Inventory of Research Excellence Policies in Four Countries

Report contributing to the Rathenau Institute’s project “Excellente Wetenschap”

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Preface

This report makes a number of observations on the rationale, design and impact of different policy instruments used to promote scientific excellence in European science systems. For consistency, throughout the report such policies are defined “excellence initiatives” even though national terminology might be different. The detailed descriptions of the four cases are presented in Part II. This report covers four countries which all make use of some form of excellence initiative and each applies its own design according to its national priorities and constraints.

Part I of the report presents some of the observations and lessons that may be drawn from initiatives in Denmark, Germany, Switzerland and the United Kingdom. These conclusions (particularly those detailing impacts on differentiation and additionality) should be read as suggestive rather than definite because of some methodological limitations which are inherent in the scope of this research, but which could be overcome through a more extensive study:

- First, the findings are based on secondary data such as evaluation reports, policy studies and scientific literature. Interviews were also conducted with key stakeholders. A more far-reaching endeavour should delve into original empirical measurements;
- Secondly, while excellence initiatives have common features – as described later in this report – they are always tailored to national contexts. Therefore, they differ significantly from one another in their design and understanding of success. In turn, this implies that not every effect could be observed or disproved with equal certainty.
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1. Introduction

Models for funding public higher education institutions – and specifically for supporting research excellence – vary between countries. Differences may include for instance who receives the endowment, and the types of activities that are supported. Funds might follow individual researchers or be tied to an institution; the policy might favour the creation of Centres of Excellence (CoE), the development of institutional strategies, or departmental research activities; etc. Many countries distribute public research funding according to performance and increasingly on a competitive basis (Hicks 2012; Lewis & Ross 2011; Jonkers & Zacharewicz 2016; Lepori et al. 2007; Jongbloed, Lepori & Huisman 2015).

Excellence initiatives can contribute to national strategies in different ways, namely (i) capacity-building, (ii) competitive research and (iii) prioritisation. As the cases also evince, stratifying the system requires capacity-building (human and infrastructural) and more competitive funding for research projects. Prioritisation can take place in mature systems that have already undergone the capacity building and competition phases (European Commission, 2009).

Hessels (2013) refers to “coordination instruments” to shape the relationships amongst the activities in a system in order to enhance their common effectiveness. Seven aspects characterize excellence policies, including (1) the coordinating actor, (2) the system addressed, (3) the activities subject to coordination, (4) the intervention taken to modify the relationships among these activities, (5) the types of relationships that are established or strengthened by this intervention, (6) the mechanism making it possible that these relationships enhance the effectiveness of the system, and (7) the kind of performance of the system that the actor aims to enhance1.

2. What are “excellence initiatives” and what are their goals?

Excellence initiatives are policy instruments designed to encourage exceptional research (OECD 2014). Although promoting scientific excellence has always been a goal of science policy, research excellence initiatives have gained popularity over the last decade. They are novel because they explicitly target a limited number of top research performers with very large-scale and long-term funding.

These initiatives concentrate resources to “[...] raise the research and innovation capacity of national research landscapes” (OECD 2014, p. 21). As such, they are grounded in an efficiency argument that assumes strong vertical differentiation will produce positive spillovers on the system’s performance. Hence, all excellence initiatives require significant and visible public investments. Of course, money must complement other critical elements such as academic autonomy, balancing core and competitive funding, transparency, accountability, and sustainability (European Commission, 2009). Still, capital is the condicio sine qua non for designing and implementing policies to promote top research.

In this document excellence policies will be defined as public initiatives that promote competition and selectivity within the research system in order to produce outstanding research. A consequence is, then, a more stratified and differentiated system. From this perspective, although “excellence initiatives” is the “fashionable” phrase, one might argue

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1 Elements (3) and (5) are the examples presented in the text. For a more in-depth cross-national comparison based on Hessels’ heuristic tool, see Horlings et al (2016).
that talking about “selectivity policies” would be more appropriate. As the report will detail, funding is the predominant policy lever. Governments use primarily funding mechanisms to stimulate competition, and policy success is often (albeit not exclusively) measured by bibliometric data.

Excellence initiatives can take different forms. In some cases, such as in Germany, extra funds are disbursed above and beyond regular research funding. In other cases (e.g. the UK), the policy allots block grant funding according to performance. The Swiss National Centres of Competence in Research (NCCR) scheme is based on co-financing, including a share from the Swiss National Science Foundation (SNSF) and shares from other sources. In Denmark, the CoE funding is part of the performance-based element of research funding, administered by the Danish National Research Foundation (DNFR).

Finally, funding decisions can be based on *ex ante* or *ex post* evaluations. The UK’s Research Excellence Framework (REF) is an example of an *ex post* evaluation of research quality. The universities’ block funding is contingent on ratings of research quality from the prior five years, assessed through peer review. In contrast, the German, Danish and Swiss schemes allocate funds based on an *ex ante* assessment of proposals.

This description of excellence initiatives, based both on the literature and the cases described in Part II, raises interesting questions. For example, to what extent is financial support justified on the grounds of outcomes vs. intentionalities? This distinction refers to the difference between *ex ante* and *ex post* evaluations mentioned above, and the “hard” and “soft” nature of the contracts between funders and beneficiaries. Systems such as the Danish CoEs are based on the assessment of proposals (i.e. intentionalities/plans), which generally require interim and final project evaluations. However, the “hard” or “soft” nature of the agreement (how and what will be finally evaluated) can differ from country to country (see also de Boer et al, 2015, pp. 12 ff.). And because both *ex ante* and *ex post* decisions are primarily based on peer assessment, what constitutes excellence in research is often a matter of consensus based on the professional expertise within the team rather than a clear measurable indicator.

Secondly, does this description of excellence initiatives imply a specific definition of excellent research? Often, top research performance is measured by bibliometric indicators and academic and peer review, which favour basic research. Yet, excellence initiatives may support different forms of excellence. For example, the REF includes a criterion on social impact purportedly to offset the former RAE’s perceived overemphasis on “excellence as peer review” (interview data – Sweeney). The German Excellence Initiative includes the promotion of institutional strategies to develop research potential, and the Swiss scheme was designed *inter alia* to empower institutional management.

Table 1, below, is a snapshot of the key outputs and expenditures of the initiatives considered in this report (see also Horlings *et al*, Table 1).

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2 This was one of the reasons why compared to the RAE, the REF gave greater weight to metrics to inform peer review and more consistency among panels
### Table 1. Key indicators of output and expenditure

<table>
<thead>
<tr>
<th>Instrument</th>
<th>DNRF CoE (DK)</th>
<th>Excellence Initiative (DE)</th>
<th>NCCR (CH)</th>
<th>REF (UK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of draft or pre-proposals</td>
<td>851</td>
<td>63 b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>number of full proposals</td>
<td>241</td>
<td>23 b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>number of funded projects</td>
<td>100 CoEs</td>
<td>184 a)</td>
<td>8 b)</td>
<td>1,911 submissions by 154 universities</td>
</tr>
<tr>
<td>approximate success rate</td>
<td>6%</td>
<td>13%</td>
<td>13% b)</td>
<td></td>
</tr>
<tr>
<td>total budget</td>
<td>€4.6bn</td>
<td>€2.1bn c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>approximate annual budget</td>
<td>&gt; €40 million (≥80% of 52 million in 2013)</td>
<td>€460m</td>
<td>c. €160m</td>
<td>total mainstream QR funding for 2015-16 £1,017 million</td>
</tr>
</tbody>
</table>

a) The total budget for the 184 projects is €4.3bn. b) 2014. c) Including SNSF grants, home institution, participants in projects, and third-party funds; exchange rate CHF 1 = € .92 (08/2016)

### 3. What are the effects of excellence initiatives?

Vertical differentiation, both between institutions and between individuals\(^3\) is assumed to make the system more attractive and to create system-wide additionality that is, the production of outcomes that would not have happened without the intervention (Tyler et al., 2009). Although it is a broad concept, in the science system five types are generally identified, including (Bloch et al. 2014):

1) Input additionality: facilitate research activities that would not otherwise have been possible;
2) Output additionality: for example publications, patents, new products or services;
3) Behavioural additionality: e.g. the choice of research topics/areas, size of research projects, publishing strategy, risk-level in research, or international collaboration;
4) Career additionality, including changes in research position, mobility and workplace, etc.; and
5) Institutional additionality, i.e. the degree to which grants have impacted host institutions and other connected research environments.

Based on the four cases (and considering the caveats presented in the preface), this section draws conclusions on the impacts of excellence initiatives in terms of differentiation and additionality.

#### 3.1 Excellence initiatives’ contribution to differentiation

Excellence initiatives have an effect on vertical differentiation between institutions within the system. However, the extent to which policies have, thus far, been successful in actually producing inter-institutional differentiation remains questionable. The cases suggest that

\(^3\) Differentiation can be “vertical” or “horizontal”. Vertical differentiation discriminates units of analysis based on their “quality”, “excellence”, “éliteness”, or “reputation”. Horizontal differentiation emphasises, for example, curricula and institutional profiles (Teichler, 2006). An example of horizontal differentiation is a binary system where universities of applied sciences are seen as “equal but different” to research universities.
excellence initiatives in the four countries expose and in some cases reinforce differentiation but do not generate it. This means that (a) to a large extent differentiation is intrinsic to every system albeit in different forms and to different degrees and (b) excellence initiatives add marginally to the degree of differentiation but, by making it visible, they contribute significantly to a system’s transparency.

Effects on individual differentiation are harder to gauge because the initiatives target primarily institutions. However, there is an understanding that institutional performance is related to individual performance and some excellence initiatives do link funds to individual performances. This means that, in general, excellence initiatives strengthen individuals because they give an important role to principal investigators. At the same time, one may question the contribution of these policies to advancing a new generation of researchers. For example, the German Excellence Initiative has a graduate school track but this will not be included in the next round because the policy is not designed to be a career support system; the REF allows institutions to “pick and choose” what staff to present for the evaluation.

Table 2 summarizes the effects of different excellence initiatives. The assessment emphasizes the contribution of excellence initiatives to differentiation in the system. The following paragraphs give some further details per country.

Table 2. Assessment of the effects of different excellence initiatives on differentiation

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Description</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DNRF (DK)</strong></td>
<td>DNRF-publications in highly cited journals increased more strongly than non-DNRF publications.</td>
<td>The DNRF scheme affects differentiation within the Danish science system both at the institutional and individual levels (although the latter is harder to assess conclusively). However, the strongest performers remained the same over time, which suggests that the initiative reinforces an implicit existing differentiation in the system.</td>
</tr>
<tr>
<td></td>
<td>The gap in publication output and citations between universities participating in DNRF CoEs and the world’s most renowned research universities has been diminishing over time.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DNRF publications have higher impact than non-DNRF publication and the difference is consistent over time.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A few strong performers (University of Copenhagen, Aarhus University and the Technical University of Denmark) produce two-thirds of public research and host 73% of CoEs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research productivity and impact of the researchers seems to increase as a result of participating in CoEs.</td>
<td></td>
</tr>
<tr>
<td><strong>Excellence Initiative (DE)</strong></td>
<td>Excellence Initiative publications in highly cited journals increased more strongly than non-Excellence Initiative publications.</td>
<td>The Excellence Initiative affects differentiation within the German science system but primarily at institutional level. Effects on individuals are indirect.</td>
</tr>
<tr>
<td></td>
<td>The gap in publications output between Excellence Initiative universities and non-Excellence Initiative has increased. However, the Excellence Initiative has not improved the publication performance at the aggregate level.</td>
<td>The Excellence Initiative provides transparency and reinforces an implicit (existing) differentiation in the system. Old top universities are redefined as “new top universities”</td>
</tr>
<tr>
<td></td>
<td>The institutional ranking of DFG awards over time does not change meaningfully depending on institutions’ inclusion in the Excellence Initiative.</td>
<td></td>
</tr>
</tbody>
</table>
The programme gives an important role to PIs in the research clusters. This strengthens individuals and rewards “big names”.

**REF (UK)**

The aggregate output quality improved (e.g. in comparison with the RAE).

Research funds have been concentrated for decades. The competitive allocation model was intended to avoid spreading out resources throughout the whole system, especially after 1992.

Richer universities benefit because they can better afford the costs of participating (and “gaming”) the system.

The REF seems designed to perpetuate existing differentiation rather than facilitating changes in the order of institutions according to their performance. This can be construed by the changes in weights in the funding allocations to pursue selectivity and concentrate resources (i.e. increasing the premium for excelling favours already top universities).

There is no evidence that the REF/RAE yields differentiation between individuals.

**NCCR (CH)**

Differentiation is embedded in the Swiss science system. The NCCR scheme promotes collaborations and strengthens central management in institutions.

There is some evidence that participating in a NCCR does not weaken researchers’ competitiveness. However, it does not seem to have a significant effect in strengthening it either (based on ERC grant numbers).

Switzerland does not have a strong tradition of thematic funding and research policy is very decentralized and funding has traditionally been generous. Switzerland has been traditionally a very strong research performer. There is no “excellence initiative” in the sense ascribed to the other systems.

**Denmark**

In Denmark, the share of DNRF-publications in journals indexed by Thomson Reuters Web of Science has increased at a far faster pace than non-DNRF publications. Schneider and Costas (2013, p.30) indicate that between 1993 and 2011 Danish publications (overall) more than doubled, from less than 6,000 to almost 14,000. If one disaggregates this information into DNRF and non-DNRF publications, it becomes clear that the former increased at a far greater pace, from 0.5% to 10.8% of the total Danish output.

Moreover, DNRF publications outscore non-DNRF publications in all impact indicators, and do so consistently over time. However, changes in institutional performances appear to go in the same direction, indicating that the CoE programme did not cause but rather reinforced erstwhile differences in the system. And indeed, the programme’s stated goal was to strengthen the research environment, not to explicitly increase vertical diversity. Yet, in conjunction with university mergers, stronger differentiation did ensue (interview data - Aagaard). A limited number of stronger performers (University of Copenhagen, Aarhus University and the Technical University of Denmark) effectively produce two-thirds of public research in Denmark (European Commission, 2016; interview data – Aagaard). These same institutions are host to 73% of CoE.

At the individual level, it is hard to identify straightforward effects. However, the nature of the CoE scheme (which is meant to support research based on researchers’ own initiatives)
may influence individual performance. A study on excellence initiatives in Nordic countries, which included three Danish CoEs, compared principal investigators’ publication and citation scores before and during the CoE period (Langfeldt et al., 2013). The study concluded that, in general, research productivity and impact of the researchers increases as a result of the CoE.

**Germany**

Bibliometric data of German universities suggest that the Excellence Initiative did affect differentiation. Between 2008 and 2011 the gap in publications and in highly cited publications (top-10%) between universities participating in the Excellence Initiative and those not participating, increased (IEKE, 2016, p. 19; Hornbostel and Möller, 2015, p.48). While the proportion of highly cited publications of non-Excellence Initiative universities remained relatively stable over time, that of Excellence Initiative universities – particularly universities with an Institutional Strategy (“ZUK-unis”, from Zukunftskonzept in German) – increased4. However, a key question remains as to whether these effects will be permanent. Initially it was not certain whether support would continue after 2017 (Hornbostel and Möller, 2015, pp.49 ff.) but several universities still expected (and in their planning, relied on) continued funding. In fact, the scheme will continue, albeit under a different mode and a different name (“Excellence Strategy”). This decision is consistent with the international evaluation commission’s (IEKE) recommendations5.

There are also indications that the Excellence Initiative has made existing differentiation amongst universities transparent. Although not explicitly, the German university system has always been divided between stronger and weaker research institutions. The Excellence Initiative appears to redefine “old top universities” as “new top universities” (see also Hornbostel and Möller, 2015, p.52; Kehm, 2012). For example, if one compares the institutional ranking of DFG awards with and without consideration of the Excellence Initiative, one will find that the rankings do not change meaningfully depending on institutions’ inclusion in the Excellence Initiative (DFG, 2012, p.76). In other words, the “winners” would be so regardless of the Excellence Initiative, but the ensuing public debate has highlighted marked differences in research performance across German universities and has ended the idea that “all are equal”. The German Science Council (Wissenschaftsrat, 2011) emphasises that research assessment instruments and have contributed to making differences in research performance more transparent and comprehensible.

Finally, a symptom of increased awareness of how the Excellence Initiative reinforces differentiation between institutions is the establishment of initiatives that attempt to mirror the system’s (newly evident) stratification. For example, shortly after the Excellence Initiative was launched new institutional groupings were formed, such as the “U-15” or the “TU-9”, purporting to represent Germany’s “top institutions”. This is a new trend in Germany, which some consider a reproduction of the British “Russell Group” (interview data - Ziegele).

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4 However, one must keep into account that ZUK-universities started off from a stronger position. Institutional Strategies can only be granted if the university was also successful in attracting at least one graduate school and at least one cluster of excellence. Leading universities with an Institutional Strategy can receive to a €20 million per annum for excellence (See Hornbostel and Möller 2015, p. 31).

5 The independent international panel of experts (Internationale Expertenkommission Exzellenzinitiative — IEKE) released its report released in January 2016.
United Kingdom

Though not primarily intended to encourage differentiation, the REF reflects the system’s existing stratification (interview data – Sweeney). Research funds have been concentrated in select research universities already since the 1980s. The introduction of a competitive allocation model was primarily intended to avoid spreading out resources throughout the whole system after polytechnics were upgraded in 1992 (Jongbloed and Leport, 2015). Moreover, in their analysis of the UK’s research assessment policies since the 1980s, Geuna and Piolatto (2016) observe that the government has repeatedly changed the weights in the funding allocations to pursue selectivity and concentrate resources in top scoring departments thus increasing the premium for being at the top. Geuna and Martin (2003) also highlight that rising costs for universities to participate in the RAE mean that richer universities have a competitive advantage, thus reinforcing existing inequalities. These findings suggest that the system perpetuates existing differentiation rather than facilitating changes in the order of institutions according their performance. For example, the table of excellence based on the REF results and produced by the Times Higher Education shows that “traditional research powers dominate” (Jump, 2014).

Finally, existing inequalities seem to be reinforced by two further features of the REF. On the one hand, there is an apparent dissonance between the REF’s incentives for disciplinary research and the policy push towards interdisciplinary and transdisciplinary research. On the other hand, there is evidence to indicate that the REF lends itself to being “gamed” because institutions can choose whether they participate, and how (e.g. what units and staff to present).  

Regarding individual differentiation, the REF does not significantly reshape the output profiles of different groups of staff. The REF analysis reveals that research outputs by early career researchers and staff with other circumstances are of equal quality to outputs by all staff (about 20% of 4* and over 70% 3*+4*). This suggests that, also at the individual researchers’ level, the REF maintains and reflects extant differentiation. In addition, the focus on publication numbers may be detrimental to producing real “breakthrough research” because opening new research lines typically requires strong investments thus not publishing for some time as a centre is built or innovative findings are produced. In turn, this means that there will be no immediate significant changes in the relationships between science performers (individuals of institutions).

Switzerland

Differentiation of funding is an integral part of Switzerland’s science structure. The ETH domain, the cantonal universities and the Universities of Applied Sciences are in principle horizontally differentiated. However, the distribution of resources favours the Federal Institute of Technology Zurich (ETHZ) and Federal Institute of Technology Lausanne (EPFL), which serve as “showcases” for the federal government. Hence, the system is de facto vertically differentiated. On the other hand, Switzerland has adhered strongly to a bottom-up approach, with some exceptions to support specific fields, which include the

6 A comparison between the results of REF 2014 and RAE 2008 hints at gaming. On aggregate the REF panels found higher output quality than the RAE during the previous period. The overall number of submissions dropped by 11%. Yet, the absolute number of outputs judged to be 4* and 3* increased. The percentage share of “world-leading outputs” (4*) and “internationally excellent outputs” (3*) grew from 51% to 72%. This is why Lord Stern’s review of the Research Excellence Framework suggests that all institutions should be required to enter all their academics.
National Centres of Competence in Research (NCCRs) (interview data – Lepori, Loprieno). NCCRs are networks in specific fields or around a specific topics. They seem to have been particularly successful in bringing about an overall concentration of research activities and rising ambitions in the fields supported. While NCCRs have features of a CoE scheme, in fact the programme supports geographically dispersed constellations and thus differs from traditional CoEs (Öquist and Benner, 2012).

The Swiss Council for Science and Innovation (Conseil suisse de la science et de l’innovation; CSSI) has conducted an impact evaluation of the NCCR programme. The analysis focuses on the NCCRs’ contribution to structuring the higher education landscape in Switzerland and is based on the completed NCCRs (2001-2013). The CSSI review indicates that (a) there might be a relationship between participating in NCCRs and the number of ERC grants, although the same source emphasizes that data are in line with the general trend of ERC grants in Switzerland, and (b) the NCCR instrument appears to have become a tool for institutions’ strategic planning and profiling.

A successful NCCR may be continued after public funding ends: over a dozen new research centres emerged from the NCCRs. A key purpose of the NCCR scheme was to strengthen central university management. An important rationale was to empower (indeed almost “force”) rectorates to prioritize. Researchers must seek support by the Rectorate and it is the rectorate that must decide what proposals to submit. This has proven important for the creation of new centres. Maintaining the existing NCCRs has proven harder as no subsequent funding is expected. The review does point out a “sustainability risk” in that after the end of the 12-year period – when roles and responsibilities are contractually regulated – network members might not comply with agreements made during the funding period. Moreover, it is clear that the roles of the partners (host and other institutions) will change over time (CSSI, 2015).

3.2 The additionality produced by excellence initiatives

All initiatives presented in this report produce some form of additionality as defined above. While it would be unsound to attempt to produce “measurable” relationships between the different policies and specific types of additionality (because of the different designs and contexts in which the policies play out), we can make a qualitative assessments about the types of additionality produced by the different excellence initiatives and their intensity (see also Horlings et al., 2016). For example, input additionality seems to be produced in at least three of the four cases (the UK being the exception, because of the REF’s nature as a “regular” reallocation mechanism of block funds as opposed to a “special initiative”); output additionality appears strongest in Denmark and the UK, while in Germany evidence suggests that on the aggregate publications decreased and Switzerland maintained an already very strong performance in output; on the other hand, behavioural additionality seems strongest in the UK because of the incentive to “game” the system, and in Switzerland because the NCCRs empower central management; graduate school tracks (e.g. Germany) clearly have a bearing on career additionality; and all initiatives have had some effect on institutional research environments, such as changes in strategies and in institutional (research) capacity.
Table 3. Types of additionality per excellence policy

<table>
<thead>
<tr>
<th>Input additionality</th>
<th>DNRF CoE (DK)</th>
<th>Excellence Initiative (DE)</th>
<th>NCCR (CH)</th>
<th>REF (UK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding for CoEs</td>
<td>Funding for CoEs</td>
<td>Co-financing NCCR (42% from HEIs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output additionality</td>
<td>Boost to total output of Danish science</td>
<td>No: global shares of publications and highly cited publications decreased slightly</td>
<td>Increase in output quality</td>
<td></td>
</tr>
<tr>
<td>Behavioural additionality</td>
<td>Encourages management prioritisation</td>
<td>Gaming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Career additionality</td>
<td>Expected attract talent</td>
<td>Graduate schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional additionality</td>
<td>Yes (UNIK)</td>
<td>University status and performance</td>
<td>Expected changes in structures, strategies, views</td>
<td>Capacity depends on REF results</td>
</tr>
</tbody>
</table>

4. Concluding considerations

This overview of research excellence policies suggests a number of considerations. Some are unsurprising, and confirm what common sense dictates. For example, there is no one-size-fits-all policy to produce excellent research. Instead, each country has a unique mix of historical, economic, and systemic conditions that lead up to an implementable “excellence initiative”. For example, a German-style excellence initiative would be inconceivable in Switzerland because of (inter alia) the latter’s consensus policymaking in federal funding allocations; Denmark’s CoE scheme fits within a broader reform agenda (which includes e.g. mergers) to reduce system fragmentation; etc. However, it is perhaps worth reflecting on some overarching and often overlooked dilemmas emerging from the cases.

First, if not carefully designed and implemented, excellence initiatives risk realizing the so-called “Matthew effect” (Merton, 1968; 1988) rather than promoting excellent research. In essence, the “Matthew effect” describes how the more eminent research performers are, the more likely it is they will continue to be rewarded, regardless of actual quality of proposals or outputs. This means that (institutional) reputation can turn into a self-fulfilling prophecy as universities or research centres designated as excellent – usually with more resources and more prestige – are ipso facto more likely to be selected for funding in any competition. Indeed, the cases presented in the Annexes A through D show that often today’s excellence policies tend to reinforce existing differences rather than generating excellence in less known or less wealthy institutions. In Germany, for example, DFG data indicate that of all applications the top ten universities received two thirds of the funding (2011-2013 period). Similarly, as mentioned above, in Denmark 73% of CoEs are hosted at three of the eight universities in the country.

7 See e.g. [http://www.spiegel.de/unispiegel/wunderbar/dfg-drittmittelranking-uni-muenchen-bei-forschungsgeld-vorn-a-1051195.html](http://www.spiegel.de/unispiegel/wunderbar/dfg-drittmittelranking-uni-muenchen-bei-forschungsgeld-vorn-a-1051195.html)
A second consideration concerns the type of research excellence initiatives promote. While policies usually intend to promote significant advances in science, the reality may be bleaker. Applicants might have no real incentive to engage in risky breakthrough research, which typically involves prolonged start-up periods and – thus – less opportunities to publish in the short term (which in turn is considered a key indicator of success). Hence, for argument sake, an extreme scenario could be one where policy rewards a well-known scientist or reputable university (Matthew effect) for producing unexciting research with little added value. Naturally, such an extreme scenario is unlikely to unfold and is not the case of the initiatives described here. However, it is a matter of concern which should be considered when designing and implementing excellence policies.

Third, the programme’s sustainability is a matter to be seriously considered. If set up blithely, excellence initiatives may be unsustainable and promote inconsistencies and dependence in the system. These policies are characterized by long-term funding. This ensures, inter alia, adequate project scope and institutional capacity building. However, ultimately the nature of excellence initiatives is temporary. Therefore, questions must be addressed about the extent to which they engender “sustainable excellence” vis-à-vis dependence on continued funding. Germany’s case exemplifies this problem. The scheme was scheduled to end in 2017. However, many institutions were relying on continued funding to sustain reforms and activities that have been initiated thanks to initial endowments. Eventually, the government decided to prolong support after 2017. A similar consideration can be made for Denmark. Here, universities were expected to continue to attract third-party funding both nationally and internationally after the natural end of the CoE programme (2026), but ultimately the government refunded the DNRF for a new post-2026 round to help universities face the challenge.

Finally, it is important to consider what organizational unit/level an excellence policy targets. It could be a research centre, a university as a whole, or even a smaller unit. However, interventions that target individual researchers in fact coincide with the familiar research council grants awarded in competition and have thus not been covered by this report. Typically, an excellence policy is aimed at research centres and involves substantial sums of resources awarded for more than just a few years.

In conclusion, the wish to avoid spreading out resources too thinly across the research system relates to the belief that facilitating a bigger concentration of talented researchers is more likely to produce excellent research. Therefore, the main function of competitive excellence funding is to create critical mass. However, what the policy should strive for strongly depends on what disciplinary field(s) and types of research (e.g. experimental, fundamental, or multidisciplinary) are being promoted. Excellence policies that intend to foster breakthrough research must be a smart mix of instruments to create focus and mass but also aimed at supporting smaller units. Moreover, a successful excellence policy should be a mix of interventions backing both the winners (already successful and reputable units) and the challengers (smaller units that still have to prove the merits of their research). Larger units may be able to reap economies of scale and economies of scope, while smaller groups might be more agile and quicker to respond to change (see e.g. Jongbloed & Lepori, 2015). These conclusions point to a fundamental principle in constructing higher education funding policies, which holds that any policy should be understood in the context of the policy mix.

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8 This is one of the reasons why the REF is hard to consider truly an “excellence initiative” like the other cases presented in this report.
wherein it rests. For example, not only research funding policies are relevant but also those governing the quality of research such as research assessment policies. Hence, existing degrees of competition and resource concentration play a key role in shaping excellence policies, their aims and their designs.

5. References
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PART TWO: COUNTRY ANNEXES
Annex A: Denmark

Introduction

This Annex describes the Danish Centres of Excellence (CoEs) funded by the Danish National Research Foundation (DNRF). DNRF activities focus on elite programmes and the CoE scheme is its primary funding mechanism (>80% of research activities between 2007 and 2012 according to the Ministry’s evaluation). CoEs are meant to increase (global) competition and internationalisation, and to support excellence in a relatively small system. Moreover, the scheme began in the early 1990s. Hence first outcomes have been assessed. In addition, Denmark has an impressive research and innovation performance. The European Union’s (EU) Innovation Scoreboard reveals not only that Denmark is an “innovation leader” but also that unlike the other leaders it has maintained its advantage over the EU. For example, between 2008 and 2014 the strongest country’s (Sweden) performance lead over the EU declined from 42% to 34% while Denmark’s grew from 25% to 33% (European Commission 2015, p.11)\(^9\).

This analysis is based on a review of relevant documentation and telephone interviews conducted in February 2016 with researchers and policymakers (Table A1). The key lessons we can learn from this case are (inter alia):

- CoEs have contributed to improving the country’s aggregate publication performance;
- CoEs have helped improve participating universities’ publication success: participating universities appear to publish more and have more impact (as measured against world benchmarks) than non-participating universities. This appears to be true over time;
- CoEs do not generate new differentiation in the system but expose and perpetuate an existing tacit differentiation. From this perspective, CoEs can be interpreted as “transparency tools”;
- Although it is hard to be conclusive, there is some evidence suggesting that the impact and productivity of individual scientists increases as a result of the CoEs. However, there is little evidence to suggest that the CoEs increase differentiation between individual researchers.

Table A1. Interviews conducted

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Trøst Hansen</td>
<td>Danish National Research Foundation</td>
<td>Senior Advisor (formerly at Ministry of Science)</td>
</tr>
<tr>
<td>Evanthia Kalpazidou Schmidt</td>
<td>Aarhus University, Department of Political Science – Danish Centre for Studies in Research and Research Policy</td>
<td>Associate Professor, Research Director</td>
</tr>
<tr>
<td>Kaare Aagaard</td>
<td>Aarhus University, Department of Political Science – Danish Centre for Studies in Research and Research Policy</td>
<td>Senior Researcher</td>
</tr>
</tbody>
</table>

\(^9\) The Scoreboard is based on 25 indicators on enablers (e.g. scientific publications or doctoral students), firm activities (e.g. public-private publications, intellectual assets), and outputs (e.g. revenues from patents or licenses). See: European Commission 2015, pp. 7 ff.
The research system

The Danish research system includes both the public and private sectors. Public research takes place in higher education (e.g., universities and universities of applied sciences), government and private non-profit organisations (MSIHE, 2014). A number of evaluations have been conducted. In 2013 the Royal Swedish Academy of Sciences’ issued the report “Fostering breakthrough research: a comparative study” (MSIHE, 2013; Öquist and Benner, 2013). In general, Denmark’s research system is deemed strong and performs well on a number of indicators used in different analyses. For example, Denmark is among a group of four innovation leader countries, and ranked third on the EU’s Innovation Union Scoreboard 2015 (European Commission, 2015); the Danish MSIHE’s “Research Barometer 2012” shows that in impact of publications (citations per publications), Denmark ranks third out of 38 countries. Moreover, Danish universities do well in global rankings such as the “Shanghai Ranking” or the Times Higher rankings (MSIHE, 2013; Kalpazidou Schmidt, 2012a).

In 2010, Denmark spent 3% of GDP (€7.40bn) on research and development, including from private foundations and charities (ibid). The current funding system of research and innovation is presented in Chart A1. As can be seen, there is a variety of funders in the Danish landscape of research funding:

- **DNRF** focuses on elite programmes;
- The Danish Council for Independent Research (DFF) is the primary funding agency for the promotion of basic research, providing predominantly individual grants for investigator-driven research within all research areas (the success rate of about 15% among the applications). It is also an advisor body to the Minister of Science, Innovation and Higher Education;
- The Danish Council for Strategic Research (DSF) is an independent funding body that promotes both basic and applied research in fields of national priority. Therefore, themes have been set by the government. It, too, is an advisory body to the Minister;
- The Danish National Advanced Technology Foundation (HTF) supports knowledge transfer and collaborations between research institutions and the private sector;
- The Danish Council for Technology and Innovation (RTI) is an administrative body for initiatives handed to the council by the Minister. These initiatives aim for the promotion of innovation and dissemination of knowledge between knowledge institutions and enterprises. It is also an advisory body to the Minister.

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10 The “research system”, as used in this report, includes research, development and innovation. According to the OECD (2002), Research and development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock knowledge, and includes basic research, applied research and experimental development. An innovation is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. It includes product innovation, process innovation, marketing innovation and organisational innovation.

11 Approximately 1% of GDP is spent on public research institutions while about 2% is spent in the private sector. Funding levels remained almost the same in the following two years, as reported by Eurostat. See: [http://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure](http://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure). Exchange rates are as of 7/1/16: €1 = kr7.44 ([http://www.xe.com](http://www.xe.com))
Recently, all the political parties in the Danish Parliament have agreed on a revision of the research and innovation, including the establishment of the new “Innovation Fund Denmark” which amalgamates the DSF, the HTF and the RTI into one foundation\textsuperscript{12}. The new foundation, established in April 2014, has an annual budget of over €201m and is responsible for implementing grants for research, technology development, and innovation, which are based on societal and commercial challenges and needs\textsuperscript{13}.

**The policy context**

Denmark has broadened its research excellence policies since the early 1990s. It was at that time that a process of academic reorientation began, which effectively overhauled the existing research policy system (Öquist and Benner, 2012). Until then, universities’ research resources were dispersed and tied to the institution’s educational tasks; additional grants from research councils were minimal and university leadership had limited recruitment and allocation powers (\textit{ibid}). During the 1980s earmarked, strategic research funding grew significantly and some universities and research units began raising their expectations of publications and international orientation (\textit{Ibid.}; European Commission, 2016). A new, fundamental, reorientation of Danish research governance began in the 1990s, epitomized by the DNRF’s establishment in 1993\textsuperscript{14}. To date, DNRF funds almost 100 Centres of Excellence (CoEs).

Changes intensified after 2001, when the new Danish government initiated a set of New Public Management-inspired reforms to transform universities into key players in the global knowledge economy (Aagaard and Mejlgaard 2012). A number of governance and funding reforms have been shaping the science system and promoting a shared construal of scientific excellence (OECD 2014; de Boer \textit{et al.}, 2015; European Commission, 2016; Henriksen and Schneider, 2014; interview data – Kalpazidou Schmidt).

The funding system of the last decade was defined most strongly by the 2006 “Globalisation Strategy”. This strategy called for a 50/50 balance between basic funding and external funding and led to a performance-based basic funding model. Hence, the current funding system promoted a shift (a) from basic towards competitive funding, (b) from basic towards strategic research, and (c) from funding many small projects towards funding fewer and larger

\textsuperscript{12} [http://innovationsfonden.dk/en/publikationer](http://innovationsfonden.dk/en/publikationer)


\textsuperscript{14} The design began in 1991
projects (Aagaard 2011, cited in European Commission, 2016; de Boer et al., 2015; interview data – Aagaard; Kalpazidou Schmidt). Today, the distribution of the performance-based part of the research fund depends on educational activities (45%), the amount of research financed by external parties (25%), the national Danish publication indicator (20-25%, Henriksen and Schneider, 2014\textsuperscript{15}), and the number of PhD graduates (10%) (de Boer et al, p. 55).

Earlier reforms had already established innovation-oriented research funding channels such as the RTI, the DSF) and the HTF, mentioned above. These councils initiated a number of CoE schemes. For instance, the RTI and the DSF initiated the Strategic Platforms for Innovation and Research (SPIR), (European Commission, 2016). Private foundations also supported CoEs.

Alongside the changes in the funding system, in 2003 parliament passed a new University Act. This Act was major overhaul of university governance. It dismantled the traditional decentralised, bottom-heavy governance system in Danish universities and introduced boards with a majority of external members and vice-chancellors appointed by the boards (Kalpazidou Schmidt 2012b). Today, deans have significant financial latitude for recruitment and organisational decisions (such as setting up and closing down departments). The Act was intended to stimulate institutional profiling, create scope for more international recruitment, professionalize and empower the managerial structures, and increase collaboration between the actors of the research and innovation system. It also emphasised that the new management units of the universities should make strategic selections of priority research areas and that universities must engage in extensive dissemination activities (Aagaard and Mejlgaard 2012; Öquist and Benner, 2012; Kalpazidou Schmidt, 2012c; European Commission, 2016; interview data – Aagaard; Hansen; Kalpazidou Schmidt).

Third, the new management system introduced with the University Act was a “window of opportunity” to justify a far-reaching merger process (2007). This reform led to (a) a concentration of resources in select institutions\textsuperscript{16} and (b) a break with the established institutional divide between academic and applied research. The number of universities was reduced from twelve to eight, and 80% of the Government Research Institutes (which traditionally focused on applied research) was incorporated into the university system\textsuperscript{17} (Aagaard 2011; European Commission, 2016; Aagaard et al, 2016; interview data – Aagaard).

Mergers also aimed at increasing the professional synergy between closely related subjects (for example the merger of Life Sciences at the University of Copenhagen and the Royal Veterinary and Agricultural University). Moreover, from the perspective of the institutions, an increased size gives the university management more room for manoeuvre. By significantly increasing university budgets, the possibilities of prioritising the funding and the usage of resources for strategic purposes increase as well – purposes that would perhaps lie outside the possibilities of a smaller university (Kalpazidou Schmidt, 2012c). At the same time the economic base for the universities has not only increased with the mergers, but has also

\textsuperscript{15} The Danish government introduced the National Danish Publication Indicator (NDPI) in 2009 to measure and assess research productivity and motivate researchers to publish in prestigious and acknowledged publication channels (Henriksen and Schneider, 2014, p. 273)

\textsuperscript{16} The three largest universities, University of Copenhagen, Aarhus University and the Technical University of Denmark, account for 2/3 of public research

\textsuperscript{17} The GRI sector was effectively dismantled as 12 of the then 15 GRIs were incorporated into the university sector
become more diversified. Universities are no longer exclusively financed by the Ministry of Science, but also by other ministries (*Ibid*).

**The Danish Centres of Excellence**

**Rationale for the initiatives**

In the policy context outlined above, a significant portfolio of the public research funding concerns the CoEs (OECD, 2014) – probably the initiative with the strongest impact on research performance. The Ministry of Science, Innovation and Higher Education (MSIHE) has conducted its latest evaluation of DNRF in 2013, including an assessment of the different funding streams. The CoE programme is the foundation’s flagship since 1993\(^{18}\). Compared to other instruments CoE funding is long-term (up to 10 years) (Schneider and Costas, 2013). The last 10-year CoEs were meant to be established in 2016/17 with the DNRF’s funding ending in 2026 (MSIHE, 2013). However, as a follow-up on the 2013 evaluation, the government refunded the DNRF with over €400m and the foundation will now start another round of CoEs in 2026 (interview data – Hansen).

DNRF strives to reward curiosity-driven applications. CoEs are collaborative research units based at research institutions (primarily universities), led by outstanding researchers that are oriented towards producing ground-breaking results, and established within and across all scientific fields. Partnerships may include researchers of different institutions, either domestically or internationally. The key goals underlying the DNRF’s establishment and the introduction of the CoE programme included prioritising certain fields of study, boosting the competitiveness of Danish research, internationalising Danish research, concentrating funds and supporting university excellence (interview data – Hansen; Kalpazidou Schmidt).

**Design of policy**

In keeping with DNRF’s belief that the proposed CoE leaders are key to the centre’s success (because their scientific merits attract a colleagues with the best profiles, including talented PhD students), the scheme is designed to reward individuals (MSIHE, 2013; OECD, 2014). The CoE scheme does not require specific organisational structures and there is no fixed formula for creating a centre (Langfeldt *et al*., 2013). However, a particular initiative to create university centres of excellence is the so-called “Investment Capital for University Research” (UNIK) established in 2007 and implemented from 2009 to 2013 (OECD, 2014; European Commission, 2016), and described below.

Although DNRF supports fundamental research, it also embraces the European Research Council’s and the U.S. National Science Foundation’s definition of “frontier research” to define fundamental advances at and beyond the frontier of knowledge. “Frontier research” describes the blurring boundaries between basic and applied research and is DNRF-fundable\(^{19}\). CoEs can be established within and across all research areas. While ~80% lie in the fields of natural sciences (>45%) and life sciences (<35%), in fact the vast majority of CoEs do not fit neatly in the usual disciplinary categories such as social vs. natural sciences but are cross-disciplinary (MSIHE, 2013, p. 20).


Funding allocation is determined by a competitive ex ante assessment of proposals. The application process follows two stages. First, prospective CoE leaders must submit letters of interest with short outline proposals. These proposals are processed by the Board alone employing an A – C scoring system with an additional “P-score” (for Potential), recently added to reward proposals that might deliver ground-breaking results despite high risk (MSIHE, 2013). In the second stage, full applications are peer reviewed (not anonymously). All applicants compete against each other (i.e. there is no pre-allocation of funds to priority areas or disciplines). Next, the Board interviews the (short list) CoEs’ intended principal investigators (PIs) prior to making a final decision. Thus far the success rate from outlines to establishing the CoE has been of approximately 6% (MSIHE, 2013).

Three high-level international experts evaluate the full proposals according to criteria set out in clear Terms of Reference, which include the following selection criteria:

- The research idea is ambitious and original and has the potential for real scientific breakthroughs in the relevant research field(s);
- The centre leader has a high standing in the international research community as well as managerial skills;
- The team: the CoE includes high-quality personnel in order to establish a creative and dynamic international research environment that will provide an inspirational training ground for young researchers;
- The structure/organization: the focus, structure, and size of the proposed CoE set the stage for scientific ventures that are not feasible within conventional funding from other sources.

Each applicant may submit the names of three experts, who must be peers of comparable international standing. DNRF chooses one of the reviewers independently, while the other two reviewers are chosen based on recommendations from external or internal sources. Subsequently, the board conducts a short interview with each applicant (i.e. CoE leader) prior to the final decision. During the interview, applicants are asked to present their overall research idea and to elaborate on the strategy for realizing the idea, including how to address possible risks and challenges. The final decision is taken by DNRF’s Board based on the full applications, the peer reviews, the applicant’s responses to the reviews and the interview with the proposed CoE leader. Following the selection, DNRF and the CoE leader initiate negotiations with the host institution on co-financing, facilities, and the centre’s sustainability after DNRF support ends. Co-financing is expected but there is no fixed percentage (see also Langfeldt et al, 2013, p. 13).

CoEs are monitored and evaluated throughout the funding cycle. The endowment is constituted by two periods of respectively six and four years. A midterm evaluation is conducted after five years and a final evaluation is made after nine years. Follow-up meetings are held annually and each CoE must submit annual reports.

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21 See Terms of Reference for Applications at: [http://dg.dk/filer/CoE/Ansoegningsruder/Terms%20of%20Reference.pdf](http://dg.dk/filer/CoE/Ansoegningsruder/Terms%20of%20Reference.pdf)


In the mid-term evaluation, each CoE submits a self-evaluation and applies for the second funding period. An international review panel evaluates the Centre, including through include a site visit. The final evaluation (after nine years) is based on the CoE’s self-evaluation, annexes, its current research plan, minutes, and 10 to 15 representative publications26. It is conducted by a three-member international evaluation panel. Each panel member must prepare an individual assessment in English, looking at a number of general and specific aspects including27:

- Research achievements: research quality (ambition, originality, progress and relevance), the Centre’s international position, education (i.e. whether the centre is an attractive unit for recruiting and training of younger researchers and PhD candidates);
- Organisation and management of the centre, including financial management;
- Social value of the grant, e.g. impact on research in neighbouring fields, fostering international collaboration, etc.;
- Overall assessment (e.g. strength and weaknesses during the entire funding period)

A key, albeit unique, CoE-type initiative was the so-called UNIK (ended in 2014), which supports research institutions of excellence by strengthening the central steering capacity of the universities. Its overall aim is to promote world-class research at Danish universities. UNIK funding was awarded for basic as well as applied research and in all thematic areas. Funding is awarded for excellent, dynamic and closely co-ordinated research frameworks involving interrelated research activities or sub-themes in a prospective field of research (Deloitte, 2012). UNIK represented a new modality of granting CoE research funds. Until then, CoE funds were granted to individual researchers, but the €64.5m UNIK funds (provided for by the Danish Finance Acts of 2008 and 2009) were allocated to universities (OECD, 2014).

The Ministry dictated a maximum number of proposals (31) based on the size of each individual university. Although the expectation was to fund 5-8 large projects across the system, in fact only four projects at three different universities were selected. Once allocated the funding could be used as freely as basic funding as long it was spent in accordance with the overall project plan. Thus is was a simple funding mechanism with few conditions (European Commission, 2016). On the one hand this reflects a widespread tendency across several countries to build institutional capacity (European Commission, 2016). On the other hand it was an ad hoc strategy to facilitate the merger process, and is not likely will to be repeated (interview data – Hansen).

Implementation of the policy
To date DNRF has funded 100 CoEs, of which 39 are currently active. Total funding of current CoEs amounts to €372.4m. The last round of funding will take place in 2017 and last until 2026. Table A2 shows the active CoEs and the funding allocated to each (in Euro28). As can be seen, three universities dominate both in leading CoEs and in funding received:

- University of Copenhagen accounts for 41% of CoEs and 43% of funds (~€162m)
- Aarhus University accounts for 33% of CoEs and 36% of funds (~€136m)
- The Technical University of Denmark accounts for 10% of CoEs and 8% of funds (~€30m)

26 http://dg.dk/for-bedoemmere/slutevaluering/
Table A2. Active CoEs funded by DNRF

<table>
<thead>
<tr>
<th>Centre of Excellence</th>
<th>Funding (~ €m)</th>
<th>Est.</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre for Personalised Medicine Managing Infectious Complications in Immune Deficiency</td>
<td>8.1</td>
<td>2015</td>
<td>Rigshospitalet (University of Copenhagen)</td>
</tr>
<tr>
<td>Center for Autophagy, Recycling and Disease</td>
<td>6.7</td>
<td>2015</td>
<td>The Danish Cancer Society</td>
</tr>
<tr>
<td>Center for Hyperpolarization In Magnetic Resonance</td>
<td>7.4</td>
<td>2015</td>
<td>Technical University of Denmark</td>
</tr>
<tr>
<td>Center for Silicon Photonics For Optical Communications</td>
<td>7.9</td>
<td>2015</td>
<td>Technical University of Denmark</td>
</tr>
<tr>
<td>Center for Intelligent Oral Drug Delivery Using Nano And Microfabricated Containers</td>
<td>7.5</td>
<td>2015</td>
<td>Technical University of Denmark</td>
</tr>
<tr>
<td>Center for Neuroplasticity and Pain</td>
<td>8.1</td>
<td>2015</td>
<td>Aalborg University</td>
</tr>
<tr>
<td>Center for Bacterial Stress Response and Persistence</td>
<td>6.7</td>
<td>2015</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Urban Network Evolutions</td>
<td>8.7</td>
<td>2015</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Carbon Dioxide Activation Center</td>
<td>8.1</td>
<td>2015</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for Music In The Brain</td>
<td>7.0</td>
<td>2015</td>
<td>Aarhus University, Royal Academy of Music Aarhus/Aalborg</td>
</tr>
<tr>
<td>Center for Stem Cell Decision Making</td>
<td>8.1</td>
<td>2015</td>
<td>The Niels Bohr Institute (University of Copenhagen)</td>
</tr>
<tr>
<td>Center for Chromosome Stability</td>
<td>8.7</td>
<td>2015</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Dynamic Molecular Interactions</td>
<td>6.6</td>
<td>2012</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Medieval Literature</td>
<td>4.8</td>
<td>2012</td>
<td>University of Southern Denmark</td>
</tr>
<tr>
<td>Center for Vitamins and Vaccines</td>
<td>7.8</td>
<td>2012</td>
<td>National Institute for Health Data and Disease Control</td>
</tr>
<tr>
<td>Copenhagen Center for Glycomics</td>
<td>8.3</td>
<td>2012</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Stellar Astrophysics Centre</td>
<td>7.4</td>
<td>2012</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for International Courts</td>
<td>5.6</td>
<td>2012</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Geomicrobiology</td>
<td>7.8</td>
<td>2012</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for Nanostructured Graphene</td>
<td>7.3</td>
<td>2012</td>
<td>Technical University of Denmark</td>
</tr>
<tr>
<td>Center for Financial Frictions</td>
<td>6.4</td>
<td>2012</td>
<td>Copenhagen Business School</td>
</tr>
<tr>
<td>Center for Quantum Devices</td>
<td>8.7</td>
<td>2012</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Permafrost</td>
<td>8.1</td>
<td>2012</td>
<td>University of Copenhagen</td>
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<tr>
<td>Centre for Star and Planet Formation</td>
<td>11.1</td>
<td>2009</td>
<td>University of Copenhagen</td>
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<tr>
<td>Center for Macroeconomy, Evolution and Climate</td>
<td>14.9</td>
<td>2010</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Centre for Quantum Geometry of Moduli Spaces</td>
<td>12</td>
<td>2009</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for Materials Crystallography</td>
<td>14.1</td>
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<td>Aarhus University</td>
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<tr>
<td>Centre for Symmetry and Deformation</td>
<td>12.1</td>
<td>2010</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center for Particle Physics</td>
<td>10.7</td>
<td>2010</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Center on Autobiographical Memory Research</td>
<td>11.3</td>
<td>2010</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for GeoGenetics</td>
<td>13.5</td>
<td>2009</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Centre for Particle Physics &amp; Origin Mass CP3 – Origins</td>
<td>10.7</td>
<td>2009</td>
<td>University of Southern Denmark</td>
</tr>
<tr>
<td>Centre for Membrane Pumps in Cells and Disease</td>
<td>14.3</td>
<td>2007</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for Massive Data Algorithmics</td>
<td>9.7</td>
<td>2007</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Centre for Ice and Climate</td>
<td>15.6</td>
<td>2007</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Centre for Epigenetics</td>
<td>14.9</td>
<td>2007</td>
<td>University of Copenhagen</td>
</tr>
<tr>
<td>Centre for DNA Nanotechnology</td>
<td>12.7</td>
<td>2007</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Centre for Carbohydrate Recognition and Signaling</td>
<td>12.2</td>
<td>2007</td>
<td>Aarhus University</td>
</tr>
<tr>
<td>Center for Research in Econometric Analysis of TimE Series</td>
<td>10.8</td>
<td>2007</td>
<td>Aarhus University</td>
</tr>
</tbody>
</table>


Experiences and effects

As in all cases, it is controversial (and, one may argue, spurious) to deterministically attribute a causal relationship between a specific – albeit dominant – policy lever and the system’s
internal differentiation and scientific performance. In Denmark, the mergers, the management reform and the overall changes in the funding system have changed the frame conditions for universities (European Commission, 2016). However, a number of studies have assessed the effects of excellence initiatives (particularly the CoE funding scheme – including UNIK –) on the Danish science system. 20 years of DNRF-supported CoEs seem to relate to a number of effects on the Danish science system.

From a quantitative perspective, one may estimate differentiation and research quality using bibliometric indicators such as publications and citations. Citations are often used as a proxy for impact because “impact” refers to scientists citing their colleagues’ work if it is of use to their argument, which in turn means that it has an impact on the citing author’s work (Martin and Irvine, 1983; Schneider and Costas, 2013). For example, the MSIHE has evaluated DNRF in 2013, providing, *inter alia*, analyses on publications and citations from Schneider and Costas (2013). Qualitative evaluations usually take the form of informed reviews from expert panels (see e.g. European Commission, 2016).

The next paragraphs outline (a) the CoE scheme’s key measurable bibliometric effects reported in the DNRF evaluation and a number of bibliometric analyses, and (b) the more discursive conclusions drawn by the expert panel’s final evaluation report of the UNIK process, based largely on interviews and participants experiences.

**Quantitative assessment**

First, Danish papers are now more, and more highly-cited than before. The gap in publication output and citations between Danish universities participating in DNRF-supported CoEs and the most renowned research universities in the world (such as Harvard, Stanford, or Cambridge) has been closing over time. For example, as shown in Table A3 (reproduced from Schneider and Costas, 2013, p. 34) Harvard’s annual publication output was 20 times the DNRF publication output in 1997 but 12.1 times in 2011. A similar decreasing divergence pattern can be seen for the other benchmark units.

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29 That is, the focus of the analysis is on DNRF and not on individual CoEs. Moreover, CoEs not funded by DNRF are not included.

30 The actual publication output for DNRF is shown in the second column. Columns for benchmark universities show how many times more output a benchmark unit has compared to the annual output from DNRF. For example, in 1997, École Polytechnique Fédérale de Lausanne had 1.8 times more publications than DNRF’s 423, which is an annual output of 778. Harvard University had 20 times more publications totaling 8458 in 1997. The benchmark units are ranked according to their total size-difference compared to DNRF for all years. Harvard is largest.
Second, within Denmark the share of DNRF-publications in journals indexed by the citation database Web of Science (WoS) has increased at a far faster pace vis-à-vis non DNRF-publications. Schneider and Costas (2013, Table 3.4, p.30) indicate that between 1993 and 2011 Danish publications rose from less than 6,000 to almost 14,000 (+117%) overall. In the same period, non-DNRF-publications increased by about 96.5% while DNRF publications increased from 0.5% to 10.8% of the total (+1,000%). Although this is evidently due in large part to a start-up phase (DNRF CoEs were not in existence prior to 1993), the speed of change has is noteworthy.

Thirdly, there is a clear difference in impact between DNRF and non-DNRF institutions. During the period 1993-2011, DNRF-funded publications accounted for 7% of all Danish publication output but had significantly higher impact. Schneider and Costas (2013, Table 3.1, p. 26) present key bibliometric indicators, including, inter alia, impact indicators such as raw mean citation score (MCS), the field-normalized citation score (MNCS) and the proportion of papers that belong to the top10% highly cited publications in the database (pp top 10%), as well as the Journal impact (mean normalized citation score of the journals in which a research unit has published, or MNJS). In all impact indicators DNRF-publications scores exceed the

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Table A3. Differences in annual publication output between benchmark units and DNRF.

<table>
<thead>
<tr>
<th>Year</th>
<th>No of DNRF pubs</th>
<th>HARVARD</th>
<th>STANFORD</th>
<th>CAMBRIDGE</th>
<th>COLLEGE LONDON</th>
<th>IMPERIAL COLLEGE LONDON</th>
<th>YALE</th>
<th>UCSD</th>
<th>MIT</th>
<th>LEEDS</th>
<th>POLYTECHNICAL FEDERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>423</td>
<td>20.0</td>
<td>8.9</td>
<td>9.6</td>
<td>7.8</td>
<td>6.5</td>
<td>7.0</td>
<td>7.1</td>
<td>7.0</td>
<td>3.9</td>
<td>1.8</td>
</tr>
<tr>
<td>1998</td>
<td>549</td>
<td>15.6</td>
<td>7.0</td>
<td>7.5</td>
<td>6.4</td>
<td>5.4</td>
<td>5.7</td>
<td>5.5</td>
<td>5.2</td>
<td>3.1</td>
<td>1.6</td>
</tr>
<tr>
<td>1999</td>
<td>554</td>
<td>16.1</td>
<td>7.2</td>
<td>7.8</td>
<td>6.4</td>
<td>5.6</td>
<td>5.6</td>
<td>5.3</td>
<td>5.5</td>
<td>3.2</td>
<td>1.7</td>
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<tr>
<td>2000</td>
<td>545</td>
<td>16.9</td>
<td>7.9</td>
<td>8.2</td>
<td>6.9</td>
<td>6.0</td>
<td>5.9</td>
<td>5.7</td>
<td>5.6</td>
<td>3.5</td>
<td>1.7</td>
</tr>
<tr>
<td>2001</td>
<td>711</td>
<td>13.2</td>
<td>5.9</td>
<td>6.0</td>
<td>5.6</td>
<td>4.8</td>
<td>4.3</td>
<td>4.3</td>
<td>4.5</td>
<td>2.3</td>
<td>1.2</td>
</tr>
<tr>
<td>2002</td>
<td>687</td>
<td>14.1</td>
<td>6.4</td>
<td>6.4</td>
<td>5.9</td>
<td>5.4</td>
<td>4.8</td>
<td>4.5</td>
<td>4.9</td>
<td>2.8</td>
<td>1.5</td>
</tr>
<tr>
<td>2003</td>
<td>656</td>
<td>14.8</td>
<td>6.9</td>
<td>7.0</td>
<td>6.2</td>
<td>5.8</td>
<td>5.1</td>
<td>5.0</td>
<td>5.0</td>
<td>3.0</td>
<td>1.8</td>
</tr>
<tr>
<td>2004</td>
<td>632</td>
<td>16.6</td>
<td>7.5</td>
<td>7.6</td>
<td>6.4</td>
<td>6.5</td>
<td>5.7</td>
<td>5.4</td>
<td>5.8</td>
<td>3.0</td>
<td>2.1</td>
</tr>
<tr>
<td>2005</td>
<td>739</td>
<td>14.7</td>
<td>6.7</td>
<td>6.5</td>
<td>6.0</td>
<td>5.6</td>
<td>5.1</td>
<td>4.9</td>
<td>4.9</td>
<td>2.8</td>
<td>2.0</td>
</tr>
<tr>
<td>2006</td>
<td>728</td>
<td>16.8</td>
<td>7.3</td>
<td>7.0</td>
<td>6.7</td>
<td>6.0</td>
<td>5.6</td>
<td>5.3</td>
<td>5.4</td>
<td>2.9</td>
<td>2.5</td>
</tr>
<tr>
<td>2007</td>
<td>756</td>
<td>16.5</td>
<td>7.4</td>
<td>6.6</td>
<td>6.7</td>
<td>5.8</td>
<td>5.5</td>
<td>5.4</td>
<td>5.3</td>
<td>3.2</td>
<td>2.4</td>
</tr>
<tr>
<td>2008</td>
<td>789</td>
<td>17.1</td>
<td>7.4</td>
<td>7.0</td>
<td>7.0</td>
<td>6.1</td>
<td>5.6</td>
<td>5.3</td>
<td>5.2</td>
<td>3.2</td>
<td>2.5</td>
</tr>
<tr>
<td>2009</td>
<td>1013</td>
<td>14.0</td>
<td>5.9</td>
<td>5.8</td>
<td>5.8</td>
<td>5.0</td>
<td>4.6</td>
<td>4.5</td>
<td>4.2</td>
<td>2.6</td>
<td>2.0</td>
</tr>
<tr>
<td>2010</td>
<td>1267</td>
<td>11.7</td>
<td>5.1</td>
<td>4.8</td>
<td>5.0</td>
<td>4.2</td>
<td>3.8</td>
<td>3.9</td>
<td>3.6</td>
<td>2.2</td>
<td>1.7</td>
</tr>
<tr>
<td>2011</td>
<td>1336</td>
<td>12.1</td>
<td>5.2</td>
<td>5.0</td>
<td>5.0</td>
<td>4.4</td>
<td>4.0</td>
<td>3.9</td>
<td>3.8</td>
<td>2.2</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Source: Schneider and Costas, 2013 (reproduction of Table 3.4, p. 34)

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31 The most straightforward impact indicator is the Mean Citation Score (MCS). This indicator equals the average number of citations of the publications of a unit. However, a major shortcoming of the MCS indicator is that it cannot be used to make comparisons between scientific fields because different fields have very different citation characteristics. For instance, using a three-year fixed-length citation window, the average number of citations of a publication of the document type article equals 2.0 in mathematics and 19.6 in cell biology. So it clearly makes no sense to make comparisons between these two fields using the MCS indicator. The MNCS indicator is similar to MCS except that it performs a normalization that aims to correct for differences in citation characteristics between publications from different scientific fields, between publications of different ages, and between publications of different document types. The MNCS indicator is obtained by averaging the normalized citation scores of all publications of a unit (see: Schneider and Costas, 2013, Ch.2, pp. 14 ff. for a more detailed methodological and definitional overview).
non-DNRF publications whilst overall and output indicators\textsuperscript{32} are lower. Moreover, the difference in impact between DNRF and non-DNRF institutions is consistent over time. Chart A2 (reproduced from Schneider and Costas, 2013, Figure 3.5, p.31 and Figure 3.7, p.33) shows that the proportion of DNRF-publications in highly cited papers is consistently greater than that of non-DNRF-publications, and that a similar pattern is found in the MNCS.

Chart A2. Development (i) in the proportion of Danish papers among the 10% most highly cited papers in WoS and (ii) of the MNCS indicator including and excluding DNRF-publications.

Source: Schneider and Costas, 2013 (reproduction of Figures 3.5, p.31 and 3.7, p. 33)

As in the other cases, it is important to note that it is not possible to attribute increased differentiation within the system to one policy instrument alone because there is always a mix of policies and factors at play. The trends over time show that changes in institutional performances tend to go in the same direction. This suggests that excellence initiatives such as the CoE programme expose and perpetuate a pre-existing tacit differentiation within the system rather than generating it. The CoE programme did not aim explicitly at increasing vertical diversity (it was meant to strengthen the research environment generally). However, in conjunction with the mergers, it was not surprising that stronger differentiation ensued (interview data – Hansen). A limited number of stronger performers (University of Copenhagen, Aarhus University and the Technical University of Denmark) effectively produce two-thirds of public research in Denmark (European Commission, 2016; interview data – Aagaard).

There are also differences in impact between fields. However, it is in multidisciplinary journals that one sees increased differentiation between top institutions and non-DNRF institutions. For example, during the period 1993-1997 the PTop10\% indicator of DNRF-institutions was 2.2\% higher than that of non-DNRF institutions (36.4\% vs. 34.2\%); by 2008-2011 the difference was +5.7\% (35.9\% vs. 30.2\%). In other fields the differences in impact changed to a lesser degree (Engineering from 0\% difference to –0.01\%; Medical and Life sciences from +0.2\% to +0.1\%; Natural Sciences from +0.4\% to 1\%; Social and Behavioural Sciences from –0.2\% to +0.4\%). (Schneider and Costas, 2013, p. 40).

Increased differentiation between individuals is harder to measure. However, because the scheme is meant to support research based on researchers’ own initiatives (with the exception of the UNIK programme) one may assume that individual performances have also been affected. A study on excellence initiatives in Nordic countries included three Danish CoEs,

\textsuperscript{32} Total number of publications of a unit (P); Proportion of papers uncited (PP uncited); Total number of citations (TCS); Number of uncited publications (P uncited); Total average normalized number of citations (TNCS); Number of publications belonging to the top 10\% highly cited publications in the database (p top 10\%)
looked at the PIs involved. It compared key researchers’ publication and citation scores before and during centre period (Langfeldt et al., 2013). It shows that, in general, research productivity and impact of the researchers increases as a result of the CoE. The study shows that publication numbers of seven researchers at the “Centre for Epigenetics” increased from 20 to 70 per year between 2002 and 2011 (the CoE was established in 2007). Publication numbers of five researchers at the “Centre for Quantum Optics” (established in 2001) doubled from less than 10 to over 20 a year; the impact also doubled during the period of funding. At the “Strategic Electrochemistry Research Centre” established in 2007 (through the Strategic Research Council and not DNRF), the publication of the two researchers investigated grew from less than 10 to more than 20 per year (Langfeldt et al., 2013, pp. 54-55).

Another possible effect of CoEs might related to the composition of the research staff (e.g. gender and age balances). Langfeldt et al. (p. 21) suggest that CoEs “may provide an opportunity for rejuvenation and gender balance in research leadership, but that this opportunity is used differently by the CoEs”. In fact, this has not been the case so far. CoEs have been criticized in evaluations for not taking into consideration gender balance (interview data – Kalpazidou Schmidt). Across the cases they studied (i.e. including also centres in Norway, Finland and Sweden), they find that 77% of PIs are over 45. However, there is a high number of junior (non-PI) personnel since this is a key task of the centres.

Qualitative assessment (UNIK initiative)
The UNIK initiative (referred to above) proved to have a number of effects, reported a final evaluation which used both quantitative and qualitative data (bibliometrics as well as interviews with stakeholders within the UNIKs). A recent evaluation qualitatively assessed the added, distinctive effects of the UNIK-initiative (Danish Agency for Research and Innovation, 2016). This evaluation classifies the effects in groups according to how likely they are a direct consequence of UNIK and – thus –can be generalised. Within this category, the report assesses whether the effects could have been achieved through other forms of (excellent) research funding instruments (i.e. how unique is the UNIK contribution).

The institutional effects directly resulting from UNIK include (p.33):

- University management’s willingness and ability to support large strategic and interdisciplinary research programmes (highly unique);
- Focusing research strategy (highly unique);
- University management’s strategic steering capacity and experience in relation to handling large grants (partially unique);
- Encouraged establishment of research infrastructure (modestly unique);
- Driving organisational change (modestly unique);
- Ex post allocation of institutional core funding to research programmes (not unique).

The effects on research directly resulting from UNIK include (p.39):

- Advancing experimental interdisciplinary research (Highly unique);
- Improved interdisciplinary research collaboration (partially unique);
- Fostering a new generation of re-searchers oriented towards inter-disciplinarity (partially unique);
- Creating international research flagships and increasing international collaboration (modestly unique);
- Strengthening academic leadership (modestly unique);
- Focusing the research profile of departments and faculties (modestly unique);
• Strengthening research excellence (not unique);
• Attracting additional external re-search funding (not unique).

Finally, the evaluation looks at “derived effects” (possible effects of the research activities of UNIK but not directly part of the core research-activities of the UNIKs). The “derived effects” directly resulting from UNIK include (p.44):
• New educational programs or courses at Bachelor’s or Master’s or PhD level (modestly unique);
• Enhanced external communication on research (modestly unique);
• Increased business collaboration (not unique);
• Increased commercialization of research results (IPR) (not unique).

Considerations on the programme’s sustainability
A key question concerns the programme’s sustainability remain. By the end of the funding period CoEs should be fully integrated into their respective universities’ institutional strategies. Agreements regarding co-funding and later embedment of centre activities were made part of the formal contracts with the host institutions. Hence, after DNRF support ends, universities are expected to (continue to) attract third-party funding both nationally and internationally. However as mentioned above, in response to this challenge the government refunded the DNRF with over €400m for a new round of CoEs starting after 2026. Private foundations, too, are crucial. They currently provide the highest proportion of private money to public universities (e.g. Novo Nordisk, Villum and Lundbeck foundations). It is likely that they will continue successful work with individual and project grants (MSIHE, 2013, pp. 36 ff.; interview data – Hansen).

References


Annex B: Germany

Introduction
This Annex describes the German Excellence Initiative funded by the German federal and state governments through the German Research Foundation (Deutsche Forschungsgemeinschaft [DFG]). The Excellence Initiative is special because it distributes extra money rather than distributing recurrent funds. It is justified by the need to make Germany a more attractive research location and more internationally competitive by rewarding outstanding achievements of German universities. In this sense the Excellence Initiative can be deemed a “differentiation instrument”, because funds are not spread out evenly; only the outstanding proposals qualify for funding. In addition, Germany has a good research and innovation performance. The European Union’s (EU) Innovation Scoreboard classifies Germany as an “innovation leader”, alongside Sweden, Denmark and Finland.

The scheme started in 2006 and will end in 2017 but an evaluation by an international panel has already taken place (2016) and decisions to continue funding have been made. On June 16th 2016, the federal government and the federal states have agreed to continue excellence funding under the heading “excellence strategy” (Exzellenzstrategie).

This analysis is based on a review of relevant documentation and telephone interviews conducted in February 2016 with researchers and policymakers (Table B1). The key lessons we can learn from this case are (inter alia):

- The Excellence Initiative has not improved the national aggregate publication performance. Germany’s global shares of publications and highly cited publications have not changed significantly over time (indeed have slightly deteriorated);
- There is an increasing gap in publications between universities that participate in the Excellence Initiative and those that do not. Bibliometric analyses suggest an increase in highly cited publications stemming from Excellence Initiative Clusters;
- The Excellence Initiative is more successful than other funding schemes in increasing publication numbers;
- The Excellence Initiative does not generate new differentiation in the system but exposes and perpetuates an existing tacit differentiation. Within the German university system weaker and stronger research institutions have always existed but the Excellence Initiative appears to have made this evident. From this perspective, the Excellence Initiative can be interpreted as a “transparency tool”;
- The Excellence Initiative was not designed to boost differentiation between individuals but it does strengthen the role of Principal Investigators. Therefore, a side-effect is that “big names” are often sought (e.g. for building convincing proposals);
- There is some evidence suggesting that because of its exclusive emphasis on research the Excellence Initiative might increase the teaching-research divide within institutions. In other words, the Excellence Initiative might induce more intra-institutional diversification and departmental conflict (which are not stated goals of the programme).

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Table B1. Interviews conducted

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank Ziegele</td>
<td>Centre for Higher Education Development</td>
<td>Executive Director</td>
</tr>
<tr>
<td>Jochen Glaeser</td>
<td>Technical University of Berlin</td>
<td>Associate Professor (Privatdozent)</td>
</tr>
<tr>
<td>Dagmar Simon</td>
<td>Berlin Social Science Center</td>
<td>Head of the Research Group</td>
</tr>
</tbody>
</table>

The research system

Germany is a federal state with multiple layers of authority and different funding flows, both at federal and state levels. Moreover, the German research system includes a number of research performers, both universities and non-universities. As of 2011-2012, about €75.5bn (2.9% of GDP) was spent on R&D. Over €50bn was for Business R&D expenditure, €13.4bn for universities and €11bn for non-university R&D; about €5.1bn was for “other educational institutions, museums, departmental research” (BMBF, 2015, pp. 9 ff.; Bode, 2015).

At the federal level, the main responsibility for research policy lies with the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung [BMBF]). The BMBF provides about 58% of the federal R&D resources. Most funds are distributed through the DFG, which promotes research at universities and other publicly financed research institutions (Dialogic, 2014, p. 82 ff.). The DFG is also the only source that allows the scientists to apply for grants without predetermined topics (Laudel, 2006, p. 492). Other federal ministries also play an important role in German research policy, including the Ministry of Economics and Technology (Bundesministerium für Wirtschaft und Energie [BMWi]), which provides 19% of the federal R&D resources, and the Ministry of Defence (Bundesministerium der Verteidigung – [BMVg]), which provides 11% of the federal R&D resources (Dialogic, 2014, p. 82 ff.).

At the State level (Länder) the ministry of Science and Education and the ministry of Economics are the main players (Dialogic, 2014, p. 82 ff.). Basic teaching and research funding comes from the states, which contribute to funding both universities and Germany’s large non-university sector (co-financed by the federal government). The Joint Science Conference (Gemeinsame Wissenschaftskonferenz [GWK]) is the main body that coordinates research policies between the federal government and State governments.

There are a number of research performers, including “non-university research institutions” (Außeruniversitäre Forschungseinrichtungen [AUF]) in the system. These performers are (Dialogic, 2014):

- Private companies (67.3% of national R&D expenditures);
- Universities (18% of national R&D expenditures);
- A wide range of public non-university research organisations. In 2010, they accounted for 14.7% of total R&D expenditure in Germany. They include (a) the Max Planck Society (MPG) (b), the Fraunhofer Society (FhG), (c) the Helmholtz Association, and (d) the Leibniz Association (WGL).

Research is funded through institutional funding or through project funding. In 2013 institutional funding (universities, AUF and DFG) was (IEKE, 2016, table 1, p.12):

- Universities: €12.6bn
- FhG: €0.6bn
Over the last decade, institutional funding has been increasing as shown in Chart B1 (IEKE, 2016, p.11).

**Chart B1. Support means of universities, institutional funding of non-university research institutions, percentage change compared to 2005**

At the same time there has been a shift in balance between institutional and project funding, to the advantage of the latter. While in 2005 institutional funding accounted for 47%, this was 43% by 2010 (Dialogic 2014).

The policy context

The Excellence Initiative (passed in 2005) is the German response to increased international competition as policy-makers pushed forth reforms in steering and financing policies to support the country’s global higher education position. Global league tables first appeared in 2003 with Jiao Tong University’s Academic Rankings of World Universities. And, although these rankings reflect global isomorphism in higher education founded on a set of assumptions about what constitutes “excellence”, they undoubtedly also played a role in the decision to adopt the Excellence Initiative (Cremonini et al, 2009; interview data – Glaeser).

The R&D landscape overall has remained stable over recent years, with just two major developments, namely (a) the integration of the research facilities of the former GDR into the system (which had only minor effects) and (b) the reorientation of funding policies (Dialogic, 2014, p.83). The latter is part of the federal “High-Tech Strategy” launched in 2006 to concentrate the public R&D resources and improve coordination between different players. In 2010 this strategy was further developed into the “High-tech Strategy 2020” with the goal of raising spending levels for education and research to 10% of GDP by 2015 (7% for education and 3% for research). According to Eurostat, Germany’s expenditure on R&D was 2.85% as
of 2013 (though BMBF, 2015 indicates 2.88% of GDP as of 2012 and the OECD’s Main Science and Technology Indicators report 2.90% in 2014).34

The German Excellence Initiative

Rationale for the initiatives

On June 23, 2005, the German federal and state governments passed the “Excellence Initiative”, a programme providing top universities a total of about €4.6bn in additional funding over two phases, (2006-2011 and 2012-2017). This Initiative focuses on research only. Its aim is to increase vertical differentiation in the system, improve research performance and improve international attractiveness of German research. Hence, the primary goal of the Excellence Initiative has been to support world-class research at universities with the aim of strengthening German universities in an increasingly more competitive national and international environment. (Cremonini et al, 2009; Klumpp et al, 2013; IEKE, 2016; interview data – Glaeser, Simon, Ziegele).

Design of policy

The Excellence Initiative is unique because it distributes extra money rather than distributing recurrent funds. This makes it different from other programmes such as the UK’s RAE/REF, which allocate core funding within the system (Klumpp et al, 2013; IEKE, 2016). The Initiative began in 2006 and named 37 winning universities in three funding lines (described below). They received over €2 billion in funding (Hornbostel 2008), but in the public discussion only the nine universities in the highest of the three categories (“institutional strategies” (Zukunftskonzepte)) were called “elite universities” (interview data – Ziegele).

In line with its aim of strengthening German top-level research and its international competitiveness, the Excellence Initiative is based on a competition to reward outstanding projects in three areas (i.e. the three funding tracks)36:

- Clusters of excellence, such as the “Nanosystems Initiative” at Munich (started 2006) or the “Cluster of Excellence on Plant Sciences” at Düsseldorf (started 2012).37

According to the DFG’s website “clusters of Excellence will enable German university locations to establish internationally visible, competitive research and training facilities, thereby enhancing scientific networking and cooperation among the participating institutions. Clusters of Excellence should form an important part of a university's strategic and thematic planning, significantly raise its profile and reflect its considered long-term priorities”. Moreover, clusters of excellence should also create excellent training and career conditions for young researchers. In conjunction with the other two funding lines, i.e. graduate schools and institutional strategies to promote top-level research, clusters of excellence will help to increase Germany’s attraction as a research location in the long term and improve its international competitiveness.

35 I.e.: there is no “official” elite denomination for the top universities
36 The application in all three lines has to go through leadership. Therefore, there is always an institutional strategic orientation
37 See list at: http://www.dfg.de/en/research_funding/programmes/list/index.jsp?id=EXC/
38 http://www.dfg.de/en/research_funding/programmes/excellence_initiative/clusters_excellence
This track does not support whole universities but certain groups within one or more units;

- Graduate schools: like the prior track, a university may have a good graduate school and may apply for funding. Together with the first track it covers over 50% of the funding. This track is meant to promote early career researchers;

- Institutional strategies to promote top-level research in Germany and increase its competitiveness at an international level. This support is for universities as a whole and covers all measures that allow universities to develop and expand their areas of international excellence over the long term and to establish themselves as leading institutions in international competition.\(^{39}\)

In 2009 the second phase of the Excellence Initiative was approved. The core principle in this phase was to engender competition between new projects and those already receiving funding. Successful draft proposals for new projects would compete with the projects that had been funded in the first phase and that could submit “extension proposals”. It is hard not to construe this approach as a policy to strengthen and consolidate the stratification of the German higher education and science system. Indeed, just 30% of winners in the second phase were new proposals. 70% were already existing projects. The funding modalities remained unchanged, except that more flexible funding amounts were specified. Graduate Schools could get from €1-2.5m annually, Clusters of Excellence between €3m and €8m (each including a 20% programme allowance). The Institutional Strategies track gave stronger emphasis to elements of research-related teaching (DFG, 2013, p.17).

The review process leading to funding decisions is rather complex and is not managed directly by the federal and state governments. Instead, they have agreed to hand the process over to a collaborative implementation group that includes the German Research Council and the German Science Council, who have set up a procedure to allocate the funds. The funding process follows a two-stage procedure (which remained in force for both the first and second phases of the Excellence Initiative). In the first stage institutions submit draft proposals; they may subsequently be invited to submit full proposals. Aside the federal and state governments, the Research and Science Councils, key actors involved in the process include:

- The Joint Commission: an international body of scientists and academics drawn from a variety of disciplines set up by the Research Council and the Science Council. It consists of an Expert Commission and a Strategic Commission. It specifies the terms of funding for the programme and decides which initiatives will be selected in all three funding lines out of those that have been invited to hand in full tenders. The Commission also develops the funding recommendations for all three funding lines;

- The Expert Commission, primarily responsible for the first and second funding lines. It comprises 14 members appointed by the Research Council’s Senate;

- The Strategic Commission, responsible for the third funding line. It includes 12 members appointed by the Science Council’s Scientific Commission;

- Review panels consist of scientists and academics. They are appointed by the Research Council’s head office to assess the content of draft proposals. Hence, their appointment is based on their qualifications and specialist knowledge of the field with which proposals deal. To avoid conflicts of interest review panels typically include a mix of national and foreign personalities;

- The Grants Committee is made up of the Joint Commission’s members as well as the ministers responsible for research and science in the federal and state governments. It

makes the final funding decisions, based on weighted voting system whereby members of the Joint Commission (scientists and academics) have the majority vote (1.5 votes each), state ministers have one vote each, and the federal minister has sixteen.

Institutions applying for funding must follow a 2-step procedure. The length of the whole process, from the submission of the first draft proposal to the final funding decision, is typically about a year. First, draft proposals are submitted to the Research Council. The Research Council’s Head Office assesses the draft proposals on their fulfilment of all formal requirements. Proposals’ contents are evaluated by review panels, whose assessments are the basis for the first screening. After considering reviewers’ recommendations, the Expert Commission draws up a short-list for the Joint Commission that in turn decides which universities will be invited to submit full proposals. During the second phase, full proposals are submitted to the Research Council and evaluated by an international review panel. The Expert Commission makes a short list for the first and second funding lines; the Strategic Commission evaluates proposals for the third funding line (but to be eligible for this at least one cluster of excellence and at least one graduate school must have been selected for funding). Next, the Joint Commission compiles a list of funding recommendations on which the Grants Committee bases its final decision. Finally, funding decisions are publicly announced by the German Federal Minister of Education and Research.

Implementation of the policy
The first phase consisted of two rounds held in 2005/06 and 2006/07. Each round followed the 2-stage selection procedure described above and yielded the following outputs (DFG, 2013):

In round-1:
- 319 draft proposals were submitted by 74 universities;
- 90 drafts (39 Graduate Schools, 41 Clusters of Excellence, 10 Institutional Strategies) were nominated for the final round of the competition;
- On 13 October 2006, the Grants Committee selected 38 of these projects for funding, located at 22 universities. These included 18 Graduate Schools, 17 Clusters of Excellence and three institutional Strategies;
- These projects received €873 million.

In round-2:
- 305 draft proposals were submitted
- 92 (44 Graduate Schools, 40 Clusters of Excellence, eight Institutional Strategies) were nominated for the final round of the competition.
- On 19 October 2007, the Grants Committee selected 47 of these projects for funding located at 28 universities. These included 21 Graduate Schools, 20 Clusters of Excellence and six Institutional Strategies;
- These projects received a € 1billion.

The second phase began in 2009 and consisted of one round only (proposal by September 1st, 2010). A total of €2.4bn was awarded for the second programme phase to fund initiatives at 44 universities. 30% of winners were new proposals and 70% were already ongoing projects, which were extended.
• 227 draft proposals were submitted by 64 universities of which 98 for Graduate Schools, 107 for Clusters of Excellence and 22 for Institutional Strategies;
• 59 drafts proposals at 32 universities were nominated for the final round of the competition (25 Graduate Schools, 27 Clusters of Excellence, 7 Institutional Strategies) were nominated for the final round of the competition;
• In the final round, the 59 successful draft proposals for new projects competed with the projects that had been funded in the first phase. Both groups of applicants had until 1 September 2011 to submit full funding proposals or extension proposals (which were reviewed in 2012);
• Finally, (June 15th 2012), a total of 99 projects at 44 universities were selected for funding. These included 45 Graduate Schools (33 extensions and 12 new projects), 43 Clusters of Excellence (31 extensions and 12 new projects) and 11 Institutional Strategies (6 extensions, and 5 new strategies).

Chart B2. Results of the German Excellence Initiative, Phase-1 and Phase-2

Experiences and effects
GWK recently tasked an independent international panel of experts (Internationale Expertenkommission Exzellenzinitiative — IEKE) with evaluating the Excellence Initiative (IEKE, 2016). The panel’s mandate was to provide a qualitative assessment of the Excellence Initiative as a strategic programme and to gauge its impact on the German science system, including effects on non-subsidized universities. They were also requested to provide recommendations for the future. The report (pp. 18 ff.) also emphasizes that the results are largely based on examples rather than a comprehensive empirical examination of the effects on the system’s vertical differentiation. Limitations are due, for instance, to general data availability and the capacity to foresee longer term effects (ibid). This section of the report draws in part from the Panel’s study, as well as other sources (earlier documents and interview data).
Quantitative assessment

Quantitative indicators are generally used in assessment and management processes to measure performance and provide information for decision-making or for informed peer review processes (Wissenschaftsrat, 2011, pp. 18 ff.). Thus, from a quantitative perspective, one may estimate differentiation and research quality using, inter alia, bibliometric indicators such as publications and citations. Citations are often used as a proxy for impact because “impact” refers to scientists citing their colleagues’ work if it is of use to their argument, which in turn means that it has an impact on the citing author’s work (Martin and Irvine, 1983). Other indicators might include acquisitions of external funds, numbers of doctorates etc. (Wissenschaftsrat, 2011, pp. 18 ff.). Some claim that the bibliometric data is proof that the Excellence Initiative promotes greater vertical differentiation in the system but this is still contested. 10 years of Excellence Initiative appear to relate to some effects on the German science system, although it is hard to pinpoint exact quantitative impacts.

First, although it is not possible to demonstrate an increased differentiation of the German university system as a whole (i.e. where universities concentrate on their competitive advantages in research) as a consequence of the Excellence Initiative, bibliometric data suggest an increasing gap in publications between universities that are part of an Excellence Initiative cluster and those that are not (IEKE, 2016). For example the 2015 “DFG-Funding Atlas” (DFG Förderatlas), shows that between 2002 and 2013 Excellence Initiative universities increased chemistry and physics publications by 42.8%. In contrast, on the aggregate all German university increased publications in chemistry and physics by 34.1%, main European countries by 17.1% and all countries globally by 49.2%40 (DFG, 2015, p. 95).

On the aggregate, the global shares of publications and highly cited publications have not changed significantly but bibliometric analyses suggest an increase in highly cited publications stemming from Excellence Initiative Clusters. Between 2003 and 2011 the global share of German publications dropped from 6% to 5.3%, and of highly cited publications from 6.9% to 6.3%41 (Hornbostel and Möller, 2015, p.37). However, over the same period Excellence Initiative universities boosted their highly cited publications. Chart B3 shows that, in general, non-Excellence Initiative universities have maintained a relatively stable HC publication output (though there are outliers) whilst Excellence Initiative universities have increased their share of HC publications more strongly. The X axis shows the HC publication share 2003-2006 and the Y axis in 2008-2011. The four quadrants can, thus, be understood as describing institutional publication performance:

- Quadrant 1 (top left) shows those universities that are “catching up”. They increased their HC output over time, passing from relatively low to relatively high (e.g. Siegen university went from 10% to 16%);
- Quadrant 2 (top right) shows universities that are “moving further ahead”. They were already good performers and benefit even more from the Excellence Initiative. E.g., Münster University’s HC output was about 14% in 2003-2006 and 17% in the period

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40 This finding may make one consider the extent of competition from countries outside Europe, e.g. China. However, such an analysis is beyond the scope of this report.
41 This trend is consistent with other Western countries. For example, the US global share of publications dropped from 26.1% to 22.4%, and its share of highly cited publications from 37.8% to 31.9%. Other (non-western) countries have seen growth. E.g., between 2003 and 2011 the global share of Chinese publications grew from 6.4% to 10.3%, and of highly cited publications from 4.5% to 9%.
• Quadrant 3 (bottom right) are universities that are “losing speed”. During the first period they had a better HC output than during the subsequent period. There are not many universities in this quadrant (e.g. Rostock went from 15% to 12%), with most remaining relatively stable over time;
• Quadrant 4 shows universities that are “falling further behind”. They have not particularly benefitted from the scheme and maintain a relatively low proportion of HC publications across the 2008-2011 and 2003-2006 periods. For instance, Kassel University (a non-Excellence Initiative university) had about 9% HC publications throughout the 2003-2011 period.

Universities with an Institutional Strategy (“ZUK-unis”) appear the strongest performers but they started off from a stronger position. Institutional strategies can only be granted if the University was also successful in attracting at least one graduate school and at least one cluster of excellence (Hornbostel and Möller 2015, p. 31).

Chart B3. Share of Highly Cited publications of the German universities per year, with an average of at least 100 journal publications (Article, Review, excluding Humanities and Social Sciences).

Source: Hornbostel and Möller, 2015 (reproduction of Figure 16, p. 50)
Note: ZUK-Unis: Universities with an Institutional Strategy (“Zukunftskonzepte”, note: taking into account the first round); Exin Unis: Universities participating in Excellence Initiative; No Exin Unis: Universities not participating in Excellence Initiative

Bibliometric information showing the proportion of highly cited publications (top-10%), reveals that between 2008 and 2011, 25.9% of publication of the Clusters of Excellence were in the top-highly cited of the WoS. This number even exceeds the Max Planck institutes (22.6%), as well as the university sector generally, and the non-Excellence Initiative universities (IEKE, 2016, p. 19; Hornbostel and Möller, 2015, p.48).
Second, the Excellence Initiative seems to lead to more publications than other existing funding schemes. This can be surmised, for instance, by looking at the “Funding Acknowledgement” of publications. While it is not possible to decide whether a publication can be assigned to a cluster of excellence or not by mapping productivity by author, because the clusters have varying memberships, fuzzy boundaries, and temporary membership and staff, “funding acknowledgements” help extrapolating research productivity. In their bibliometric impact analysis of the Excellence Initiative, Hornbostel and Möller (2015) show that – of their publication sample – 51.3% of the funding acknowledgement in the WoS is for Excellence Initiative clusters (Exzellenzcluster) and 30.8% for “other”. A further 17.9% do not have a funding acknowledgement in the WoS but in the full text, or not at all. Table B2 is based on Hornbostel and Möller, 2015, (Table [Tabelle] 2, p. 35), and refers to years 2009-2011.

Table B2: Funding acknowledgment coverage in Web of Science, a case study on the so-called Most Important Publications of excellence cluster successor requests (2009-2011, N = 552)

<table>
<thead>
<tr>
<th>Funding Acknowledgement in WoS</th>
<th>Publications</th>
<th>Percent</th>
</tr>
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<tbody>
<tr>
<td>Cluster of Excellence Funding Acknowledgement</td>
<td>283</td>
<td>51.3</td>
</tr>
<tr>
<td>Other Funding Acknowledgement</td>
<td>170</td>
<td>30.8</td>
</tr>
<tr>
<td>No Funding Acknowledgement in WoS</td>
<td>99</td>
<td>17.9</td>
</tr>
<tr>
<td>Cluster of Excellence Funding Acknowledgement in full text</td>
<td>22</td>
<td>4.0</td>
</tr>
<tr>
<td>Other Funding Acknowledgement in full text</td>
<td>24</td>
<td>4.3</td>
</tr>
<tr>
<td>No Funding Acknowledgement in full text</td>
<td>53</td>
<td>9.6</td>
</tr>
<tr>
<td>Total</td>
<td>552</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Third, similarly to other cases (e.g. Denmark’s CoEs), there are indications that the Excellence Initiative exposes and perpetuates a pre-existing differentiation rather than generating it. The German university system has traditionally been differentiated between stronger and weaker research institutions. The Excellence Initiative appears to affirm “old top

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42 A number of methodological caveats are described in the Hornbostel and Möller, 2015 (pp, 35 ff.)
universities” as “new top universities” (see also Hornbostel and Möller, 2015, p. 52; Kehm, 2012; Wissenschaftsrat, 2011).

Besides bibliometric information, a common measure to assess differentiation is also an institution’s success in gaining research awards – in Germany, especially DFG awards. The “DFG-Funding Atlas” (DFG-Förderatlas) shows inter alia the institutional ranking of DFG awards over time. Table B3 presents the top 10 ranking changes in DFG awards between 2008 and 2010 (with and without consideration of the Excellence Initiative), and the top-10 DFG awards 2011-2013. As can be seen, the rankings do not change meaningfully neither depending on institutions’ inclusion in the Excellence Initiative (DFG, 2012, p.76), nor between 2008-10 and 2011-13. (DFG, 2015, p. 60).

<table>
<thead>
<tr>
<th>Top-10 rankings DFG awards 2008-2010, including the Excellence Initiative</th>
<th>Top-10 rankings DFG awards 2008-2010, excluding the Excellence Initiative</th>
<th>Top-10 rankings DFG awards 2011-2013</th>
</tr>
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Source: DFG-Förderatlas, 2012, Table 3.2, p.76; DFG-Förderatlas, 2015, Chart 3.3 p. 60 (table adapted by author)

One can also look at the effects of the Excellence Initiative at system level. Arguably the Excellence Initiative has had some impact on Germany’s innovation performance (although, it is always hard to attribute changes to one instrument alone). The EU’s Innovation Scoreboard (2015) distinguishes between three main types of indicators, namely enablers, activities, and outputs. Within the enablers, “open, excellent and attractive research” is one of the three innovation dimensions (European Commission, 2015) because research affects systems’ innovation performance.

A group of countries defined “Innovation Leaders” excel consistently and over time. Indeed these countries have improved over the last seven years. Innovation leaders include Denmark, Sweden, Finland and Germany – all of which invested significantly in “excellence”. Thus, one could argue that innovation performance is linked to investments in excellence. Yet, the argument is not conclusive because (a) over the last eight years innovation performance has been improving for all innovation leaders up until 2012 but (with the exception of Denmark) has since started to decline; (b) benchmarked against the EU average, the leaders (again with the exception of Denmark) are witnessing a declining performance lead, even as their innovation indexes grow (e.g. Sweden’s performance lead over the EU declined from 42% to 34%); and (c) a number of “innovation followers” (including inter alia the Netherlands,

43 The 2015 edition does not present the data disaggregated by inclusion/exclusion in the Excellence Initiative, but shows the different disciplinary areas.
44 The Scoreboard is based on 25 indicators on enablers (e.g. scientific publications or doctoral students), firm activities (e.g. public-private publications, intellectual assets), and outputs (e.g. revenues from patents or licenses). See: European Commission 2015a, pp. 7 ff.
whose innovation lead over the EU average is now about 17%), have also grown while not declining significantly at any particular point in time (European Commission, 2015, Figures 4-5, pp. 11-12).

**Qualitative assessment**

From a qualitative perspective, one can make a number of considerations. First, there are no clear quantitative data to show effects on individuals. The Excellence Initiative has no serious effect on individual differentiation because it does not fund individuals. However, the programme makes individuals very strong because of the important role for PI in the research clusters. This has the effect of attracting “big names” to be more successful (interview data – Ziegele). The 2016 evaluation report (IEKE, 2016, p.6) states that the Excellence Initiative’s effect on young research careers is “[…] ambivalent at best” and that it “[…] was not designed to be a career support system for junior researchers and it cannot solve all problems of junior research tracks”. In this context, the following points can be emphasised (interview data – Ziegele):

- Changing from an idea of research as individual right to an institutional thinking (i.e. clusters where people must come together). The individual right is not for funding, which now encourages prioritisation (of fields and/or alliances);
- Graduate schools are meant to support younger researchers. However, next (proposed) round will not include a graduate school pillar, but will include evaluation criteria to assess plans to support young researchers, within clusters;
- The DFG system will remain and be complementary. This is based on individuals and performance (i.e. it is a competition between individuals or teams).

Another important issue to consider is the changing shape of intra-institutional diversity. For example, because the Excellence Initiative rewards research and financial incentives for teaching are relatively marginal, the divide between teaching and research within universities remains strong and indeed has increased (Kehm, 2012). Moreover, universities that have received funding for excellence clusters and graduate schools need to redistribute their internal budget, potentially leading to inter-departmental conflicts (Esterhazy, 2014)

Next, the Excellence Initiative has led to a number of reactions and by-initiatives. For example, Germany has one Rectors’ Conference, which is seen as “the voice of universities”. However, shortly after the Excellence Initiative was established new groups formed, such as the “U-15” or the “TU-9”, purporting to represent Germany’s “top institutions”. This is a new trend in Germany (which some see as a threat to inter-institutional solidarity within the system), although it can also be seen as the reproduction of concepts such as the British “Russell Group” (interview data – Simon; Ziegele). To improve transparency of data on research performance, a number of initiatives are taking hold or have been proposed. For example, the establishment of a “basic data set for research” to define nation-wide standards for data related to research, and the “research rating system” of informed peer review (currently for a select number of fields, e.g. sociology) (interview data – Ziegele).

**Considerations on the programme’s sustainability**

In general, nobody gainsays that the Excellence Initiative has made the German university system more dynamic and has become a tangible symbol for the will to improve the international competitiveness of German universities. However, many argue that it is unlikely the funding, albeit significant, will have serious permanent stratifying effects on the system
Moreover, there are concerns about the programme’s sustainability and long-term impact. Initially it was not certain whether support would continue after 2017 (Hornbostel and Möller, 2015 pp. 49 ff.). However as mentioned earlier, it has been decided to continue the scheme, albeit under a different mode (the “Excellence Strategy”). Indeed, despite being contrary to the federal government’s initial stance, several universities had been expecting – and relying on – a continuation of the Excellence Initiative funding stream for support. The Excellence Initiative funds should initiate a process of priority setting (e.g. also saving on lower priority areas, thus promoting intra-institutional differentiation) but it is hard to establish to what extent this will endure (IEKE, 2016, p. 35). To date, it is too early to say which universities have succeeded in using the funds in the most sustainable way (e.g. through investments and the institutionalization of tenure-track positions).

Moreover, it is also hard to determine whether the Excellence Initiative prompted new research priority areas in the Clusters of Excellence, or merely led to a “bundling of existing research capacities and hence increased visibility” (IEKE, p. 5). However, the public debate ensuing from the Excellence Initiative has highlighted marked differences in research performance across German universities and, unquestionably, has ended the idea that “all are equal”.

Also for these reasons, the IEKE recommended to continue the Excellence Initiative at least at the current level of funding (i.e., any future initiative should award at least €500m per year, as it did in 2014). The IEKE also gives a number of opinions/options on the nature and scope of a possible next phase, including:

- Continued and increased focus on strengthening world-class research in Germany and the improvement of the international competitiveness of universities (without mixing them up with other goals). In keeping with this philosophy, the IEKE proposes to call the new initiative “Excellence Initiative II – top research at universities” (Exzellenzinitiative II – Universitäre Spitzenforschung);
- Discontinuation of the Graduate school pillar to focus only on Clusters of Excellence and Future Concepts (i.e. institutional strategies)\(^45\);  
- Prolong the duration of all projects of the current Excellence Initiative by two years, that is, to the end of 2019, to enable proper planning for the next phase
- Redesign of the Clusters of Excellence pillar: disadvantages of smaller disciplines and barriers of collaboration between geographically distant universities in competing for funds should be removed. The emphasis should be solely scientific excellence and independent of political and regional factors. Regional collaboration needs only to be scientifically advantageous;
- Promotion of internal differentiation in institutions: university management receives a further overhead of 20%, in addition to the normal (DFG) overheads (Programmpauschale). This overhead should be used to strengthen governance, to stem potentially centrifugal forces, and to reallocate funds to make planned restructuring as part of the processes of differentiation sustainable;
- Introduction of an “Excellence Premium” to support processes of differentiation from above, by giving additional funds to university management. In contrast to the existing future concepts (so-called third funding line (Zukunftskonzepte)), the Excellence Premium should not be awarded by application but solely due to past merit. It should be awarded to the ten best universities for a duration of seven to eight years. The

\(^{45}\) It must be noted that the inclusion of Graduate trajectories can be and would be an added value in future concepts or clusters of excellence arrangements, (interview data – Simon)
Excellence Premium should amount to about €15m per university per year. The methodology for a comparative evaluation of German universities should be based on a combination of awarded DFG grants and prizes, such as the Leibniz Prize, Humboldt Professorships, or the European Research Council.

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(Eds). Institutionalization of World-Class University in Global Competition. Springer, pp. 81-97


Annex C: Switzerland

Introduction
This Annex describes the Swiss National Centres of Competence in Research (NCCR) established by the government in 2000. NCCRs are networks in specific fields or around a specific topics set up to promote institutional competition, research excellence, and reinforce the university landscape and management. The analysis is based on a review of relevant documentation and telephone interviews conducted in February and March 2016 with three Swiss researchers (Table C1). The key lessons we can learn from this case are (inter alia):

- The NCCRs support Switzerland’s outstanding research and innovation performance, but it is hard to ascribe changes to this programme alone;
- The scheme has structural effects and, especially, it empowers central management of institutions since it “forces” rectorates to prioritise (the rectorate is responsible for selecting what proposal to submit and researcher need rectorate approval). NCCRs can help institutions’ strategic planning and profiling;
- NCCRs are said to have a positive effect on promoting equal opportunities and young researchers (also because these are eligibility criteria for the proposals);

Table C1. Interviews conducted

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benedetto Lepori</td>
<td>Università della Svizzera Italiana</td>
<td>Lecturer (Faculty of Informatics)</td>
</tr>
<tr>
<td>Dietmar Braun</td>
<td>University of Lausanne</td>
<td>Professor (Institute of Political, historical and international Studies)</td>
</tr>
<tr>
<td>Antonio Loprieno</td>
<td>University of Basel</td>
<td>Professor (Faculty of Economics; Former rector)</td>
</tr>
</tbody>
</table>

Compared to the cases presented in Annexes A, B, and D (e.g. Denmark, Germany and the United Kingdom) Switzerland is an outlier. The availability of funds and the country’s consensual policymaking makes strong competition and short-term “opportunistic” interventions to promote excellence unnecessary. At the same time, differentiation is “built in” in the system and research policy is more concerned with framework conditions. The following paragraph from Öquist and Benner (2012, pp. 58-59) recaps the reasons for Switzerland’s persistent excellence in research:

To sum up, Swiss research governance has evolved steadily over time, but its emphasis on a culture of excellence and measures to enhance and sustain focused research efforts have also been reinforced. This emphasis starts at the policy-making level, where priorities are long-term and generally avoid opportunistic interventions, concentrating more on the framework conditions. Academic leaders are selected in a traditionalist manner, but this does not rule out vigorous interventionism, especially in the recruitment process. Some leaders have acted very strongly to change the course of the universities and successfully redeployed organisational matrices; others have been less successful (the contrasting cases of EPFL and ETH are instructive). Recruitment is predominantly international and the local inbreeding so characteristic of the Nordic countries, in particular, seems rare in the Swiss case. The funding system focuses on efforts to supplement the generous floor funding and allow scholars to work on long-term programmes of their own design. Academic governance puts a premium on the discretion of academic leaders and enforcement of rigorous publication patterns; dedicated and well-crafted support schemes for younger researchers; and concentration in highly competitive fields (through the NCCRs). However, Swiss research governance remains weak in one respect: in parts, the career and tenure track system is still relatively deficient. This has triggered a critique from young scholars in the country who call for a more comprehensive
career system. Similarly, the privileged position of the universities has recently been questioned and the mandate for the polytechnics widened. Hence, the conditions for Swiss universities are not given but exposed to critique, and how the balance between stability and change will be crucial to the future of Swiss science.

The research system

Switzerland has traditionally hosted some of the world’s most renowned research universities. Public research has long been dominated by four areas: clinical medicine, biomedicine, physics and chemistry. Industrial research is strong in pharmaceuticals and food technology, with several companies heavily engaged in basic research as well. Thus, research funding has historically been selective, with a narrow focus, clear-cut goals and selection processes, and a uniquely privileged position for initiator-led research conducted in academic settings (Öquist and Benner, 2012).

The research system includes public and private HEIs, as well as the private R&D institutions (Mulatero, 2014; Melin, 2015; Lepori, 2016):

- The Federal Institutes of Technology (FIT) domain includes two federal institutes of technology (Federal Institute of Technology Zurich (ETH Zurich) and Federal Institute of Technology Lausanne (EPF Lausanne) and four affiliated research institutes. The ETHZ and EPFL are mostly specialised in natural sciences and technology and they account for a large share of public research expenditure. The affiliated institutes include the Paul Scherrer Institute (PSI46), a multi-disciplinary research centre for science and technology and three more applied institutes oriented towards services in the field of material testing (Empa47), aquatic science and technology (eawag48) and forests, snow and avalanches (WSL49).
- Ten cantonal universities: seven are “universal”, covering a broad spectrum of disciplines and three are specialised: St. Gallen (economic and social sciences); Lucerne (law, theology, cultural studies and social sciences), established in 2000; and Lugano (architecture, communication sciences, economics and business studies, ICT), established in 1996;
- Seven public and two private Universities of Applied Sciences (UASs). Their focus is on teaching but they also have a mission to conduct applied R&D and engage in knowledge transfer. However, UASs do not have the right to award PhDs (they gained the right to award Masters in 2007). For the UAS sector, research is an additional task and it is envisaged that in the longer term they would spend 20% of their resources on research;
- Moreover, the private business sector, centred on the large research units of multinational companies, is a very strong player in the Swiss research system (Mulatero, 2014).

Cantonal Governments are responsible for guiding and monitoring the universities and – in part – the UAS sector. The Federal Government’s remit is also partly the UAS sector but,

46 https://www.psi.ch/
47 Swiss Federal Laboratories for Materials Science and technology (in German: Eidgenössische Materialprüfungs- und Forschungsanstalt [Empa]): https://www.empa.ch/web/empa
49 Swiss Federal Institute for Forest, Snow and Landscape Research (in German: Eidg. Forschungsanstalt für Wald, Schnee und Landschaft [WSL]): http://www.wsl.ch/index_EN
most notably, the Federal Institutes of Technology (FIT) domain (ETHZ, EPFL, PSI, Empa, eawag, WSL) (Mulatero, 2014). The Swiss National Science Foundation (SNSF)\(^{50}\) and the Commission for Technology and Innovation (CTI)\(^{51}\) are the most important funding agencies; the Swiss Science and Technology Council (SSTC) is the main advisory body for research policy (Dialogic and Empirica, 2014, p.123).

Direct funding and the coordination of research activities remains the Federal Government’s responsibility. The State Secretariat for Education, Research and Technology (SERI) designs and implements federal research policy (as far as government agency research is concerned). In its four-year strategic plan (presented as the ERI-Message, i.e. “Education, Research and Innovation”-Message), the Federal Council presents federal goals and measures in the field of Education, Research and Innovation and asks Parliament to grant the necessary funds (Mulatero, 2014, p.16). The current Strategic Plan covers 2017 to 2020.

A number of bodies are in charge of allocating of public funding (see Lepori, 2016):

1. The **SERI** manages a large share of the federal funding to public R&D, including:
   - Federal institutional funding to the Cantonal universities and the UASs (also for strategic cooperation projects);
   - The Swiss contributions to international research performers (CERN) and to international funding agencies (European Space Agency (ESA)), as well as the Swiss contribution to European Framework programs
   - Direct federal contributions to public and non-profit research institutes outside the university sector, subject to recognition by the federal government
   - Federal co-funding to Vocational Education and Training.
2. The **Council of the Federal Institutes of Technology** (FIT) manages the whole federal funding to the FIT domain and is responsible for the repartition of the funds between the two schools (ETH Zurich and EPF Lausanne), the four institutes of the FIT domain and the strategic programmes;
3. The **SNSF** is the most important national funding agency, with the mission of supporting knowledge-oriented basic research and the training of young researchers. The SNF is a private foundation whose tasks are defined by the national research act and which is almost completely funded by the federal state. Most SNF funding decisions are adopted by committees composed by academics and based on external peer reviews of project applications;
4. The **CTI**: an independent expert commission within the Department of economy which is de facto the national agency for the support of innovation. The Commission is composed of representatives from academia, policy and private companies. It funds primarily cooperative projects between higher education institutions and private companies;
5. The **Cantons** are involved in public R&I funding through institutional funding of the ten Cantonal universities and of the public UASs (which conduct applied R&D and engage in knowledge transfer, as mentioned above);
6. **Other federal ministries** fund some policy-relevant research in their specific domain (e.g. agriculture, defence, and energy;
7. **Private non-profit funding** (is rather limited in Switzerland).

\(^{50}\) See [http://www.snf.ch/en/Pages/default.aspx](http://www.snf.ch/en/Pages/default.aspx)

\(^{51}\) The National Strategic Plan 2017-2020 intends to transform the CTI into an autonomous public agency like the SNF, called *Innosuisse*
Switzerland is a top-ranking investor in research and development as a percentage of GDP (3% in total, of which roughly a third is public expenditure). Large shares of funding go primarily to the universities themselves, either through federal funding for the two federal universities or with the regions as primary funders. External funding is primarily through the SNSF, mainly as an add-on through project support (Öquist and Benner, 2012).

Over time, Switzerland has remained at the forefront in its R&D investments. The country saw an increase of 18% in intramural R&D funds between 2008 (€15bn, see: Dialogic and Empirica, 2014, Table 16, p. 124 – data from OECD) and 2015 (€17.7bn, see Lepori 2016, Figure 5 – data from Swiss Federal Statistical Office) 52.

A key feature of the funding system of Swiss research is the clear-cut division between the public and the private sector, with a particularly dominant role for the latter. Private R&D activities are almost entirely financed by the companies themselves (very limited public funding to private R&D is available including, inter alia, through joint projects with public research funded by the CTI). Several sources indicate that by 2008, more than two thirds of all R&D activities were performed and funded by the business sector (see, inter alia, Dialogic and Empirica, 2014, p.124; van Dalen et al., 2014, p. 67) 53. This was still the case with the latest data available, as shown in Chart C2 below, reproduced from Lepori, 2016. The dependency on private-sector research (which entails an inherent dependency on positive economic outlooks) is deemed one of the main structural challenges facing Switzerland’s R&D and innovation system (Mulatero, 2014, p.3).

Not providing public funding to private R&D is a lasting characteristic of Swiss research policy. Support to private R&D through tax incentives is also virtually nihil (KPMG, 2011). This position is based on the consensus (associations of Swiss enterprises and multi-national companies agree) that State support should focus on the public sector while companies should fund directly their own R&D (Lepori, 2016). Private funding of higher education research is substantial, exceeding 10% of total R&D expenditures in the higher education sector; it benefits largely the two Federal Institutes of Technology, but also UASs. It is mostly in the form of R&D contracts.

Public funding of R&D is almost entirely devoted to the higher education sector and shared between the Confederation (2/3) and the Cantons (1/3). Cantonal funding is composed almost completely by institutional funding to higher education, whereas federal funding is divided approximatively in equal parts between institutional and project funding. Public funding abroad is mostly made up of contributions to international funding agencies such as the European Space Agency, international performers and as contributions for the participation in European Framework programmes (Lepori, 2016).

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52 CHF 1 = €0.917782, see: www.xe.com
53 Switzerland has had its fair share of policy initiatives focusing on innovation and private research investments but this share has been much smaller than in all the other reference countries, and the SNSF’s dominance in the research funding system has been retained. See: Öquist and Benner, 2012, p. 57
Chart C1. The research funding system in Switzerland

Source: Mulatero, 2013 (reproduction of figure 1, p. 8)

Chart C2. Funding flows for R&D in Switzerland

Source: reproduced from Lepori, 2016, p. 22 (translated from Swiss Federal Statistical Office (SFSO)).
The policy context

Every four years since the late 1990s the Swiss federal government has been adopting a national strategy for Research and Innovation (the “ERI strategic plan”), which is then transmitted to the federal parliament together with the request for budgetary credits for the following four years in what is known as the “ERI-message”. The plan integrates different policy domains, including tertiary education (both higher education and Vocational Education and Training), research funding, cooperation with Cantons in general education, and international research cooperation. The current ERI strategic plan (2013-2017) has a budget of CHF 26bn with an annual increase of 3.7% (Schweiz. Bundesrat, 2012 [cited in Lepori, 2016]). It includes a number of research and innovation priorities54 such as promoting Switzerland’s international reputation through more competitive funding, measures to support promising fields of research, strategic international cooperation and networking. The strategy for the period 2017-2020 was approved by the federal government in February 201655.

Despite its tradition of consensus on research policy decisions, Switzerland has policies and steering mechanisms with selective effects, epitomized by the uneven distribution of resources favouring ETHZ and EPFL, which serve as “showcases” for the federal government. These two institutions receive, vis-à-vis the other universities, very generous block funding (estimated at CHF 1bn and 500m respectively, with almost automatic annual increases) (Öquist and Benner, 2012; Braun and Benninghoff, 2003).

Most policy initiatives in the recent years dealt with the governance and organizational structure of the system, rather than with the definition of specific thematic priorities in research. Such reforms have substantially reshaped the overall governance of R&I in Switzerland. Some new measures have been proposed in the 2017-2020 strategic plan. The key policy governance reforms include the following (Lepori, 2016; Dialogic and Empirica, 2014):

- The Higher Education Coordination and Funding Act (HEDA) of 2015 is meant to overcome the traditional fragmentation between different domains of the Swiss higher education sector (Universities, FITs, UAS) and between the Confederation and the Cantons;
- The reorganization of the federal administration in the R&I domain: in 2013 the State Secretariat for Education and Research (SER) and the Office for Professional Education and Technology (OPET) merged into the new SERI. This reform also established the Federal Department of Economic Affairs, Education and Research (EAER) effectively ending the split of responsibility for education/research and innovation at the federal level. This reorganization substantially strengthened the political governance of the whole system and fostered more coordination between basic science and innovation-oriented activities;
- The revision of the Swiss Research and Innovation Act, to make more systematic and consistent the legal basis of the Swiss R&I policy and to coordinate with the new university act (HEDA). This revision sharpened the tasks of the SNF and the CTI, clarifying their complementarity;
- Reform of the CTI into an independent public institution, organized like the SNF and with a clearer distinction between policy and funding decisions, more flexibility and independence. The proposal for the reform was submitted to the Parliament by the Federal Council in November 2015 and it is expected to be approved within 2016;

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54 It also includes priorities for (vocational) education, which we omit in this report
The Creation of the Swiss Innovation Park as part of the Research and Innovation Act to offer excellent location opportunities for innovative companies in Switzerland, as well as support services in R&I.

The National Centres of Competence in Research (NCCR)

Rationale for the initiatives

In general, Switzerland does not have a strong tradition of thematic funding\(^{56}\) and, as mentioned above, research policy is very decentralized and funding has traditionally been generous (interview data—Lepori; Öquist and Benner, 2012). However, the economic crisis of the 1990s meant that research funding stagnated (OECD 2006, p.33), and led to greater demands for productivity from Swiss research. In 2000, the government established National Centres of Competence in Research (NCCRs), which are networks in specific fields or around a specific topics. The NCCR scheme has the following overarching objectives (Benninghoff and Braun, 2010; CSSI, 2015, p. 8):

- To foster institutional competition, division of labour and collaboration among universities;
- To support excellence in research, in particular with the aim of bolstering Switzerland’s international position in new fields considered to be strategic;
- To contribute to structural reinforcement of the university landscape, i.e. favouring long-term institutional anchoring of scientific excellence;
- To systematically encourage more sectorial objectives deemed important for Swiss research excellence such as knowledge and technology transfer (KTT), support for young researchers (essentially PhD students), and promotion of equal opportunities.

The programme is run by the SNSF, which has got extra money from the Ministry for this. The Ministry has no say in the presentation of topics (it is bottom-up). The initiative affected the structure and orientation of Swiss universities. Although partly built upon the previous federal Priority Research Programmes (PRPs), NCCRs favoured greater autonomy in the design and execution of projects (CSSI, 2015). An important rationale was to empower (indeed almost “force”) rectorates to prioritize. Researchers must seek support by the Rectorate and it is the rectorate that must decide what proposals to submit. The selection process is based on peer review. The SNSF chooses 10 peer reviewers and the government can choose six. Hence, the government has some decision-making role, although actual political interference is minimal (interview data, Braun).

Design of policy

The NCCR scheme is open to all research fields and provides a means of obtaining long-term investments for consortia for researcher-driven ideas. The SNSF indicates the intentions of the programme – according to SNSF (2016, p. 4) NCCRs “strengthen the Swiss research scene in areas where outstanding research has already been done or wherever excellent researchers aim to push the boundaries of science. To this end, the initiators – starting out from their home institutions – establish a network of partner institutions in which the concerned research groups work across disciplines. Swiss universities or other research facilities close to academia serve as home institutions. The NCCRs thus generate a critical mass of competence and new insights, allowing Switzerland to keep pace with other research-intensive nations and become scientifically more competitive.”

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\(^{56}\) Although there are the SNF’s National Programmes since the mid-1970s, which have continued until today
NCCR management teams are based at higher education or research institutions. Besides the research groups based at the home institution, a NCCR also avails itself of a network of other teams across Switzerland. Funding comes both from the SNSF (determined by parliament) and from the higher education institutions and from third parties. The SNSF share of funds for the 14 centres that ended in 2014 amounted to about 33% (see also below).

The selection process\(^{57}\) is stringent and includes several stages (SNSF, 2016a). The submissions made in response to calls for new NCCRs are evaluated by international peer committees and the SNSF in a two-stage procedure, which includes a pre-proposal and a proposal. Subsequently the SNSF recommends highly rated NCCR proposals to the EAER for implementation. The final decision on establishing NCCRs lies with the EAER.

The review of pre-proposals determines the suitability of the proposed research for the NCCR funding scheme, its potential for restructuring the relevant research field and its expected impact on science, knowledge and technology transfer as well as on the advancement of young researchers and women researchers. This phase is characterized by two parallel evaluations which cover number of evaluation criteria\(^ {58}\). A scientific evaluation by experts, and a structural evaluation by the Programmes division of the Research Council takes place. The latter considers (a) the need to restructure the chosen research field, (b) knowledge and technology transfer and the advancement of young and female researchers, (c) the suitability of the home institution and (d) the novelty of the topic and the structural goals compared to previous NCCRs in the same field. The outcome of this phase is not a short-list. Pre-proposals are divided into three categories according to their chances of success (good, uncertain, and slight). Applicants are informed and may submit a full proposal if they so choose.

During the proposal stage, each submitted proposal is subjected to an in-depth scientific evaluation and another structural evaluation. Proposals are assessed on several criteria such as scientific quality, added value of the NCCR, potential for stimulating interdisciplinary research and new scientific approaches, suitability of the NCCR management to supervise the NCCR (both in organisational and scientific terms), adequacy of the funds requested, and The support of the home institutions.

Based on the results of the scientific and the structural evaluation, the Programmes division of the Research Council either recommends or does not recommend proposals for funding. The SNSF then forwards the NCCR proposals recommended for funding to the SERI for evaluation with regard to research and higher education policies. The SERI evaluates the proposals with regard to research and higher education policies and the EAER has the last word in deciding which NCCRs are to be established and with what budgets. The final decision is strongly based on sustainability criteria such as significance for strategic planning of the home institution; management, consistency and compliance with federal goals, and integration within Switzerland’s international scientific cooperation agreements.


\(^{58}\) Significance of the research topic for Swiss research; originality, innovation potential and interdisciplinarity, critical mass and added value of the NCCR in comparison with the sum total of the individual projects, potential of the NCCR to attain a leading international role, plausibility of the goals/measures with respect to knowledge and technology transfer, advancement of young researchers and women researchers, academic reputation of the NCCR Director and the Deputy Director, and leadership experience of the management team, academic reputation of the project leaders, suitability of the home institution
Implementation of the policy
So far the SNSF has launched four series comprising 36 NCCRs in total, as shown in Chart C3. The NCCRs of the first series came to an end in 2013 after twelve years, those of the second and third series are ongoing and the fourth series started its in 2014. For the series of 2014, a total of 63 pre-proposals were submitted, 23 passed to “full proposals” and eight were ultimately awarded (SNSF, 2016b).

Chart C3. NCCRs in Switzerland over the four series to date

The funding is based on co-financing, including a share from the SNSF and shares from other sources, as follows (SNSF, 2016a)59:

- The SNSF has funded on average €3.2m per NCCR per year
- Home institutions contributed on average €1.37m per NCCR per year
- The total budget 2001-2013 (including SNSF grants, home institution, participants in projects, and third-party funds) was €2.11bn

The fourteen NCCRs of the first series completed their work in 2013 and involved over 6,000 researchers60. Funding was provided by SNSF (30%), home institutions (15%), network partners or partner universities (42%), and third parties (13%) (SNSF, 2016a, p.26).

Experiences and effects
In general, it is hard to see effects of different policies (including the NCCRs) on differentiation in Switzerland. On the one hand, differentiation of funding is “built in” the country’s higher education structure (i.e. the ETH, the canton and the UAS level are in principle “horizontal” forms of differentiation, but de facto are vertical also in virtue of the funding policies). On the other hand, Switzerland has adhered strongly to a bottom-up approach, with some exceptions to support specific fields (including via NCCRs) (interview data – Lepori; Loprieno).

The NCCRs seem to have been particularly successful in bringing about an overall concentration of research activities and rising ambitions in the fields supported. While it does

59 Amounts have been converted by author (see http://www.xe.com/)
60 For a list and description of these 14 NCCRs see SNSF, 2016a, p.26
have features of a Centre of Excellence scheme, in fact the programme supports geographically dispersed constellations and thus differs from traditional CoEs (Öquist and Benner, 2012).

On behalf of the SERI, the Swiss Council for Science and Innovation (Conseil suisse de la science et de l’innovation – CSSI) has conducted an impact evaluation of the NCCR programme. The analysis focuses on the NCCRs’ contribution to structuring the higher education landscape in Switzerland and is based on the completed NCCRs (2001-2013).

Quantitative assessment

In general, the over 14-year NCCR scheme experience appears to relate (at least) to a number of effects on the Swiss science system (see also SNSF, 2016a).

- Approximately 30,000 scientific publications were produced by the NCCRs between 2001 and 2014 (SNSF, 2016a);
- Since their launch, the NCCRs have entered into 870 partnerships with companies and founded or supported 86 start-up enterprises. In addition, they have generated 370 patents and their expertise has aroused the interest of corporate global players;
- The NCCRs have created 138 assistant professorships, in addition 5,200 young researchers have completed their doctorates in the NCCRs’ doctoral programmes. The specific advancement of young researchers has allowed them to fast-track their academic careers and has helped other NCCR doctoral students to succeed in business and administration;
- The CSSI review does point out that that there are “encouraging results” if one considers the European Research Council (ERC) grants. While it is necessary to be cautious in making causal relationships, about 25% (77 out of 304) of ERC grants awarded to Swiss researchers under the 7th Framework Programme went to researchers who have been active in the NCCR. Nonetheless, one must note that this is in line with the general trend of ERC grants in Switzerland. Indeed, the CSSI report (p. 24) states that participating in a NCCR does not weaken researchers’ competitiveness61.

Hence, it is hard to ascribe changes in Switzerland’s research performance to this one instrument. For years, the country has excelled over the EU and OECD averages in, for instance, publications and citations. For example, its Average of Relative Citations62 is almost 1.60 (the EU’s is just below 1.20). An value above 1.0 means that a country’s papers are cited more frequently than the world average in a specific research area (Dialogic and Empirica, 2014, p. 121)

Switzerland is also the strongest “Innovation Leader”, according to the EU’s Innovation Union Scoreboard 2015. A group of countries defined “Innovation Leaders” excel consistently and over time. Switzerland is the overall innovation leader in Europe, outperforming all EU Member States, including the EU leaders Germany, Denmark, Finland and Sweden, which invested significantly in “excellence” (see Chart C4)

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61 Original text (p. 24): “Une analyse exploratoire tend à confirmer que, pour des chercheurs actifs en Suisse, la participation à un PRN n’affaiblit pas la compétitivité”

62 The observed scientific impact of papers produced in a given country based on the number of citations received divided by the average citation count of the papers in a given subfield in a given period
Qualitative assessment

The CSSI review identifies four sorts of effects, namely (a) structural, (b) related to knowledge and technology transfer, (c) promotion of young researchers and equal opportunities and (d) system effects (CSSI, 2015).

Structural effects might include the creation of new Chairs, the reorganization of research and teaching, the development of new courses, the introduction of research networks and technology platforms, as well as new infrastructures (for research and for teaching). As mentioned earlier, a key effect (and indeed purpose) of the NCCR scheme was, *inter alia*, to strengthen the central university management. This has proven important for the creation of new centres. For example the University of Bern developed new centres thanks to a direct mandate from the rectorate, ensuring core funding through the university’s overhead funds. Maintaining the existing NCCRs has proven harder as no subsequent funding is expected (SNSF, 2016).

Secondly, the way NCCRs are structured helps ensure that the results of basic research are channelled as directly as possible into society, through collaborations with companies, as mentioned above. This means possible positive effects with regards to knowledge and technology transfer.

Thirdly, the NCCRs are said to have had a positive effect in promoting young researchers and equal opportunities. The NCCRs are the result of a balance between research needs (i.e. thematic direction of the centre) and the strategic objectives of all partners. Moreover, the international openness in doctoral recruitment has had a significant effect;

Finally, there is evidence of some effects on the system. Swiss research has traditionally performed very well and the innovation system is considered excellent. In that sense it is hard to see significant changes following the NCCRs. There are however indications that (a) there might be a relationship between participating in NCCRs and the number of ERC grants and (b) the NCCR instrument appears to have become a tool for institutions’ strategic planning and profiling.
It is worth emphasising that, while the NCCR scheme supports researcher-driven ideas, it effectively funds the network as a whole. Competition for fund allocations within universities is usually minimal since it simply derives from institutional strategic plans which, for example, may reallocate vacant professorial position depending on performance.

Considerations on the programme’s sustainability

One of the underlying hypotheses of the whole programme is that, as a result of benefitting from NCCR funding and in particular being a home institution to an NCCR, structures, strategies and views change. A successful NCCR will produce sustainable structural change, and promote knowledge transfer and maintain excellence in the system as a whole. Because NCCRs are research projects, they are not expected to continue in the same form at the end of their lifecycle but their legacy is often promoting dissemination, supporting national umbrella organizations in their respective fields, creating research institutions and/or (graduate) schools that can be permanent, etc. Over a dozen new research centres emerged from the NCCRs. Examples include the Oeschger Centre for Climate Research at the University of Bern, the Interfaculty Centre for Affective Sciences at the University of Geneva and the Swiss Nanoscience Institute (SNSF, 2016).

The CSSI review does point out a “sustainability risk” whereby after the end of the 12-year period network members might not continue or comply with agreements made during the funding period, when roles and responsibilities were contractually regulated (between the HEIs themselves and with the funder). Instead, afterwards negotiations are looser and a phasing out can occur. The review recommends that in order to achieve lasting structural effects the NCCRs could be organized as stronger entities based on formal agreements (e.g. spin-offs with their home institutions).

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Annex D: United Kingdom

Introduction

This Annex describes the United Kingdom’s Research Excellence Framework (REF). The REF is not an “excellence initiative” in the strict sense of the word because it is a formula-based model to inform the selective allocation of research funds to universities. It is not an ad hoc and time-limited scheme (modifications in the formula are made regularly). The origins of the REF lie in the 1986 Selectivity Exercise (subsequently Research Assessment Exercise [RAE]). Although it is unlike other excellence programmes, it does build competition into the block grants to universities and, thus, does support concentration of resources.

This analysis is based on a review of relevant documentation and telephone interviews conducted in February and March 2016 with researchers and policymakers (Table D1). The key lessons we can learn from this case are (inter alia):

- The long-term nature of this policy means that institutions learn to “game the system”. Several changes in the formula and weights, led to changes in institutional strategies (e.g. on what data to submit);
- On several occasions the government has changed the weights in the funding allocations in order to concentrate resources. Also for this reason, the REF perpetuates existing differentiation in the system rather than facilitating changes in the ranking order of institutions (e.g. the former polytechnics have been struggling to improve their positions since the RAE);
- The costs for universities of participating in the REF are very high and returns are diminishing over time. This risks benefitting the richer universities, thus aggravating existing inequalities in the system;
- There is no clear evidence that the REF (or before it the RAE) promoted differentiation between individuals.

Table D1. Interviews conducted

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
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<tbody>
<tr>
<td>Jeroen Huisman</td>
<td>University of Ghent (Centre for Higher Education Governance) (formerly professor at University of Bath)</td>
<td>Professor of Higher Education</td>
</tr>
<tr>
<td>Maria Nedeva</td>
<td>University of Manchester (Business School)</td>
<td>Professor Science and Innovation Dynamics and Policy</td>
</tr>
<tr>
<td>Ben Martin</td>
<td>University of Sussex (Science Policy Research Unit)</td>
<td>Professor Science and Technology Policy Studies</td>
</tr>
<tr>
<td>David Sweeney</td>
<td>Higher Education Funding Council of England</td>
<td>Director (Research, Education and Knowledge Exchange)</td>
</tr>
</tbody>
</table>

The research system

The UK research system is largely centralised, although regional autonomy for innovation policy has been increased in recent years. The Devolved Administrations of Scotland, Wales and Northern Ireland have responsibility for aspects of health and education funding. Block funding for higher education institutes is provided by separate higher education funding councils (or similar bodies) in each country, although the bulk of research funding comes via the Research Councils which have a UK-wide remit (Cunningham, 2015, p. 2). The lead
executive role in research is played by the Department for Business, Innovation and Skills (BIS), which is also home to the Government Office for Science (GO-Science). GO-Science is headed by the Government’s Chief Scientific Adviser (CSA). S/he reports directly to the Cabinet and chairs the Council for Science and Technology, which in turn advises the Prime Minister and senior ministers on strategic policies (Ibid.).

The public funding system is described as “dual”. The two main streams of public funding in the UK are (a) institutional block funding and (b) project grants from the research councils.

Research funders include (Cunningham, 2015):

- **BIS**: responsible for the public sector, for the allocation of the UK Science Budget via the Research Councils and, to a lesser degree, the Royal Society and Royal Academy of Engineering;
- The seven Research Councils support R&D and research training both in Higher Education Institutions (HEIs) and their own institutes, and provide research grants for programmes, projects and research centres. Some of the Councils also maintain their own research facilities in the UK and abroad for university researchers. In 2002 they formed a strategic partnership called “Research Councils UK” (RCUK) to enhance the overall impact and effectiveness of their research, training and innovation activities63;
- The Higher Education Funding Councils and their equivalents in the devolved administrations allocate block grants to UK universities based on the Research Excellence Framework (REF) allocation exercise (which will be discussed later);
- **Innovate UK** (formerly The Strategy Board [TSB]) supports technology and innovation, mainly through collaborative work between businesses or between businesses and academia, also internationally;
- The Treasury (together with Innovate UK) supports the private sector’s investments in R&D through a number of mechanisms, most notably tax breaks;
- Other Ministries and Departments have research portfolios within their areas of responsibility. They commission R&D through their laboratories and institutes or from outside sources such as HEIs. Key ministries are the Department for Environment, Food and Rural Affairs, the Ministry of Defence and the Department of Health.

Research performers include (Dialogic and Empirica, 2014):

- 165 HEIs (of which 115 universities, including federal universities such as those of London and Wales, which are counted as a single entity);
- Public laboratories and several government departments in the UK that perform research activities by means of several government agencies: the department for Business, Innovation and Skills (e.g. National Measurement Office, UK Space Agency), the department for Environment, Food and Rural Affairs (e.g. Animal Health and Veterinary Laboratories Agency, Food and Environment Research Agency), department of Health (e.g. Public Health England) and the ministry of Defence (e.g. Defence Science and Technology Laboratory). However, several government laboratories (such as the National Physical Laboratory), now reside either partly or wholly in the private sector;
- UK businesses (although R&D business expenditures seem quite low regarding international standards.

The two charts below show the relationships amongst the different actors within the UK’s research funding system and the funding flows for R&D in 2014.

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63 [http://www.rcuk.ac.uk/about/aboutRCUK/](http://www.rcuk.ac.uk/about/aboutRCUK/)
Chart D1. UK Research and Innovation System

Source: Cunningham, 2015 (reproduction of figure 1, p.6).
The policy context

A key long-term policy defining the UK’s strategic direction in science and innovation investment has been the 2011 *Innovation and Research Strategy for Growth (IRS)* published by BIS. The strategy is holistic and encompasses research, innovation and education aspects, as well as proposing investment decisions for research infrastructures. Aside the IRS, a UK *Industrial Strategy* including ten Sectoral Strategies also formed a basis for strategic planning. The Industrial Strategy outlines a number of actions of relevance to the UK business sector and the role of Government support. In 2013, the Minister for Universities and Science set out the so-called “Eight Great Technologies” which would guide UK industrial investment.

On 17 December 2014, a new strategy called “*Our Plan for Growth: science and innovation*” was published. The Plan has the ambition for the UK “to be the best place in the world for science and business” and comprises the following six elements:

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64 http://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment/2014
66 Two have been added, namely quantum technologies and the internet of things, see Cunningham, 2015, p. 12.
1. Deciding priorities (a process supported by the Eight Great Technologies and the Industrial Strategy)
2. Nurturing scientific talent
3. Investing in our scientific infrastructure
4. Supporting research
5. Catalysing innovation
6. Participating in global science and innovation

Finally, research programmes (as distinct from innovation support programmes) are operated by the seven UK Research Councils. There are no thematic priorities; instead support is meant to maintain the overall performance of the research system and thus is “horizontal”. The key goals of research programmes is to ensure the production of excellent research, to maintain and develop research infrastructures, and to ensure a supply of scientists, engineers and technologists (Cunningham, 2015, pp. 8 ff.).

The RAE and the REF

The UK was the first country in Europe to introduce formula-based funding for research (as opposed to funding allocated on a historical basis). The Research Assessment Exercise (RAE) began in 1986 to periodically measure the quality of research conducted by UK universities. It has recently been replaced by the Research Excellence Framework (REF) which, *inter alia*, places more emphasis on the societal (non-academic) impact of research. The amount of block funding depends on this assessment. Hence, it effectively builds competition into the block grants to universities. (Geuna and Piolatto, 2016; Dialogic, 2014, p. 13; Minelli *et al*, 2015).

The costs to conduct the REF have recently been evaluated to ensure continued efficiency of the process. Previous RAEs have been highly cost-effective given the value of public funds distributed through their outcomes (including the estimated cost to HEIs). For example, the funding bodies estimated the costs of the 2008 RAE in England to be some 0.5% of the value of public research funding that was subsequently allocated with reference to its results. (Farla and Simmonds, 2015, p.5).

Rationale for the initiatives

The REF rewards past performance on the assumption that it predicts future success. The evaluation of research in the UK determines the amounts of block grants universities will receive. In other words, the REF’s primary purpose is to inform the allocation of quality-related research funding (UK government, 2016).

The REF produces assessment outcomes for each submission made by institutions, enabling the following uses (Farla and Simmonds, p.4 ff.):

- The funding bodies use the assessment outcomes to inform the selective allocation of their research funding to HEIs, with effect from 2015-16;

68 Under the name “research selectivity exercise” 69 See also a critical article by Giosuè Baggio on the THE: “Universities need a REF that rewards potential”. At: https://www.timeshighereducation.com/comment/universities-need-a-research-excellence-framework-that-rewards-potential 70 See also http://www.ref.ac.uk/media/ref/content/background/REF_SIA_final.pdf
The assessment provides accountability for public investment in research and produces evidence of the benefits of this investment;

The assessment outcomes provide benchmarking information and establish reputational yardsticks.

**Design of policy**

The REF is a process of expert review. It is conducted jointly by the four UK higher education funding bodies, and is managed by the REF team on their behalf. Although it is very similar to the RAE (which was last conducted in 2008), the REF uses three specific criteria, namely (a) the quality of research outputs, (b) the wider impact of research and (c) the sustainability and vitality of the research environment (Manville *et al.*, 2015; Farla and Simmonds, 2015).

The REF has developed through an evolutionary process building on the experiences since the 1986 selectivity exercise. Every successive assessment exercise kept into account earlier successes and produced changes (e.g. in weights, see below) to adapt to new policy priorities (Farla and Simmonds, 2015; interview data – Huisman; Sweeney). The discussion and feasibility analysis resulted in the use of bibliometrics in Natural and Bio-Medical Sciences, and Economics and Statistics. Bibliometrics was used as an instrument to inform peer review, which remained the dominant method of assessment (Geuna and Piolatto, 2016, p. 263).

The framework covers 36 Units of Analysis (UOAs), which are specialist areas organised by subject. Institutions can choose what specialist areas to enter. Submissions to the exercise were completed in November 2013 and the results were published in December 2014. (Farla and Simmonds, 2015, p. 4).

As part of the evaluation (2008-2013), HEIs must provide the following information:

- Information on staff in post on the census date selected by the institution to be included in the submission;
- Details of publications and other forms of assessable output which they have produced during the publication period. Up to four outputs must be listed against each member of staff included in the submission;
- Description of the submitted unit’s approach to enabling impact from its research, and case studies describing specific examples of impacts achieved;
- Data about research doctoral degrees awarded and research income;
- Description of the research environment.

The evaluation process is conducted by an expert sub-panel for each of the 36 UOAs working under the leadership of four main panels organized by subject area and appointed by the four UK funding bodies. The four main panels are responsible for developing the panels’ criteria and working methods, for ensuring adherence to the published procedures, for the consistent application of the overall assessment standards, and for signing off the outcomes of the assessment. The evaluation grades three “sub-profiles”, which form the overall quality profile according to different weights:

1. Output (“originality, significance and rigour” with reference to international research quality standards): 65%.

71 See: [http://www.ref.ac.uk/media/ref/content/pub/assessmentframeworkandguidanceonsubmissions/GOS%20including%20addendum.pdf](http://www.ref.ac.uk/media/ref/content/pub/assessmentframeworkandguidanceonsubmissions/GOS%20including%20addendum.pdf)
2. Impact on the economy, society and/or culture: 20%;
3. Environment, in terms of its “vitality and sustainability”, including its contribution to the vitality and sustainability of the wider discipline or research base: 15%.

Similarly to the RAE, the evaluation grades go from “unclassified” to 4-star (for each sub-profile as well as overall). The overall quality profile is the aggregate of the weighted sub-profiles, published in steps of 1 per cent. For example if 12.8% of outputs, 20% of impact and 0% of environment are graded 4*, then the overall 4* quality profile is: (0.128×0.65) + (0.20×0.20) + (0×0.15) = 12%. Table D2 shows the definitions of the starred levels for each profile, as reported in Annex A of the “Assessment framework and guidance on submissions” document.

Table D2. Definitions of the starred levels in the overall quality profiles and each of the sub-profiles

<table>
<thead>
<tr>
<th>Overall</th>
<th>Output</th>
<th>Impact</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Star</td>
<td>Quality that is world-leading in terms of originality, significance and rigour.</td>
<td>Quality that is world-leading in terms of originality, significance and rigour.</td>
<td>Outstanding impacts in terms of their reach and significance.</td>
</tr>
<tr>
<td>3-Star</td>
<td>Quality that is internationally excellent in terms of originality, significance and rigour but which falls short of the highest standards of excellence.</td>
<td>Quality that is internationally excellent in terms of originality, significance and rigour but which falls short of the highest standards of excellence.</td>
<td>Very considerable impacts in terms of their reach and significance</td>
</tr>
<tr>
<td>2-Star</td>
<td>Quality that is recognised internationally in terms of originality, significance and rigour</td>
<td>Quality that is recognised internationally in terms of originality, significance and rigour.</td>
<td>Considerable impacts in terms of their reach and significance.</td>
</tr>
<tr>
<td>1-Star</td>
<td>Quality that is recognised nationally in terms of originality, significance and rigour.</td>
<td>Quality that is recognised nationally in terms of originality, significance and rigour.</td>
<td>Recognised but modest impacts in terms of their reach and significance</td>
</tr>
<tr>
<td>Unclassified</td>
<td>Quality that falls below the standard of nationally recognised work. Or work which does not meet the published definition of research for the purposes of this assessment.</td>
<td>Quality that falls below the standard of nationally recognised work. Or work which does not meet the published definition of research for the purposes of this assessment.</td>
<td>The impact is of little or no reach and significance; or the impact was not eligible; or the impact was not underpinned by excellent research produced by the submitted unit.</td>
</tr>
</tbody>
</table>

Source: REF Assessment framework and guidance on submissions. (HEFCE, 2012)

http://www.ref.ac.uk/media/ref/content/pub/assessmentframeworkandguidanceonsubmissions/GOS%20including%20addendum.pdf
There are some key changes compared to the RAE, including eligibility criteria for assessment panels and for staff (participating from HEIs). However, the main change is the consideration of the non-academic impact of research (i.e. an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia). The assessment process for the impact element of the REF was evaluated separately by RAND Europe, upon request of the UK higher education funding bodies (Manville et al., 2015). The outcomes of this element of the REF are believed to reflect the overall results (interview data – Sweeney).

Another significant change was the reduction of the number UOAs from 67 in the RAE to 36 in the REF, and the main panels from 15 to 4. This change was intended primarily to (a) enable greater consistency across the exercise, (b) reduce the number of (fluid) boundaries between UOAs and hence reduce the need for HEIs to make tactical decisions about what work to submit in which UOAs, and (c) narrow the disparities in sub-panel workloads (HEFCE 2015).

Implementation of the policy
The REF was undertaken by the four higher education funding bodies for England, Scotland, Wales and Northern Ireland in 2014. It was managed by the REF team based at HEFCE on behalf of these bodies, and was overseen by a steering group of representatives from these bodies. The funding bodies use results to inform the selective allocation of their research funding to HEIs, with effect from 2015-16 (HEFCE, 2014).

During this exercise 154 UK institutions made submissions in 36 subject-based units of assessment. They made 1,911 submissions, including 52,061 FTE academic staff, 191,150 research outputs and 6,975 impact case studies. The overall quality was judged, on average across all submissions, to be very good. 30% was judged world-leading (4*); 46% internationally excellent (3*); 20% internationally recognised (2*); and 3% nationally recognised (1*) (HEFCE, 2014).

Experiences and effects
On 16 December 2015, Universities and Science Minister Jo Johnson launched a UK-wide review of the Research Excellence Framework (REF) to ensure that future university research funding is allocated more efficiently, offers greater rewards for excellent research and reduces the administrative burden on institutions. The review is chaired, in a personal capacity, by the President of the British Academy, Lord Nicholas Stern and evidence is currently being analysed (calls for evidence was open until 24 March 2016). (UK government, 2016).

Quantitative assessment
The REF Website draws a number of conclusions from the REF results. For example, it shows the proportion of submissions at different quality levels (i.e. 4* to 1*); it compares the

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73 This report looks at the methodology of assessment, not at the impact of this element on the differentiation
74 In fact, 44% of impact submissions were rated 4* and 30% “overall” (i.e. “impact” was more frequently “outstanding” than the “overall” quality of the submissions). See, e.g., the article on Times Higher Education’s (THE) “REF 2014 results: table of excellence”. At: https://www.timeshighereducation.com/news/ref-2014-results-table-of-excellence/2017590.article
75 See: http://www.ref.ac.uk/results/analysis/
REF results with the RAE’s; it evaluates the consistency of assessment across UOAs and in comparison with RAE.

First, on the aggregate the REF panels found better output quality than the RAE during the previous period. Not only did the absolute number of outputs judged to be 4* and 3* increase but, because the overall number of submissions dropped from 215,507 in the RAE to 191,150 in the REF, the relative increase is significant. Across all submissions, the number of “world-leading outputs” (4*) grew from 14% to 22%, “internationally excellent outputs” (3*) went from 37% to 50%, and the sum of 3* and 4* was 72% in the REF vs. 51% in the RAE. These figures align with citations figures, as shown in the chart below, taken from the REF website. The number of UK outputs in the top 1% of the world’s most highly cited papers increased by 44%. This was 31% for outputs in the top 5% of the world’s most highly cited papers, and 29% for outputs in the top 10% of the world’s most highly cited papers.

However, these improvements might well be an effect of “learning by doing” or ‘playing the system’. Institutions have much leeway in whether they participate, in what UOAs and what staff they present. This is often seen as a weakness since it allows institutions to “play the game” (interview data – Nedeva). They learn how to obtain good results through significant investments in the selection of outcomes and the preparation of submissions, resulting in grade increases rather than a real improvement in the quality of research (Geuna and Piolatto, 2016).

Indeed, Lord Stern’s review of the Research Excellence Framework suggests that institutions should be required to enter all their academics (at the moment, departments choose to submit any number of researchers to the REF), to prevent the “gaming” around submission numbers that many consider to be the REF’s biggest flaw.

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76 Although the outputs submitted in the RAE and REF, and the set of papers included in the citation analysis (data provided by Scopus) are different, they both indicate a similar trajectory of improvement in the UK’s research performance.

77 For example Cardiff Metropolitan and the University of Brighton (referred to later in the report) were the only two former polytechnics that performed relatively well in the REF. Yet, the former entered only 35 researchers to three units of assessment and the latter entered 209 researchers to 10 units (see: https://www.timeshighereducation.com/news/ref-2014-results-table-of-excellence/2017590.article).


79 This is part of Cambridge University’s submission to the review.
Second, although the REF is not primarily intended to encourage differentiation (interview data – Sweeney), results indicate that both the REF and RAE reflect differentiation in the system and that this has not changed significantly from one exercise to the next. Chart D4 shows how the volume of submitted activity judged to be 4* is distributed across institutions in the REF and in the RAE. The nature of the distribution shows that the two exercises provide a similar degree of differentiation between institutions. Moreover, institutional average results show that excellence was found in institutions with submissions of all sizes and that each element of the assessment – outputs, impact and environment – provided differentiation between institutions.

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80 A similar chart can be produced for the activity judged to be 3*+4*

81 Three-quarters of the institutions had at least 10% of their submitted activity graded at 4*. One quarter had at least 30% graded at 3* or above, three-quarters of the institutions had at least 49% of their submitted activity graded at 3* or above. One quarter had at least 79% graded at 3* or above. See: http://www.ref.ac.uk/results/analysis/institutionalaverageresults/
However, in their analysis of the research assessment policies since the 1980s Geuna and Piolatto (2016) reveal that whilst the REF and the RAE provide a similar degree of differentiation, the government has repeatedly changed the weights in the funding allocations to pursue selectivity and concentrate resources. Since a large number of research units were receiving very high rates, the government changed the weight distribution after 2002/03, skewing the funds towards the top rating with more than 85% of mainstream Quality-Related (QR) funding to (then82) top 5 and 5* scoring departments. Then, in 2004/05 an extra funding stream of €35m was introduced for the “very best” 5* departments. These developments meant that about 80% of HEFCE funds were concentrated in 25 higher education institutions (Geuna and Piolatto, 2016, p. 264). In 2011/12, 73% of mainstream QR funding was allocated to the top 20% of the distribution, while the Research Council funding was even more concentrated with 84% going to the top two deciles (Geuna and Piolatto, 2016, p. 264). With the REF the government has decided to skew the weight distribution again by increasing those for 4* submissions. Hence, one may argue that by increasing the premium for excelling, the RAE/REF system is designed to perpetuate existing differentiation rather than facilitating changes in the order of institutions according their performance.

A comparison with national and international ranking results seems to corroborate this conclusion. Albeit disputed for a number of methodological reasons, institutional league tables are often used to gauge differentiation. The Times Higher Education (THE) produced a “table of excellence” based on the REF results, and compared them with the RAE results. It is interesting to compare these results with both national rankings (such as the Times ranking of UK universities) and global rankings. There are several global rankings, but for argument purposes this report will use the Academic Ranking of World Universities (ARWU), known as the “Shanghai ranking”83, and the “Leiden Rankings” developed by the Centre for Science and Technology Studies (Centrum voor Wetenschap en Technologische Studies [CWTS] in Dutch) at Leiden University. The latter is interesting because unlike most other rankings, it does not rely on subjective data obtained from reputational surveys or on data provided by universities themselves. Instead, it is entirely based bibliometric indicators (the 2016 rankings are based on Web of Science indexed publications from the period 2011–201484).

Table D3 presents the top-10 institutions in the REF and the RAE, as well as in the latest Times, Shanghai, and Leiden rankings. What can be seen is that the different exercises show a strong degree of overlap in their assessments. The institutions in blue are present in at least four lists.

82 The 4* system was introduces for the 2008 RAE. Until then it was 1, 2, 3a, 3b, 4, 5, 5*
83 The ARWU is conducted by researchers at the Center for World-Class Universities of Shanghai Jiao Tong University, in China.
Table D3. Ranking of top-10 institutions based on THE “table of excellence” (REF and RAE), 2016 Times UK University Ranking and the 2015-16 Academic Ranking of World Universities

<table>
<thead>
<tr>
<th>REF</th>
<th>RAE</th>
<th>TIMES National</th>
<th>ARWU</th>
<th>Leiden Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Imperial College London</td>
<td>1 University of Cambridge</td>
<td>Imperial College London</td>
<td>University of Cambridge</td>
</tr>
<tr>
<td>2</td>
<td>LSE</td>
<td>2 LSE</td>
<td>2 University of Oxford</td>
<td>2 University of Oxford</td>
</tr>
<tr>
<td>3</td>
<td>University of Oxford</td>
<td>2 University of Oxford</td>
<td>Imperial College London</td>
<td>UCL</td>
</tr>
<tr>
<td>4</td>
<td>University of Cambridge</td>
<td>4 Imperial College London</td>
<td>University of St Andrews</td>
<td>Imperial College London</td>
</tr>
<tr>
<td>5</td>
<td>Cardiff University</td>
<td>5 UCL</td>
<td>5 Durham University</td>
<td>University of Manchester</td>
</tr>
<tr>
<td>6</td>
<td>King’s College London</td>
<td>6 University of Manchester</td>
<td>University of Warwick</td>
<td>University of Edinburgh</td>
</tr>
<tr>
<td>7</td>
<td>UCL</td>
<td>7 University of Warwick</td>
<td>University of Exeter</td>
<td>King's College London</td>
</tr>
<tr>
<td>8</td>
<td>University of Edinburgh</td>
<td>8 University of York</td>
<td>University of Surrey</td>
<td>University of Bristol</td>
</tr>
<tr>
<td>9</td>
<td>University of Edinburgh</td>
<td>9 University of Essex</td>
<td>LSE</td>
<td>University of Warwick</td>
</tr>
<tr>
<td>10</td>
<td>University of Bristol</td>
<td>10 University of Edinburgh</td>
<td>UCL</td>
<td>10 LSE</td>
</tr>
</tbody>
</table>

Sources: THE[^85], The Times[^86], ARWU[^87], Leiden Ranking[^88]. Compiled by Author.

Notes: THE “Table of excellence” data selected in this Table includes only institutions that entered over ten units. The THE included institutions entering as few as two units, leading to two very specialized institutions in the top-10 (the Institute of Cancer Research at #1, and the London School of Hygiene & Tropical Medicine at #10). For the “Leiden ranking” we chose the ranking based on the number of top-10% publications (number of publications of a university belonging to the top 10% of their field).

It is open to question to what extent public investments that perpetuate existing differences will eventually lead to spill-overs on other institutions. For example, the THE REF/RAE “table of excellence” reveals that Cardiff Metropolitan University is the highest ranking “post-1992 institution”[^89] (41st place), followed by the University of Brighton (58th). In general, they sum up, “some post-92s gain, but traditional research powers dominate”. None the less, it is worthy of note that both institutions were aided by strong showings on impact. Therefore, despite claims that the impact element “[…] has not had the revolutionary effect that some had predicted” in helping some post-1992 institutions to break “[…] into the upper echelons of the rankings”[^90], impact does seem to impinge on the system. According to Farla

[^86]: The rankings for 2015-2016 were presented on the following website:[http://www.ukuni.net/articles/UK-University-Ranking-2016-Times](http://www.ukuni.net/articles/UK-University-Ranking-2016-Times)
[^89]: Former polytechnics that gained university status when, in 1992, the UK passed from a binary to a unitary higher education system. Post-1992 institutions have traditionally remained more teaching-focused and have performed worse than traditional research universities in research assessments and in global and national rankings
and Simmonds (2015, p.3) it “[…] yielded tremendous insight into each institution’s wider social and economic achievements and was widely welcomed as both a platform for marketing and internal learning” (see also Manville et al., 2015).

In terms of individual diversity, the REF analysis reveals that research outputs by early career researchers and staff with other circumstances were found to be of equal quality to outputs by all staff91 (about 20% of 4* and over 70% 3*+4*). There is, thus, little evidence to indicate that the REF reshapes the output profiles of different groups of staff.

Qualitative assessment
Most Pro-Vice-Chancellors and REF managers acknowledge important institutional benefits from the REF (Farla and Simmonds, 2015). For example, participating in the exercise is said to yield reputational dividends as well as strategic intelligence about institutional and departmental performance; the impact element provides insight into each institution’s wider social and economic achievements. Moreover, the REF is said to prompt better institutional research management systems, improved marketing and promotional material, more awareness of equality and diversity issues, and additional income (Farla and Simmonds, 2015). However, the “differentiation effect” is said to be primarily reputational rather than budgetary (the “money shifts” are said to be, in fact, limited (Dialogic 2014, p.60; interview data – Sweeney).

In general, from a qualitative perspective, one can make a number of considerations, for example (interview data – Huisman; Martin; Nedeva; Sweeney; Geuna and Martin, 2003; Geuna and Piolatto, 2016):

• The current system has not changed the institutional order but increased the premium for being at the top. This means that it reinforces extant inequalities. In the UK there has been a strong drive towards concentration but that has subsided as the goal is now more to let HEIs engage with different parts of the economy. The current REF makes explicit the existing differentiation;

• Some argue that the RAE has “homogenised” the system (following the 1992 reforms that abolished the binary system). Now, former polytechnics want to do well on the same scores as “traditional” (research intensive) universities. However, while there are policies pushing towards more interdisciplinary research, every five years the RAE/REF conducts a disciplinary based evaluation. This implies that there is a dissonance between policy and evaluation and that there is more emphasis in disciplinary research. In turn, this tends to (a) confirm existing inequalities, and (b) encourage “gaming the system” as HEIs choose where to submit and what staff outputs to submit;

• The current UOA-structure assumes that the “unit of accountability in science and research” and the “unit of production of research” are the same, i.e. nation-based. Yet, this is questionable. Only in in lab-based sciences this is true because the research is done in the lab in the university but in other fields the research may happen in another country, and the organization does not really matter. The unit is evaluated but the research may be conducted abroad hence is it hard to increase internal differentiation;

• The cost of such exercises might exceed the benefits. Today, the REF costs over £200m (or 4k per academic) only to decide how to allocate the money. Geuna and Martin (2003) look at the RAE evolution in the UK and argue that the first 2-3 times it

91 See: http://www.ref.ac.uk/results/analysis/outputprofilesanddiversity/
had benefits but over time the costs rose within universities, leading to diminishing returns. This indicates that ipso facto the richer universities will benefit, thus reinforcing existing inequalities;

- The focus on publications may be detrimental to producing real “breakthrough research” because opening new research lines typically requires strong investments (e.g. in time and money), which requires not publishing for some time as a centre is built or innovative findings are produced. In turn, this would mean losing opportunities to participate in the REF.

Considerations on the programme’s sustainability

The REF is not an ad hoc programme and is, thus, expected to continue (it has, in effect, been going on for three decades). However, methodological questions remain, most notably with reference to the different elements that are evaluated and the associated weights. For example, a recent THE article\(^9^2\) reports on the disagreements about the extent to which the next REF should focus on overall university performance and support “critical mass at the institutional level”. This position is strongly advocated by the Russell Group of universities (according to critics because it would favour universities that already perform well in the overall assessment).

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