreasing trend continues.

Figure 10: Share of international co-publications in all national publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 11: Share of international co-publications in all RCAP

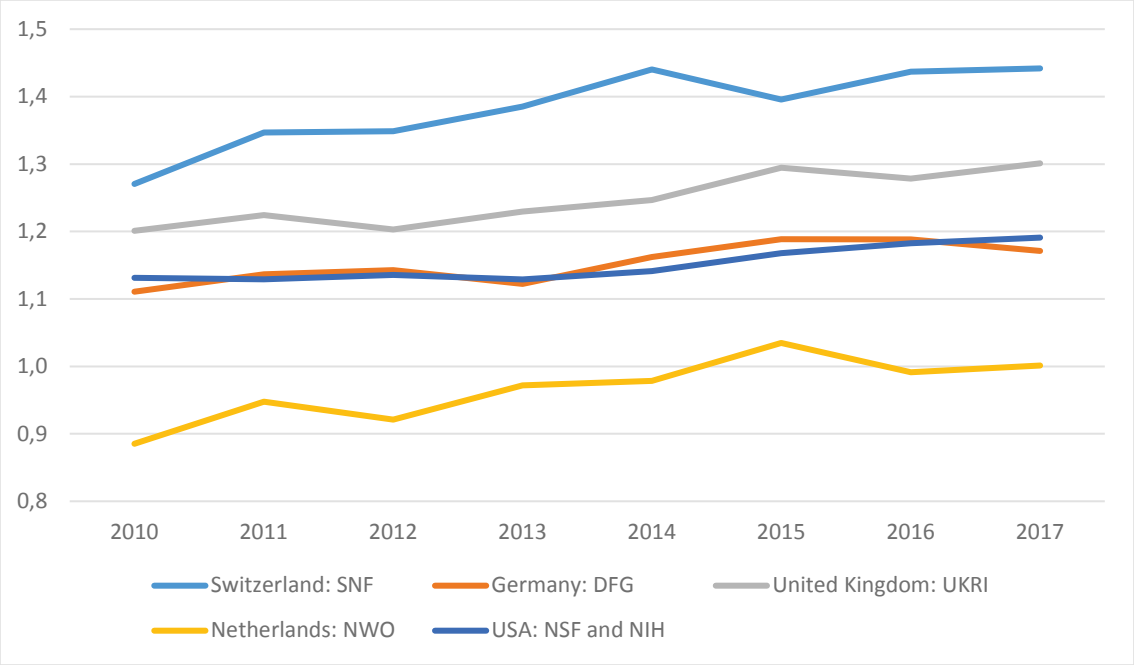


Source: Web of Science, queries and calculations by Fraunhofer ISI

Only in the Netherlands has the share of co-publications ever been higher among those acknowledging the NWO than on average. Between 2010 and 2012, the share of international co-publications among Dutch RCAP is 55 - 58% versus 53 - 57% for all Dutch publications (cf. Figure 10, 11). Since 2013, however, the share of international co-publications in Dutch RCAP decreases in relative terms and has fallen behind the national average. In all other countries, the international co-publications rate among RCAP has been below average from the onset. For example, Germany's international co-publication rate in 2017 was 53% among RCAP versus 59% on average. In Switzerland, the difference was even higher with an international co-publication rate of 65% among RCAP versus one of 75% among all Swiss publications. In the UK, the share of international co-publications among the RCAP reaches almost the share of all co-publications in the UK (51%) in 2012, however in 2017, the share of RCAP co-publications accounts for only 56% while the national average is 62%.

In summary, the analysis thus unambiguously demonstrates that publications funded by national research councils are less commonly drafted in international collaboration than other publications that do not acknowledge any such funding.

Figure 12: Share of purely national co-publications in all publications: RCAP in relation to all national publications



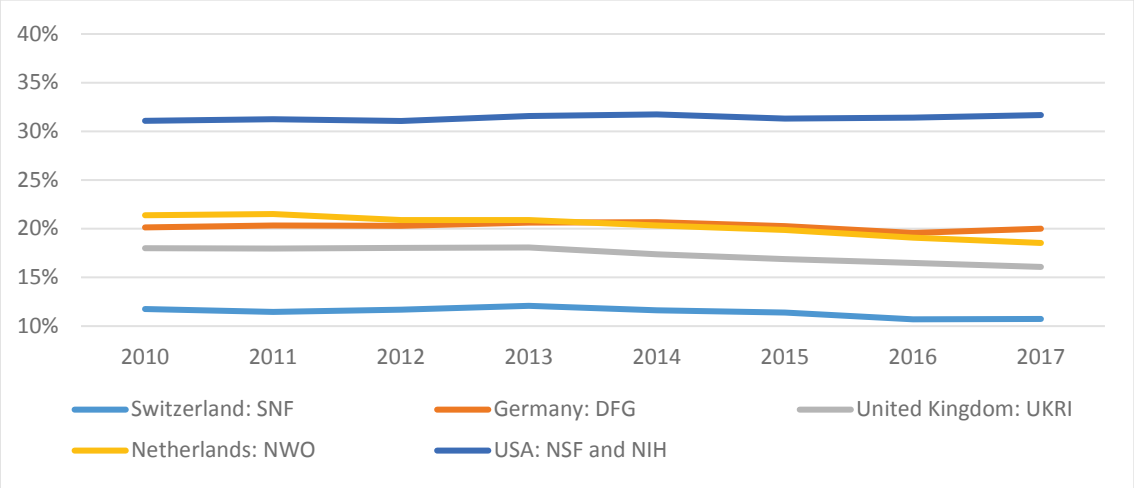
Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 12 shows the development of the relations between the share of purely national research council acknowledging co-publications in all RCAP of a country and the share of the total number of national co-publications in all publications of a country. In short, it indicates whether research council acknowledging publications are more commonly drafted in collaboration with national co-authors (exclusively) than others.

In contrast to the findings for international co-publications, shares of purely national co-publications among RCAP range notably above national average for Germany (23% versus 20% in 2017), Switzerland (15% versus 11% in 2017), the UK (21% versus 16% in 2017) and the USA (38% versus 32% in 2017), cf. Figure 13, 14. Only the Netherlands display a slightly different picture with by and large below average national cooperation rates among RCAP, e.g. 19% versus 21% in 2010. Overall, this is an interesting fact since – on the other hand – the Netherlands are the country with the highest international cooperation rate among RCAP. From an opposite perspective, this general pattern of opposing inclinations regarding international and purely national cooperation can also be found for other countries. Switzerland, for example, displays the lowest relative prevalence of international co-publications among RCAP but the highest with respect to purely national co-publications.

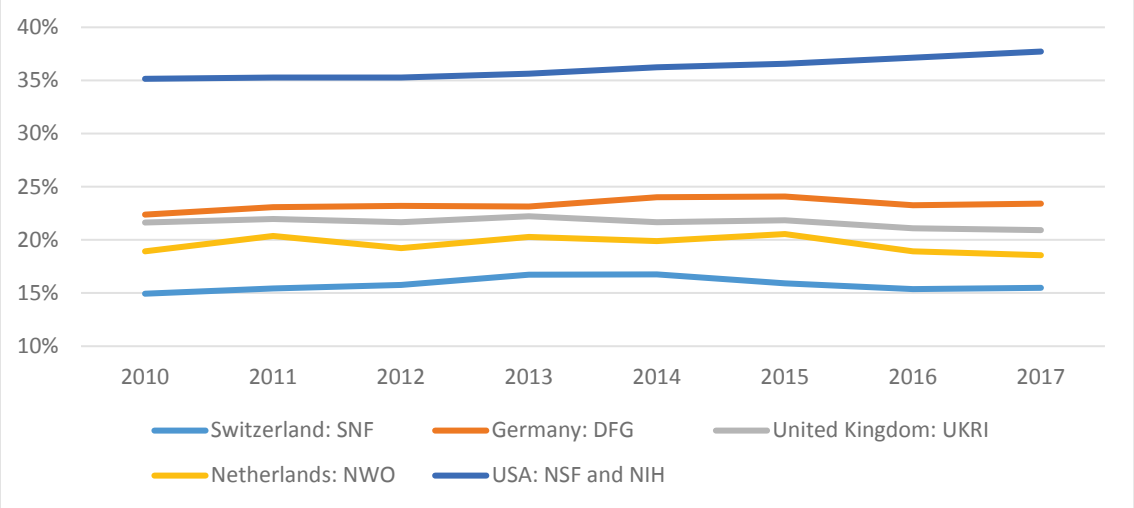
Different from the trend for international collaboration, moreover, the positive deviation of purely national co-publication rates among RCAP and those among other publications are widening in all countries under study. Since 2010, for example, the relation of purely national co-publication rates in Germany has increased from about 1.1 to about 1.2.

Figure 13: Share of purely national co-publications in all publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 14: Share of purely national co-publications among RCAP in all RCAP



Source: Web of Science, queries and calculations by Fraunhofer ISI

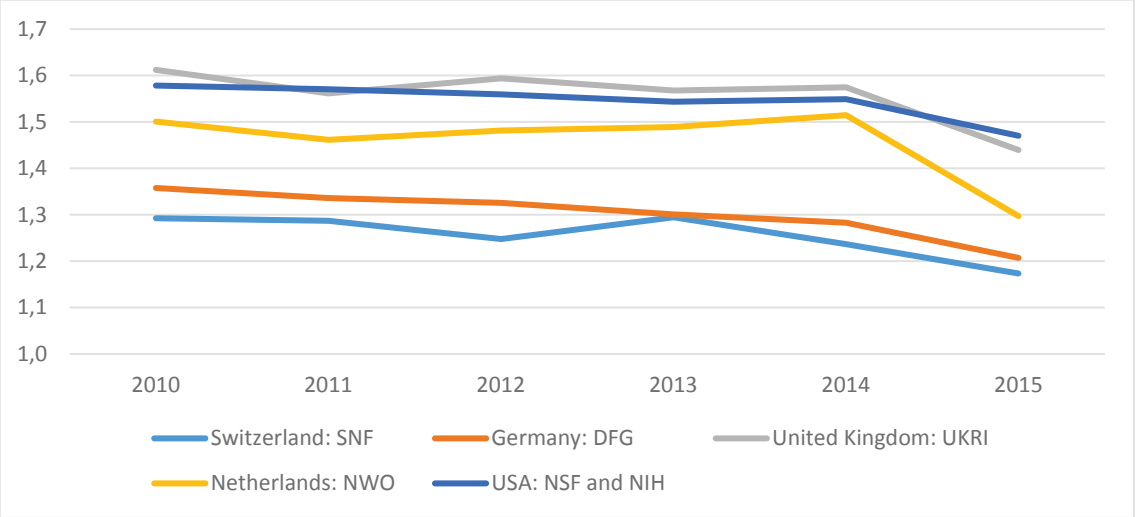
7 Share in top cited publications (Excellence Rate)

This section focuses on the prevalence of genuinely excellent publications among RCAP. For each country, the number of publications belonging to the worldwide top 10% based on field-specific citation rates is calculated and set in relation to the total number of its publications. This share of highly cited publications is known as "Excellence Rate" (Bornmann et al. 2012; Waltmann and Schreiber 2013).

In line with the above analysis of co-publications, Figure 15 displays the relation between the Excellence Rates among a country's RCAP and that among all national publications. In all countries, the Excellence Rates remain fairly stable over the years. After 2014, however, we can observe a certain (in the case of the Netherlands notable) decrease in the Excellence Rates of the RCAP while they remain stable for all national publications.

Each of the countries has an overall Excellence Rate that surpasses the reference value of 10% (Switzerland 19%, Netherlands 17%, UK 15%, Germany and USA 14% in 2015). Nonetheless, the Excellence Rate among RCAP surpasses the national average in all countries. The most notable positive deviations for RCAP are found in the US with an Excellence Rate of 20% in 2015, the UK (21%) and the Netherlands (22%) (about 5-7 percentage points above average each). Germany and Switzerland, in contrast, display lower deviations with RCAP Excellence Rates of 17% in Germany and 22% in Switzerland in 2015 (3 percentage points above average).

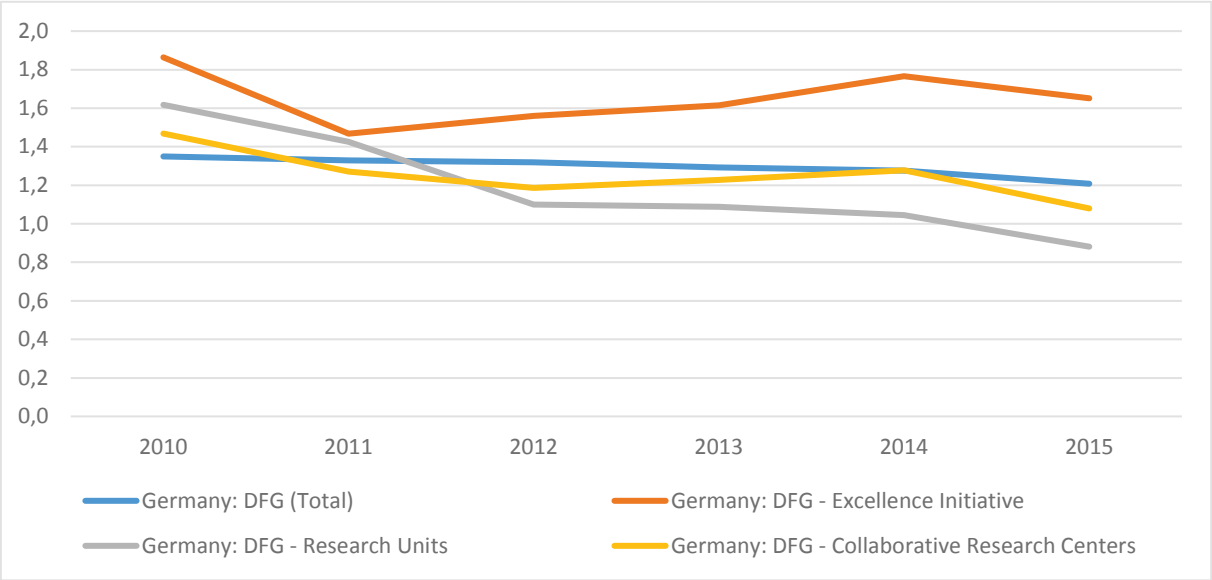
Figure 15: Excellence Rate: RCAP in proportion to all national publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

Figure 16 displays the comparison of the Excellence Rate for the publications acknowledging individual DFG programs to the Excellence Rate for all German publications. Once more, the abovementioned limitations regarding the validity of the underlying data apply. Nonetheless, the available data seem to indicate that publications funded by the Excellence Initiative display somewhat higher Excellence Rates than general DFG acknowledging publications while this is not the case for those referring explicitly to Collaborative Research Centres and the contrary applies to those referring to Research Units. Importantly, it must be noted that this analysis cannot control for any positive selection biases which are in practice quite likely.

Figure 16: Excellence Rate: RCAP of DFG funding programs in proportion to all German publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

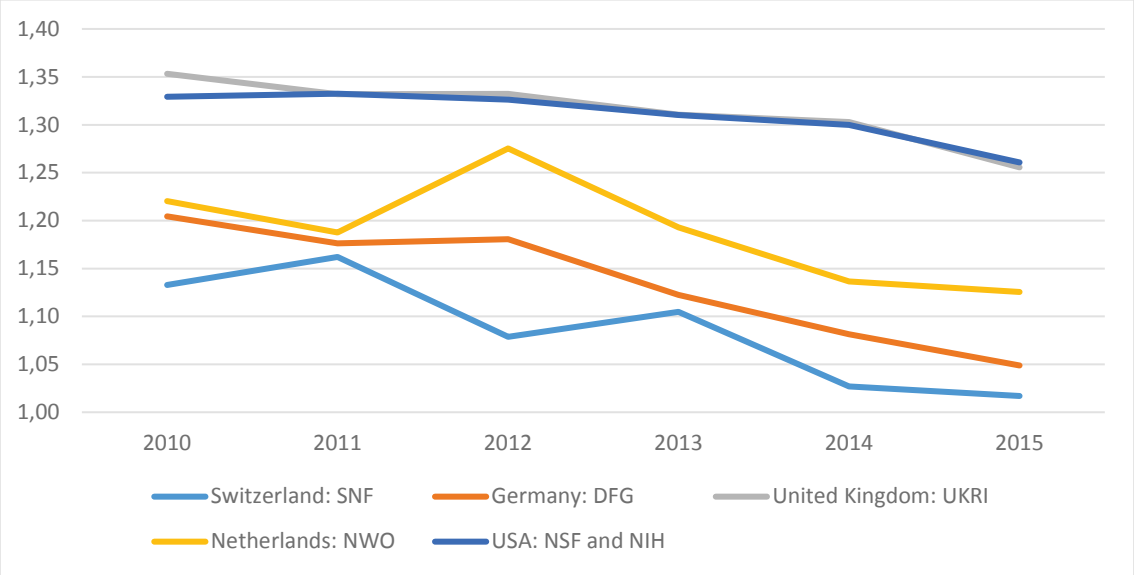
8 Discipline-specific citation rate (Crown Indicator)

The discipline-specific citation rate, also known as Crown Indicator (CI), assesses the citation rate for a country or another set of publications taking into account varying citation rates in different scientific disciplines. The indicator is defined as a normalized value with 1.0 indicating the international average. Thus, a CI of 1.4 indicates that the publications of the analyzed set are cited 40% above the international average, 0.8 means that the citation rate is 20% lower than the international average. (Waltman et al. 2011)

Figure 17 documents the relation between the CI for the RCAP compared to the CI for all publications in the five countries under study. In line with the Excellence Rate, the overall CI for all countries is above the world average (Switzerland 1.7, Netherlands 1.6, UK 1.4, Germany and USA 1.3 in 2015).

Concerning the relation between CIs for the RCAP and CIs for all national publications, positive deviation are highest for the USA with a RCAP-CI of 1.7 and the UK with a RCAP-CI of 1.8 in 2015. While the CI for the Dutch RCAP (1.8) is also higher than the average, the CI for German RCAP (1.4) and Swiss RCAP (1.8) are less distinct from and increasingly national average. Despite some fluctuations, moreover, Germany, the Netherlands and Switzerland display clear tendencies of convergence between RCAP-CI and the CI on national average.

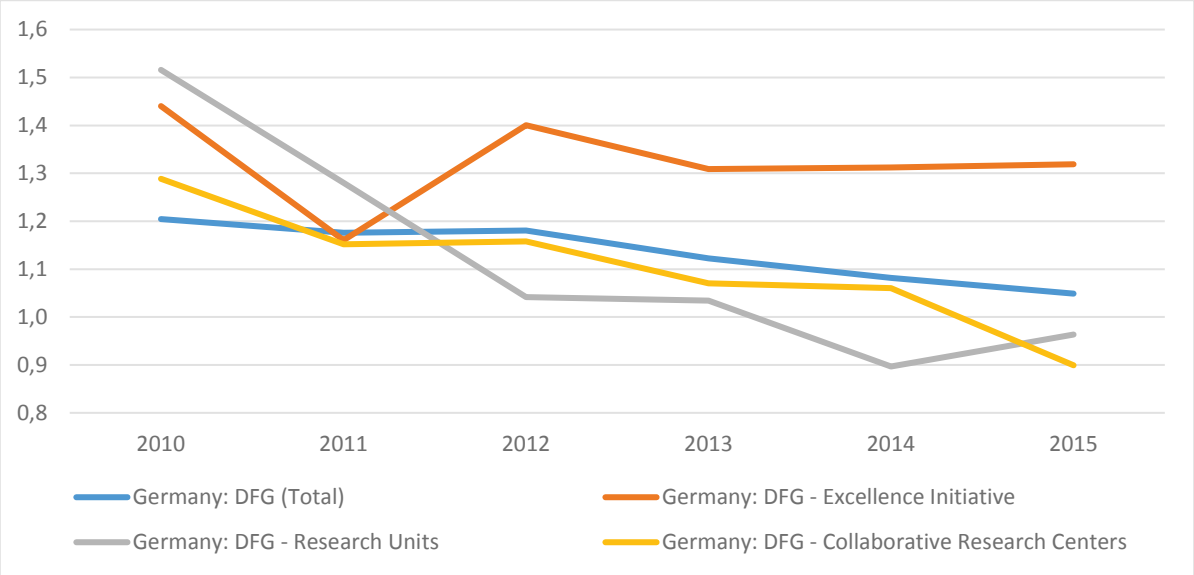
Figure 17: Crown Indicator: RCAP in proportion to all national publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

In Figure 18, the CI for the publications acknowledging specific DFG programs is compared to the average CI of DFG acknowledging publications. Once more, the underlying data support only very generic conclusions. In line with the findings for the Excellence Rate, the CI of publications acknowledging the Excellence Initiative appears notably above average. Publications acknowledging Collaborative Research Centers reach a CI similar to that for publications acknowledging the DFG in general with a very recent decreasing tendency. The Crown Indicator of publications acknowledging Research Units, in contrast, has been decreasing notably to a level below general national level.

Figure 18: Crown Indicator: RCAP DFG funding programs in proportion to all German publications



Source: Web of Science, queries and calculations by Fraunhofer ISI

9 Summary

In summary, the analysis of research council acknowledging publications reveals a number of general findings.

First, the number of research council acknowledging publications (RCAP) has been growing in all five countries, following additional investments in basic research. However, the relative increase of publication activities that are verifiably funded by research councils has been lower in Germany than elsewhere (except the US).

Second, the relative share of RCAP has remained stable in all five countries since 2010. Absolute increases in RCAP have not triggered changes, as other publication activities have grown proportionally. In fact, the degree of continuity of the relation between RCAP and all publications is quite remarkable.

Third, the share of RCAP is generally higher in the natural sciences than in engineering and generally lowest in the social sciences and humanities. This finding applies across all countries under study with very minor variations. As the effect is found equally in both Web of Science and SCOPUS it cannot simply be attributed to journal coverage.

Fourth, RCAP are less commonly based on international collaborations and more commonly based on purely national collaborations than other publications. This two-sided effect is increasing as the deviation of RCAP's international and purely national collaboration rates from the national average increases in either direction. Germany occupies middle ground between Switzerland with notably *below* average international and notably *above* average national collaboration rates and the Netherlands in which both rates are closer to (but still distinct from) the national average.

Fifth, RCAP display above average Excellence Rates and Crown Indicators across all countries under study. In Germany (as well as in Switzerland), however, these differences are less pronounced than elsewhere, notably in the US and the UK. In general, RCAPs' positive deviations in Excellence Rates have been stable over the years. Very recently, however, there is a decreasing tendency, through which e.g. RCAPs' Crown Indicators seem to be converging towards the respective national average in several countries.

Finally, an analysis of RCAP reporting funding from specific DFG programs indicates that the number of publications acknowledging the Excellence Initiative and, to an extent, those acknowledging Collaborative Research Centres has been increasing dynamically and that they reach above DFG average quality standards. For those that acknowledge Research Units, in contrast, no such effects could be identified. Due to data limitations, however, these findings should be considered as indicative rather than definite.

Appendix 1: Numbers of publications

Annex Table 2: Numbers of publications in the five countries (2010-2017)

	2010	2011	2012	2013	2014	2015	2016	2017
Switzerland	23.549	25.331	27.038	28.637	29.590	30.967	32.596	33.716
Germany	93.168	97.864	102.057	105.977	106.904	110.617	113.562	115.559
United Kingdom	103.919	107.908	112.270	118.281	118.953	125.347	129.540	131.765
Netherlands	33.592	35.388	37.889	39.691	40.441	41.810	43.062	43.244
USA	368.377	383.510	395.290	409.920	417.071	426.447	432.386	435.083

Source: Web of Science, queries and calculations by Fraunhofer ISI

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