



JRC SCIENCE FOR POLICY REPORT

Performance based funding: a comparative assessment of their use and nature in EU Member States

A working paper

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Abstract

Performance based funding is used by most EU Member States to increase the performance of their public research system. This report analyses the different nature of these systems. This report aims to inform Member States to engage in mutual learning to improve the design of their allocation systems.

Title A comparative analysis of Performance based funding systems in the EU Member States – a working paper

- Performance based funding systems provide incentives to increase the performance of public research systems
- The nature of systems in place differs widely
- The specific features of PBF assessment designs can generate unintended consequences
- The assessment suggests PBF as a potential avenue for improvement for several Member States
- The choice for specific designs, taking into accounts costs and potential benefits, should take into account the national context

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Foreword

This working paper aims to inform a Mutual Learning Exercise on Performance based funding organised for the EU Member States by DG RTD. It will form the basis for a further analysis once further data becomes available through a study contracted out by DG JRC J6.

Acknowledgements

This working paper draws among other sources on the RIO Country Reports 2014 which were drafted by a network of experts following a template prepared by DG JRC J6. The country specific information has been reviewed and supplemented in close coordination with the country specialists of DG JRC J6: Robert Gampfer, Hristo Hristov, Jessica Mitchell, Giovanni La Place, Milena Slavcheva, Maren Sprutacz, Blagoy Stamenov, Katarzyna Szkuta, Jana Zifciakova. Athina Karvounarakis and Peter Fako have also provided support to a specific section of the report. Finally the report has benefited from comments from Benedetto Lepori and Emanuela Reale. Finally we would like to thank Xabier Goenaga Beldarrain for encouraging us to write this report.

Executive summary

Policy context

The introduction of performance based funding systems is one of the central mechanisms through which many EU MS have tried to increase the effectiveness and performance of their Public Sector Research systems (ERA priority 1). In the EC communication on "Supporting Growth and Jobs – An Agenda for the Modernisation of Europe's Higher Education Systems" the Commission recommends the introduction of *funding mechanisms linked to performance which introduce an element of competition*. The Council Conclusions of November 2011 also recommend the introduction of mechanisms linked to performance and competition to improve the governance of the higher education system. The initial aim of this working paper is to provide an input to a DG RTD managed Mutual Learning Exercise on performance based funding in the framework of the Horizon 2020 Policy Support Facility¹. To do so, it presents an analysis of the different approaches taken by EU MS to use performance based allocation of organisational level public R&D funding. In addition this paper identifies a number of issues which Member States should take into account when evaluating/implementing these type of funding allocation mechanisms.

Main Findings

The report analyses the PBF systems in place in EU research systems. Most EU Member States have implemented Performance Based Funding systems. Performance based funding systems differ widely in nature and in terms of the type of assessments they use. Many countries use a funding formula which is partially based on the quantitative assessment of research outputs. Another set of countries rely instead on evaluations of research output through peer review. A subset of the latter mixes peer review with the quantitative assessments of research outputs.

The report contains a brief overview of the ongoing debate regarding the benefits and disadvantages of peer review and bibliometric assessment approaches. In the design of systems it is important to take into account the potential for generating perverse incentives. The costs involved in setting up different types of assessment, is also a factor to consider.

A provisional assessment of the effect of PBF on the evolution of the output and impact of the EU national research systems is included in the report. The available evidence on the effect of this funding mechanism is mixed. However, all countries which did not experience a consistent improvement in impact scores did not have a PBF system in place. These countries recently also received recommendations by international organisations to implement a PBF system. Differences in the funding allocation system in place are not the only factors affecting MS Performance. Other issues in which Member States differ include the share of organisational level funding which is allocated through PBF, the speed within which the system is introduced, the degree of stakeholder involvement, the impact different systems have on the autonomy of research performers, the criteria on which they evaluate and their likely impact on research excellence indicator as well as the other missions and behaviours which the government wants to promote in these organisations. An extended analysis of the impact of funding allocation regimes on research system performance will be carried out in a follow up to this report.

In view of supporting mutual learning between the Member States this report presents an analysis of the different assessment and allocation systems in use in the Member

¹ <https://rio.jrc.ec.europa.eu/>

States. The analysis and the annexes provide examples of relevant practices such as the way PBF was gradually introduced in Denmark, the sophisticated bibliometric approach in use in Flanders and the successful, though relatively costly, peer review approach in place in the UK. Much can be learned from the experiences of countries which have had PBF systems in place for a long time and especially from the rationale for the changes in PBF design which they have implemented over the course of the past decade.

Related and Future JRC work

It is the intention to build upon this working paper in future publications which will complement the qualitative analysis, with newly collected quantitative data for the EU MS. These future reports will include an update of the current working paper as well as a report analyzing the impact of differences in funding allocation systems on the performance of research systems. These analyses will take into account the new research excellence indicator for assessing the performance of Member States on ERA priority one, which the JRC is developing in consultation with ERAC and DG RTD.

1. Introduction

The introduction of performance based funding systems is one of the central mechanisms through which many EU MS have tried to increase the effectiveness and performance of their Public Sector Research systems (ERA priority 1). Already in 2010, OECD Member States indicated their interest to engage in mutual learning on this topic. Given its prominence among ERA priorities and the fact that different EU Member States have implemented PBFs with different characteristics, it remains an important potential topic for Mutual Learning among EU MS as well. The initial aim of this working paper is to provide an input to an RTD PSF Mutual Learning Exercise on performance based funding. To do so, this working paper will present an overview of the different approaches taken by EU MS to use performance based allocation of organisational public R&D funding. In addition it aims to identify a number of issues which should be taken into account when evaluation/implementing these type of funding allocation mechanisms. It is the intention to build upon this working paper in future publications which will complement the qualitative analysis, with newly collected quantitative data for the EU MS and to use this as a basis for an assessment of the effect of differences in funding systems.

With public funding constituting around 35% of total R&D spending in European countries, public spending to research and development is widely considered as one of the main mechanisms for orienting science, technology and innovation policies (OECD, 2002; 2013). For more than thirty years, EU Members States have been seeking for a consistent policy strategy to ensure an efficient allocation of public funding (Lepori, 2007a; 2007b). The focus on efficiency is central to the new public management approaches with its stress on monitoring and evaluation of policies and funding, which has influenced policy makers in many member states. Austerity induced public budget restrictions have further increased the emphasis on efficiency also in the public research system. A widely held assumption is that enhancing competitive allocation mechanisms would allow for improving the research performance and encouraging a more efficient use of the funding resources, by selecting the best research groups, promoting cooperation and competition between research groups, promoting specific subjects or research themes and supporting structural changes in the modes of knowledge production with the aim to increase societal impact (Geuna, 2001; Braun, 2003). This approach received support from the European Commission, which invites MS to "introduce or enhance competitive funding through calls for proposals and organisational assessments as the main modes of allocating public funds to research and innovation, introducing legislative reforms if necessary" (COM, 2012). Yet, national policy frameworks are still fragmented and the empirical evidence supporting competitive allocation mechanisms as a tool to enhance an efficient allocation of funding is mixed (Abramo, Cicero, & D'Angelo, 2012; Auranen & Nieminen, 2010; Sandström, Heyman, and Besselaar, 2014).

Countries with different administrative traditions tend to implement competitive funding instruments in different ways (Bleiklie & Michelsen, 2015). Moreover, the efficiency and performance effects generated by competitive funding is not homogenous between countries and within the same country due to the differences in the quality levels of public research systems and of national research performers. Roughly one can group European countries in two categories. One group of countries traditionally has large Public Research Centres, public research organisations, which play an important role in carrying out also basic research. Universities in these countries which include France, Spain, Germany and most of the Central and Eastern European countries with the Academies of Science, are playing an increasingly important role as a research actor but the PRC remain important players. Another distinction which is important to consider among higher education systems is whether countries have

binary systems of research universities and universities of applied science, such as the Netherlands, Germany, Belgium, Norway, Denmark, Finland and Ireland or systems in which all universities are in theory treated alike as is the case in most large European research systems except from Germany (Lepori and Jongbloed, 2015, Kyvik, 2004). Universities are the prime target for performance based funding systems in most countries. In some systems research performance based funding allocation extends to other important research performing actors, such as Public Research Centres including the academies of sciences in the Central and Eastern European countries. Where this is the case this will be flagged in this report.

The EU policy emphasis appears to have shifted from promoting an increase in competitive (including project) funding in general, to stressing the potential benefits of including competitive elements in the allocation of organisational funding. Performance based funding mechanisms are the central way to do this. In the EC communication on "Supporting Growth and Jobs – An Agenda for the Modernisation of Europe's Higher Education Systems" (COM, 2011) the Commission recommends the introduction of *funding mechanisms linked to performance which introduce an element of competition*. The Council Conclusions of November 2011 recommend the introduction of mechanisms linked to performance and competition to improve the governance of the higher education system (EU Council, 2011). As a further indication of the importance EU Commission R&D policy makers attach to the introduction of Performance Based Funding it is illustrative to read the very specific Country Specific Recommendations which the European Commission gave to the Czech Republic in the European Semester Reports:

(2011) Establish a transparent system of quality evaluation of academic institutions and link it to its funding in order to improve the performance of tertiary education

(2012) Adopt the necessary legislation to establish a transparent and clearly defined system for quality evaluation of higher education and research institutions. Ensure that the funding is sustainable and linked to the outcome of the quality assessment

(2013) Adopt measures to enhance accreditation and funding of higher education. Increase the share of performance- based funding of research institutions

(2014) Accelerate the development and introduction of a new methodology for evaluating research and allocating funding in view of increasing the share of performance-based funding of research institutions.

While many EU MS have adopted performance based funding mechanisms albeit to different extents, the nature and methodologies adopted by MS differ widely. It is the aim of this report to provide a comparative overview and analysis of the different types of performance based funding mechanisms in the EU Member States. This is accompanied by a reflection on the pro's and con's of the different methodological approaches to performance based funding.

2. Brief review of the literature

The introduction of performance based funding is considered to increase the accountability of universities over their spending of public R&D funding (Hicks, 2012). As discussed among the main motivations for moving from a trust-based block funding system towards the implementation of performance based funding mechanisms is to give governments, as a "principal", greater leverage over their "agents": research performing organisations in their public research systems. Performance based funding, the argument goes, can be used to stimulate research organisations to increase the volume or quality of their output or to engage in other behaviour deemed desirable by the principal such as the aforementioned prioritisation of certain fields of research, profiling, greater interaction with industry, other ways to increase their socio-economic impact, internationalisation etc (Geuna and Martin, 2003, Marginson, 1997, Tapper and Salter, 2003, European Commission, 2010, Hicks, 2012). Competition for resources between research performing organisations, in itself, is furthermore believed to increase efficiency and performance. Not only is it thought to stimulate organisations to perform better on specific tasks of their missions, but also from a systemic perspective, it allows for the allocation of resources to the actors that make most productive use of them, while encouraging underperforming actors to increase their performance. In doing so, the efficiency and performance of the system as a whole may improve (see also Herbst, 2007; Hicks 2012; OECD, 2011).

For even in cases where the share of funding involved is small, organisations can be susceptible for the gains/loss of prestige/reputation to which their degree of success in performance based assessments gives rise. The susceptibility of universities to factors that influence their relative degree of prestige has been observed over the past decades in relation to the importance given by university administrators to the performance of their organisations in the various university rankings (Hazelkorn, 2010). Among the underlying reasons why universities are motivated by these effects on their level of "prestige", is that their reputation has an influence on their future access to resources (attractiveness to students, staff, collaborators, the acquisition of project funding etc) and the influence they can project in the scientific and societal realm. The reputational effect may even have a stronger impact on the strategic behaviour of universities than the effects of changes in the funding allocation (Hicks, 2012). Whether this holds may require further empirical scrutiny.

The incentives which performance based funding places on public research performing organisations are frequently "translated" by these organisations to incentives at the level of departments, research groups and the individual researchers that make up these professional work organisations (Whitley, 2003). Incentives for behaviour which results in an improved outcome in performance based evaluations such as the publications of high impact publications or successful collaboration with industry can include promotion opportunities, recruitment, salary increases, bonuses or access to resources to do research. For example, some Danish universities provide direct financial incentives to researchers who engage in high impact publishing (Andersen and Pallesen, 2008) and UK universities are known to recruit staff which can improve their evaluation output prior to the research evaluation exercises (OECD 2012). Through this trickling down of incentives from the intermediary level, to the organisational level and from the organisational level to the level of individual research groups and researchers the performance of the system as a whole may gradually improve.

Over the years, there have also been detractors of performance based funding mechanisms arguing for example that due to their frequently imperfect design and implementation they create perverse incentives and end up stimulating "gaming" behaviour such as salami style publishing strategies² as well as in extremis, other undesirable behaviour (scientific fraud, self-plagiarism etc) (Hazelkorn, 2010). The prioritisation of certain fields or disciplines by policy makers also means that other fields and disciplines get a smaller share of the "public funding pie". By design not all universities and/or research organisations can compete equally on the basis of the performance based measures favoured. Both dynamics therefore often raise a certain degree of institutional resistance from actors/groups who lose out in this redistribution – or from actors who feel forced to change their behaviour to conform to the indicators on which their behaviour will be assessed (see e.g.: Sorlin, 2007; Tsiouri, 2015; Good et al, 2015).

Depending on its implementation, performance based funding and the increase in competitive funding in general, is also considered by some to increase short-termism by reducing the certainties required by organisations and individual researchers to engage in long term, risky research and investment in research infrastructures. Others argue that performance based funding approaches risk disadvantaging non-orthodox or multi-disciplinary research in the face of dominant mainstream approaches – an argument which could be made for both peer review and some bibliometrics based approaches, though for different reasons as we will come back to in the discussion (see also Rafols et al, 2012; Hicks 2012). Unless countervailing incentives are in place, performance based funding systems may also reduce university's effort in applied research or e.g. in social science and humanities research to grapple with local or regional issues in order to focus on topics that can be more easily published in international journals (Hazelkorn, 2010). Finally there are the not unsubstantial costs involved in setting up and running the assessments on which performance based approaches to the allocation of organisational funding are based. Several experts and analysts raise the question whether these costs yield sufficient benefits (e.g. Martin 2011; Hicks, 2012; OECD 2010; Boer et al, 2015).

Butler (2003) analysed the impact of an earlier iteration of the Australian performance based funding system. She found an increase in the number of WoS indexed publications but highlighted that this may have come at the expense of the average impact of these papers. The incentive system of the PBF, she argued, should therefore be carefully thought through as the effect may not be the one desired. Sivertsen (2012) showed how the Norwegian system had had a positive impact on the output and impact of the Norwegian system. As will be discussed in the result section most of the countries which have implemented a PBF in the past decades include incentives which promote an increase in output and an increase in impact, either directly or by promoting the publication of articles in higher impact journals.

² In case a PBF provides incentives on output indicators only, researchers can be incentivised to "slice up" their results and publish several papers rather than a single one.

3. Methods, definitions and sources:

This section defines how performance based funding is understood in this report by building upon the **definitions** developed by the OECD NESTI for "project funding" and "institutional funding as well as a recent publication by Diana Hicks (2012) on performance based funding. While in this definition we base ourselves largely on the van Steen (2012) and Lepori (2007) definitions, which is also employed by Eurostat, we make an adaptation in the label of organisational level funding which in Van Steen (2012) and Lepori (2007) as well as OECD and ESTAT documents is referred to as institutional funding. The reason for doing so is that "institutions" in the social science (economics) literature are often referred to as "rules, norms, habits and ways of doing things" as distinct from organisations (See also North, 1990; Edquist, 1997). There are also analysts who argue that organisations are a type of institution or rather are subsystems which consist of a set of intra-organisational institutions (Hodgson, 2007). However in order to analyse the relationship between PBFS and university autonomy we consider the strategic actor-hood of universities and make a distinction between "internal control" and "external autonomy" (Cruz-Castro et al, forthcoming; Whitley, 2008). Since organisational level funding tends to be allocated on the basis of a set of institutions (rules) an alternative argument could be made for retaining this label for this type of funding. In case this is done, however, the definition would need to be adapted and it would be a challenge to distinguish it from project funding which is also allocated within an institutional framework.

Public research funding is generally allocated in two main ways, through project funding and through organisational level funding. **Project funding** is defined as "the total of national budgets in a given country, attributed to a group or an individual to perform an R&D activity limited in scope, budget and time, normally on the basis of the submission of a project proposal describing the research activities to be done." (Van Steen, 2012). Since the 1980s the importance of project funding has increased in many European Member States. The other traditional way of providing public support to research is through organisational funding of universities and public research organisations **Organisational level funding** is defined as "the total of national budgets in a given country, attributed to a research performing organisation (university or PRO), with no direct selection of R&D project or programmes and for which money the organisation has more or less freedom to define the research activities to be performed." (Van Steen, 2012). Organisational funding can be in the form of non-competitively allocated **Block funding**. To a large extent this block funding may be earmarked for particular expenditures such as researcher's salaries (especially in research systems where permanent researchers are civil servants) and/or infrastructure. The university may, however, also have its own discretion in allocating a non-earmarked part of this block funding. Organisational funding may also be allocated in a **variable/competitive** manner tied to ex post assessments of the output and performance of universities (OECD, 2010). It is this latter type of competitively allocated organisational funding which we consider as performance based funding. As indicated in the introduction, many EU MS have implemented some form of performance based funding over the past decade(s) and the share of organisational funding which is allocated competitively on the basis of performance assessments has increased in many MS.

Since analysts and policy makers have used different understandings of Performance Based Funding, it is useful to further define what we mean in this paper by performance based funding systems by building on the definition developed by Diana Hicks (2012) to assess whether Member States have implemented a performance based funding system for the allocation of organisational research funding. In order to be considered as PBF, Member States funding allocation systems must have the following characteristics:

"- **Research must be evaluated**. Evaluations of the [output or] quality of degree programmes alone will not be considered as PBF. This excludes many of the PBF systems in the US states as well as a number of EU MS funding systems. These will be touched upon but not considered as PBF.

- Research evaluation must be **ex post**. Evaluations of project proposals or the evaluations of organisational proposals for excellence initiatives that are a relatively recent feature of the funding framework of many EU Member States are *ex ante* evaluations and are therefore not considered as PBF.

- **Research output and/or impact must be evaluated**. Research systems which distribute funding on the basis of PhD numbers alone are not considered to be performance based by Hicks (2012). In this report they will be considered as such since PhD theses/Defences are considered research outputs.

-Part of the **governmental allocation of university research funding must depend** on the outcome of the evaluation. Ex post evaluations which are solely intended to provide feedback to universities or governmental actors will not be considered Performance Based Funding Systems.

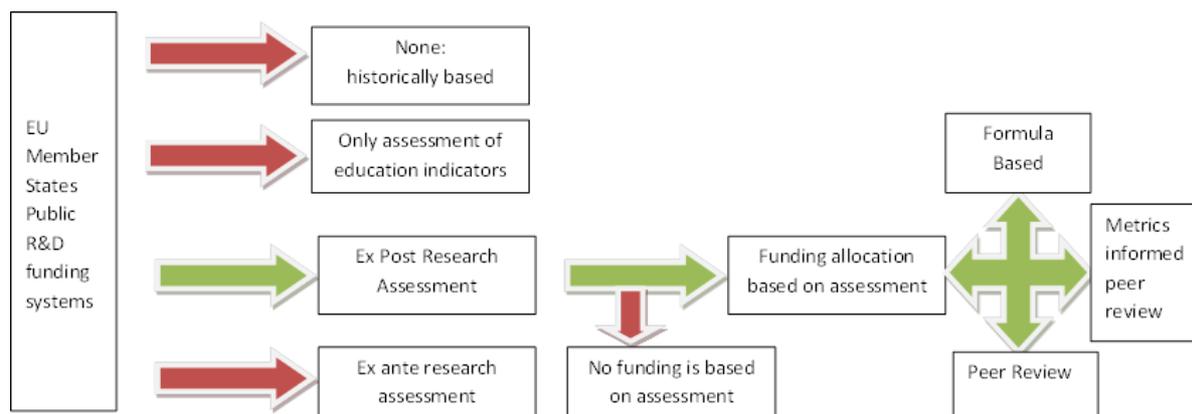
- The performance based funding system must be a **national or regional system**. Individual university systems will not be considered as PBF, but the systems in place in e.g. the German Lander or Flanders will be considered" (Adapted from Hicks, 2012).

In this working paper, countries will be classified according to the type of Performance Based Funding System they have in place, distinguishing between:

- 1) countries who have no performance based elements in their university funding allocation system and countries which allocate funding solely on the basis of education related metrics or assessments (without research output considerations),
- 2) countries which allocate on the basis of formulae which include research performance metrics, separating those which

2a) do and those which 2b) do not include bibliometric indicators of research output, and

3) countries which allocate funding on the basis of peer review based assessment exercises. The latter category can be separated into metrics based peer review and "pure peer review".



As indicated the definition provided is not the only way in which policy makers and analysts refer to Performance Based Funding. For example a number of European Member States, most US states and many Higher Education Policy analysts (see Boer et al, 2015) refer to performance based funding also in case only education based metrics (such as student inputs or student graduation outputs) are considered.

This report includes a preliminary analysis of the potential effects of different PBF by considering the change in the research output in the systems concerned. Plotting countries on the basis of a relative impact score, say share of highly cited publications, versus an input measure, such as the amount of public funding to publicly performed R&D, only gives a partial insight in the effect of a PBF in the country under question. Performance of a country on the basis of output and impact measures is strongly influenced by other factors than the absolute public investments in publicly performed R&D such as the scientific human capital base, the stock of tacit scientific knowledge, the institutional set up of the research system and their pre-existing scientific research infrastructure. What is important, however, in assessing the effect of the introduction of a PBF or the lack thereof, on output and impact measures, is to take into account the evolution of public R&D investments in publicly performed R&D in the period under study. A large increase in output (and impact) may be partially due to an expansion of the system associated with a substantial funding increase over a sustained period, rather than being the effect of institutional changes such as the introduction of a PBF and the institutional and behavioural change that follows this introduction. Likewise relative drops in output and impact or a failure to improve on these indicators may be related to sustained underfunding of the public R&D system. An extended analysis of the impact of different funding systems is planned for a future paper. In this report we include already some first plots to provide the reader with an indication of the potential impact or not of the PBF in the context of steady inputs, increases or decreases in the amount of public funding going to universities and PROs.

Since, as will be discussed in the results section, many countries use journal based bibliometric indicators in their assessment, it is expected that universities are incentivised to promote publications in journals with a higher impact factor. For this reason, we take the ARIF (Average of Relative Impact Factors) as one of our impact indicators: "ARIF is a field-normalised measure of the expected scientific impact of publications produced by a given entity [...] based on the impact factors of the journals in which they were published. As such, the ARIF is an indirect impact indicator reflecting the scientific "impact" measured by the average citation rate of the journal instead of the actual publications (also taking the publication year of scientific contributions into account in the normalisation process)" (ScienceMetrix, 2013).

Since the underlying motivation for promoting researchers to publish in higher impact journals is to improve the quality and impact of the output, it is relevant to explore whether this incentive also truly leads to higher impact publications. We therefore consider two more common impact indicators. The first is the field weighted citation impact or ARC. The ARC is a "field-normalised measure of observed scientific impact (also taking account of the publication year and document type of scientific contributions in the normalisation process)" (ScienceMetrix, 2013). Finally we present the evolution in the share of (field weighted) 10% highly cited publications which is a measure of the extent to which research systems succeed in producing high impact scientific results. To assess whether the implementation of PBF also had an impact on the number of publications published in a system (Butler, 2003), this indicator will also be explored.

Considering differences in institutional structure and public R&D funding levels there are limits to the extent that meaningful comparisons can be made between North Western European Countries, Southern European and Central and Eastern European Member States. The institutional cum organisational structure, including e.g. the funding system, was probably relatively similar in the EU13 countries in the early 1990s. Since then they have evolved in different directions and it may therefore no longer be possible to refer to a single type of EU13 funding model even if they do still share similar features such as the important role of the Academies of Sciences (Radosevic & Lepori, 2009). Nonetheless comparisons between e.g. the EU 13 Member States may be meaningful to assess potential differences in output and impact which are expected to be partially related to these differences in funding models. That being said comparison between countries such as Czech Republic, Poland, Hungary and Slovakia may be especially useful considering similarities in their public R&D intensity and institutional structures. Likewise comparisons between North Western European Countries or between South European countries can initially be the most appropriate while other meaningful insights may be gained from comparing different funding types.

Sources:

This report is based on a comparative qualitative analysis of recent trends in and current use of performance based funding instruments in the EU Member States. An extensive knowledge of national R&I systems is required which may be too much for an individual analyst to possess. This analysis is therefore based on two types of sources of qualitative information. The first are the RIO CR 2014 which have been drafted, following a set of guidelines developed by DG JRC J6, by a network of national experts in national R&I systems. These reports have been reviewed by JRC J6 country desk officers and National Contact Points appointed by ERAC. In order to cross check and supplement these sources we also build on collected national policy documents and the results of analyses and assessments published in the academic literature and further contacts with research policy experts in several of the countries under consideration. The project will continue on the basis of this working paper for which it will rely on the results of the PREF study contracted out by DG JRC J6. For the national level bibliometric data, use is made of a data collection that was carried out by ScienceMetrix for DG RTD.

4. Public funding allocation

This section provides a synthetic analysis of the performance based funding systems for competitively allocating organisational funding which are adopted in the different European Member states. This section is based on brief national case studies which are described in annex 1 where the reader can thus find more detailed information on the systems in place in the individual EU MS.

In order to gain an understanding of prevailing funding systems in the Member States, table one first provides an overview of the relative importance of project versus organisational level funding. Project funding is by its nature competitive funding. However, it is based on ex ante evaluations of research proposals, rather than on ex post assessments of outcome. The table does not make a distinction between block funding and performance based organisational level funding, but when countries implement Performance Based Funding Systems it generally implies that part of the organisational level funding is allocated in a competitive manner. The share of organisational funding thus provides a certain indication of the potential for performance based funding in a system if such a change is to be budget neutral (ERAC Peer Review Spain, 2014). Academic stakeholder organisations argue that PBF should, instead of being sliced from the core funding, should include additional funding (EUA, 2015). The table is based on data collection exercises performed on behalf of Eurostat and the OECD. This is complemented for some countries for which data is missing, by informed estimates made by the experts responsible for the RIO Country Reports 2014. The latter data can not be considered comparable with the data from the other data collections or between countries. It is provided here, to give a first rough indication of the situation in these countries. A currently ongoing data collection in the context of the PREF study, aims to generate a more complete and comparable set of data on the share of project and organisational funding. Within the latter category this study will also provide data on the share of competitively allocated organisational level funding which more often than not will be allocated through performance based funding systems.

On the basis of the available data we can make a provisional distinction between a few different groups of Member States according to the relative importance of project versus organisational funding. A first group of countries is characterised by a high level of organisational funding. The share of this funding which is allocated on a competitive basis through performance based funding systems still needs to be determined. It is also clear, from looking at e.g. Slovakia, that different data collection exercises have provided us with different estimates of the respective shares. A second group of countries shows a greater balance between organisational and project funding – again the relative share of organisational funding which is allocated competitively still needs to be assessed and will be included in a future iteration of this report. The qualitative analysis of the evolution of funding mechanisms in the different member states presented in the next section will also provide greater insight in this. There is a third group of countries which is characterised by relatively high shares of project funding in comparison to block funding. For some of these countries the data will need to be further corroborated from the PREF study. It is also relevant to know that some of the countries in this third group are clear examples of the inclusion of competitive elements in their allocation of organisational funding (performance based funding such as the UK (Cunningham 2015)). For a fourth group of countries no data is yet available.

Table 1 Share of organisational vs project funding for R&D (%)

Country	Eurostat		NESTI		Country report	
	Org.	Project	Org.	Project	Org..	Project
Croatia					94.40	5.6
France	92.7	7.3				
Luxembourg	82.9	17.1				
Portugal	80.6	19.4				
Slovakia	77.3	22.7	60.5	39.5		
Austria	73.2	26.8	74.5	25.5		
Netherlands	69.3	30.7	71.2	28.8		
Malta					71	29
Poland			68.6	31.4		
Spain						36.9
Germany	65.8	34.2	61.4	38.6		
Cyprus					60	40
Denmark			56.7	35.3		
Sweden					55.1	45.3
Finland			50.4	49.6		
Greece	49.6	50.4				
Belgium			45.7	54.3		
Czech Republic	45.5	54.5	52.4	47.6		
Ireland	33,3	66,7	35,1	64,9		
Estonia					31	69
UK					20	80
Bulgaria						
Hungary						
Italy						
Lithuania						
Latvia						
Romania						
Slovenia						

Highlighted in orange: countries above 75% of organisational funding; Highlighted in pink: countries between 50% and 75% of organisational funding; Highlighted in green: countries below 50% of organisational funding; No highlight: tbd. Source: ongoing PREF study (forthcoming).

Now that table 1 has provided us with a provisional overview of the main public R&D funding systems in many of the EU Member states the following sections will analyse the usage of different types of performance based funding systems in these countries.

4.1 Performance based funding models

As shown in table 2 most European countries have implemented some form of performance based funding. The exceptions are Greece, Malta, Cyprus and Luxembourg (Alexander, 2015; Tsipouri, 2015; Warrington, 2015). In the latter three cases this is probably a partial consequence of the relatively small size of the system. Where, as in the case of Luxembourg or Malta there is only one university in a country, performance based funding may be therefore less suitable. In other instances, i.e. Greece, the absence of performance based funding may be due to resistance from the academic community which has protested heavily against suggestions to introduce performance based evaluation and allocation models (Tsipouri, 2015). This group includes countries that allocate funding on the basis of education/training based metrics (student inputs, number of graduates etc) and related metrics only. For example most US states allocate their organisational funding for universities on the basis of a formula which takes into account the output of the university in terms of the number of graduated students alongside other indicators. Most of these states do not consider research output performance based metrics. This category was not considered performance based funding under Hicks (2012) definition. However, we do refer to it in this working paper to explain the differences in funding systems and to highlight the fact that most other approaches include education based metrics in complement to the research output based metrics in their funding allocation systems (this applies to many countries which use formula or peer review RPBF systems). Another traditional metric would be to base funding allocation decisions on the number of research staff in the organisation. This criterion is not performance based and while most countries base part of their funding allocation on the basis of this indicator it is considered part of non-competitively allocated block funding rather than performance based funding – since some countries include this criterion in more complex funding models (e.g. Poland) it will nonetheless be mentioned in some of the sections below.

Countries like Spain, Slovenia, Hungary and Germany have pursued some of the goals of performance based funding, such as international excellence, by awarding centres or units of excellence to universities based on the assessment of proposals (CHEPS Germany 2006 in Hicks, MINECO, 2015, SI Country Reports, 2015; Drory, 2015; Fernandez, 2015). Since these initiatives are based on voluntary ex ante selections of proposals they are not considered as performance based funding systems in this report. Many of the countries that did implement Performance Based Funding have also engaged in the set up of centres of excellence type funding programmes, including Norway with its Centres of Excellence, Poland (KNOW), Finland (Centres of Excellence in Research), France (IDEX), Denmark, Sweden³ and Austria (Institute of Science and Technology) (Jacob, 2015; Klincewicz, 2015; Bitard, 2015; Cuntz, 2015; Pekka, 2015).

Table 2 Dominant approach for the allocation of competitive organisational level funding

None RPBF		Research Performance Based Funding		
None or Education metrics only	Centre of Excellence	Formula based (non bibliometric)	Formula based (bibliometric)	Peer review assessment based
MT, HE, CY, LX, BG, LV ⁴	SI, ES, HU ⁵	IE, NL, AT, GE (state level)	BE (FL), FI, DK, NO, PL, SE, PT	UK, EE, FR, IT, LT, CZ, SK

³ See e.g. <http://www.nifu.no/files/2012/11/NIFUarbeidsnotat2012-4.pdf>

⁴ Bulgaria and Latvia actually may have elements of a Performance Based Funding System as discussed in the annex. There are some doubts on the about the extent that

The other countries can be roughly categorized into three groups. The second RPBF category bases allocation decisions of part of the organisational funding on formula which are based on assessments of research outputs as assessed through (quantitative) bibliometrics. This group comprises of Belgium, Denmark, Finland, Portugal, Sweden, Norway and Poland. Hicks (2012) did not include the Netherlands, Ireland and Austria among the countries which have implemented PBF systems because they do not base their funding allocations on assessments of research outputs. However since successfully defended PhD theses could be considered a research output, this report includes the countries that include this indicator as an element in their funding allocation systems as the first category of research performance based systems. As will be highlighted in the results and discussion section, the incentives which these systems generate are expected to be different from the systems that include publication output assessments. The nature of the funding formulae and the criteria used differ considerably between these countries. Governments are still changing and fine-tuning their approaches to formula based funding as will be described in the analysis that follows.

The third group, consisting of the UK, Estonia, Italy, France, Czech Republic, Slovakia and Lithuania takes a different approach. These countries have opted for a funding allocation system which is based on peer assessment of universities and/or university groups: in most cases these peer review assessment are heavily based on bibliometrics and other metrics and thus approach the second category in nature. There are also exceptions such as the UK. There are strong variations in the nature of the performance based funding systems between these countries: especially the United Kingdom stands out as the country with a long tradition of research performance based funding allocation on the basis of an elaborate peer review system.

Table 3 Overview of Performance Based Funding Systems in several EU MS

EU MS	Year implementation/revision PBF	Agency Responsible	Performance Contract
Austria	2002; 2013	BMFWF	Yes
Belgium (FL)	2003; 2006, 2012; 2014	EWI (BOF Key)	No
Belgium (Wa)			Yes
Croatia	2013	MSES	?
Czech Republic	2013 (potential new change in 2015/2016)		No
Denmark	2009	Ministry of Education	Yes
Estonia	2012	Ministry of Education; Estonian Research Council	Yes

it is implemented already and since e.g. in Bulgaria funding levels per university have remained fairly stable it is unclear what effects it has had (Todoreva 2015; Worldbank, 2013; Soete et al, 2015). In the case of Latvia PBF elements have been implemented relatively recently for PROs and while there are plans to implement a PBF for universities this has met with institutional resistance and it is still unclear whether these changes will be implemented in 2016.

⁵ The Hungarian government published in 2014 a concept note in which it discussed the introduction of a performance based funding system.

Finland	1998/2010 / 2014	Ministry of Education	Yes
France	2008 / 2013	HCERES	Yes
Italy	2010, 2014	ANVUR (VQR)	Yes
Lithuania	2009, 2011 and 2012.	Minister of Education and Research	?
The Netherlands	2012	MoESC	Yes
Poland	2008/2013	KEJN	No
Portugal	2015	FCT	Yes
Slovakia	2013	MESRS	No
Spain			Yes
Sweden	2009	Swedish Research Council	Yes
UK	1986 (RAE), 2015(REF)	HEFCE (REF)	?
Germany	Various	Lander	Yes
Ireland		HEA	No

4.1.1 Formula based funding allocation formula

The Netherlands bases the allocation of part of its organisational funding to universities on a set of education and research related indicators. The education part mainly revolves around student and graduation numbers. The research part however also includes a component on PhD defences. A remaining substantial share of the research part is allocated on the basis of historical/political considerations (CPB, 2014; Janssen and Den Hertog, 2015). Austria also takes into account a number of education and research related metrics. As in the case of the Netherlands, other publication based output assessments/indicators are not included in the funding allocation model. However, as in the case of some other systems, input based metrics such as the volume of project funding are included in the formulae (Cuntz, 2015). In Germany, in addition to the Excellenz Initiativ described earlier, many of the states (Länder) have implemented a form of performance based funding on the basis of both teaching and research performance. The weighting differs by type of university: for the universities of applied science (hochschule) teaching indicators carry a greater weight than for research universities. The indicators used differ by state, with all Länder using measures of third party funding and number of completed doctorates, and individual Länder incorporating further indicators as deemed appropriate. At least in 2010, none of the Länder included bibliometric assessments of publication output (OECD, 2010; Van Dalen et al, 2014). Bulgaria states in legal documents that it does consider the R&D output in the formula based allocation of its university funding (see annex 1). However, some analysts argue that in practice Bulgaria does not have a performance based system as the funding levels of its universities have remained stable in the past years (see annex). Others argue that a performance based funding system needs to be implemented in Bulgaria to increase the quality and relevance of its research output (Todoreva, 2015; Worldbank, 2013; Soete et al, 2015). Latvia has used some performance based elements in the restructuring of its system of Public Research Organisations. For universities, however, no PBF system is in place, though it is being considered for the near future (see annex 1). Bulgaria and Latvia are therefore grouped in table 2 among the countries which at present have not yet implemented a Research Performance Based System.

While in contrast to Hicks (2012) we include the Netherlands, Austria, Ireland and Germany as performance based funding systems it is clear that they are border-line cases distinct from the formula based allocation models which are based on a (bibliometric) analysis of publication output. The next paragraphs will mainly discuss the use of Performance Based Funding allocation which is (partially) based on assessments of the research output.

4.1.2 PBF based on Journal based impact assessments

A number of countries (DK, FI, NO, BE (FI)), have introduced publication based metrics based formulae. Perhaps the simplest approach is to count publications in international journals as was done in some assessment exercises in the past. However, this practice was shown to encourage publication in lower impact journals to boost output (Butler, 2003).

In the Norwegian system (Sivertsen, 2009; Fosse Hansen 2009) journals are therefore ranked to weight publications of higher impact/quality. The Danish system drew inspiration from the Norwegian system (Hansen, 2009). It is journal based: publications are counted in around 20,000 peer reviewed journals and publishing houses. The journals and publishers have been selected by sixty eight panels of researchers. The journals and book publishers are divided into two groups, where publications in the top 20% receive a higher weight than publications in the other outlets (Hansen, 2011; Grimpe, 2015; DASTI, 2009, 2014). Poland, which introduced a PBF system in 2008 and revised it in 2013, uses the journal impact factor (Klincewicz, 2015). Here the KEJN conducts detailed assessments on the basis of the following criteria: counts of publications taking into account impact factors of specific academic journals, patents, revenues from industry co-operation and external R&D funding normalized by numbers of R&D employees of an organization, scientific awards of researchers, patents, and financial results of commercialization of research results. In 2013, the evaluation criteria were substantially modified to further promote organizations conducting world-class research. Journal impact factor based assessments are also used in the Czech Republic, though the government has implemented measures to attempt to address the problems in assessing SSH research bibliometrically (Malek, 2014). Because the Czech approach includes peer review elements, it is also discussed in the next section. In Finland around 90% of organisational level university funding is allocated on the basis of completed qualifications and credits as well as scientific publications and competitive project funding (Pekka, 2015). Spain is a special case as at the national level it uses individual level assessment on the basis of self-reported data, to give researchers a (modest) variable bonus to their fixed salaries. As this is not a performance based funding system to allocate competitive organisational funding it was decided to exclude Spain from this category in table 1.⁶

⁶ Higher education funding in Spain is a regional level competence and it is possible that some regions have implemented PBF type funding systems: a recent report from the European University Association indicates that Catalonia has uses PBF to allocate funding to university but it is unclear whether this is research or education based.

4.1.3 PBF based on citation based impact assessments

Whereas the previous countries based their bibliometric assessment of counts of publications, potentially weighted on the basis of the quality of journals, Belgium (Flanders) and Sweden, have explicitly introduced a combination of output and publication level citation based impact metrics to take into account both the volume as well as the actual impact of the research output. In Belgium (Flanders) the share of the competitively allocated organisational research funding (the BOF- Key) which is based on bibliometric assessments of the research output has increased from 10% when it was first introduced in 2003 (DeBackere and Glanzel, 2004) to 36% in 2008. In the latest revision in 2012, the weight of the social sciences and humanities have increased on the basis of a specially developed publication database made for this purpose (DeBackere and Veugelers 2015). In addition to citation based impact assessments Flanders also considers a journal based indicators in its formulae. Sweden has implemented a sophisticated field weighted impact measurement system to assess university output (Hicks , 2012, Jacob, 2015 Sivertsen, 2015).

As discussed in more detail in the country based Annex 1 the formulae used in bibliometrics based funding allocation tend to take into account many other factors than publication and citation metrics alone. These can include employment of graduates; external research funding; faculty characteristics and qualifications; faculty size; student enrolment, graduate students graduated; PhD defences, impact of research; participation in international research projects, collaboration with industry, private sector funding etc (elaborated on Hicks, 2012). In many systems (see e.g. Denmark, Poland and Czech Republic) also the variable part of organisational research funding retains an element that is based on previous funding decisions (historical factors), which are used in part to avoid too large swings in research funding that could cause instability (Hicks, 2012; Srholec, 2015).

4.1.4 PBF based on peer review assessments

The different UK Research Assessment Exercises which started in the 1992, were among the first central research assessment approaches used for performance based funding allocation decisions. Apart from the UK a number of other countries including CZ, FR, IT and LT (partially) use peer review based assessments of research outputs. In the UK, the HEFCE allocated performance based funding on the basis of a mechanism known as the Research Excellence Framework (formerly the Research Assessment Exercise – RAE), a peer review process which produces ‘quality profiles’ for each submission of research activity made by universities. Once funding levels for institutions have been set, these are used for the annual allocation of funding until the next round of assessment (Cunningham, 2015). After a series of extensive consultations and reviews, the Higher Education Funding Councils replaced the RAE with the new REF. For the REF, the government had initially proposed a metrics only exercise (Martin and Whitley, 2012). However after strong resistance from the academic community, and partially on the basis of considerations regarding the limitations of bibliometrics, the HEFCE has so far shied away from a switch to a bibliometrics based assessment of its universities in its evaluation exercises. Disciplinary panels were given the possibility to use the results of centrally provided bibliometric analysis, but they were not given clear top-down instructions on how to use these metrics. The REF includes societal impact assessment on the basis of cases provided by the evaluated departments (Martin, 2011). The French Ministry of Higher Education and Research established the AERES National Agency in 2008 to undertake, at national level, the evaluation of research in both research organisations and universities. This organisation has been replaced in 2013 by the High Council of the Evaluation of Research and Higher Education (HCERES). The HCERES evaluates all French research teams and research Centres. The evaluations provided are based on a peer-review assessment which is based, though not exclusively on, bibliometric indicators. Research groups are requested to select a number of high quality outputs on which they will be evaluated. They have to argue as well how their research has a societal impact, can be considered as frontier research or helps addressing societal challenges. Other factors that are taken into consideration include the integration of research teams in international networks. In Lithuania 50 per cent of university funding is allocated on the basis of evaluation of R&D results. These evaluations are based on four criteria including participation in international projects, contract research for companies, public-private collaboration, and results of the evaluation of research production. The latter focuses on publications and patents and is annually carried out by LMT in accordance with the principles of international peer review (RIO Country Report LT, 2015).

4.1.5 PBF based on metrics based/informed peer review

The Czech Republic and Slovakia have a fairly structured system in place in which bibliometric analysis plays a central role. In Slovakia, the 2014 formula for allocating performance based funding to universities (€118.5m) gives a 43% weight to the R&D quality of a university (as established by the last accreditation), a 22.5% weight to the share of a HEI in the national research/arts output, a 10% weight to the share of a HEI in the national number of PhD students, a 10% weight to the share of a HEI in domestic grants, a 10% weight to the share of a HEI in foreign grants and the rest is determined by other factors. A considerable share of the Performance based funding allocation is thus based on the results of evaluations carried out by the Accreditation commission. This Commission approved new, more stringent rules on 15 April 2013. The new rules put more emphasis on research excellence in terms of scientific papers published/cited in journals listed in international bibliometric databases (WOS, SCOPUS),

research monographs published with high-quality publishers and international patents. The last evaluation took place in 2009-2010 (Balasz, 2015). In the Czech Republic initial reform plans considered to allocate almost the full amount of institutional funding using performance-based formulae. However, a medium term modification of the evaluation methodology, called Metodika 2013, has been introduced for the period 2013-2015, (CRDI, 2013). On the base of this methodology organisational level funding is going to be allocated until 2016 (Srholec, 2015). The first part of this assessment is based on an assessment of research output of publications in indexed journals. A second part of the evaluation is based on high impact results, including ERC grants. Each organisation selects a number of high quality results in each scientific field under consideration. These results are peer reviewed and compared for every organisation. A third part of the evaluation concerns non-scientific outputs of R&D, including patents and plant varieties. The remaining points in this part of the assessment exercise are allocated on the basis of an assessment of income generated through applied projects and collaboration with industry. The whole assessment relies on panels of experts to make the assessment for each field. The funding allocation decisions are based for 75% of the assessment of the scientific output, for 10% on the evaluation of high impact research outputs and for 15% on the assessment of applied research (Malek, 2014). According to Good et al (2015) the result is a system that is primarily quantitative in nature. In Italy, the ANVUR published its latest metrics informed peer review assessment in 2013. This is a large scale exercise in which all universities and PROs are evaluated: it is done at the level of universities rather than research units as in the UK (ResearchItaly, 2015). The share of organisational level funding allocated on the basis of performance criteria has risen from 7 % in 2009 to 13.5 % in 2013 and is set to increase further in the coming years. Currently, existing rules are said to limit the ability of the funder to fully allocate this funding across universities on the basis of performance (European Commission, 2015a). The ANVUR based its assessment on the best research outcomes obtained by each organisations (universities and research institutes) in the seven years from 2004 to 2010. The approximately 195,000 publications by 130 organisations are evaluated partly by submitting them to international experts who appraise their scientific quality, and partly by analysis of the citations received from third parties and an examination of the impact they have made in their respective field of research. Secondly it considers the ability of the evaluated organisation to attract funding, the number of international collaborations, patents registered, spinoffs, museums and archaeological sites, third-party activities etc⁷.

4.2 Taking into account disciplinary differences

Peer review systems tend to bring together field-based committees which have some discretion for developing appropriate standards of judgment for their field (PL, IT, CZ, UK, FR, SK). These committees may, for example, decide on how to evaluate different types of publications, books or other forms of intellectual output: be it Open Access databases, films, patents, plant varieties etc which may be more important in some fields than in others. In France, for example, the HCERES committees take into account PhD supervision in some fields (Mathematics) but not in others. In Lithuania the weight given to the four categories differ between fields. For example, results of the evaluation of research production are given the highest weight in social sciences and humanities (80%) as well as physical and biomedical sciences (55%). Assessment of R&D activities in other fields of science mostly depends on institutions' capacities to attract funding from privately and internationally funded R&D projects (Paliokaite, 2015). In the Czech Republic Peer review is especially important in assessing the publication output in the social sciences and humanities. In the natural science fields the assessments are mainly based on journal (impact factor) based bibliometrics (Malek, 2014). Also in formula based approaches, field differences can be taken into account,

⁷ <https://www.researchitaly.it/en/understanding/overview/assessment/>

either by applying field normalisations in publication level analyses (e.g. SE, BE), by taking into account field journal rankings in the journal weighted output assessments (e.g. BE, DK), or by developing complete custom made bibliometric databases for the Social Sciences and Humanities as was done in Belgium (Flanders – see annex).

4.3 Current developments in assessment models

The Czech Republic is one of a number of countries which is currently revising its performance based funding approach – a new design is being developed by Technopolis and will be considered for introduction in 2015/2016 (Good et al, 2015; Srholec, 2015). Another country in which the government is currently considering a change in the system is Sweden. Sweden currently has a system in place which is based on a sophisticated (field weighted publication based) bibliometric assessment (Hicks, 2012; Jacob, 2015, Schmidt, 2010). The previous government launched a study into the extent to which this could be replaced by a system in which peer review played a larger role (Jacob, 2015; Sivertsen 2015). Partially due to political changes, it is unclear in which direction this will develop further, but as will be discussed in the next section, a national level research information system to support such a peer review based system is being set up at present (Sivertsen, 2015). As highlighted in previous sections and the annexes Hungary, Latvia and potentially Bulgaria are said to be considering the introduction of a Performance Based Funding System.

4.4 Research Information Systems

Both Peer Review based assessment exercises and Formula based approaches require research organisations, research funders or evaluation agencies to systematically keep track of research outputs and a number of other data and metrics (staff numbers and characteristics, research project funding contracts, etc, etc). In order to address this challenge, universities and later national governments have been establishing Current Research Information Systems (CRIS). Norway was probably the first European (though not EU) country in which research universities have themselves set up a national wide Research Information System (FRIDA), which is used to supply information and reports to the ministry as well as internal information and knowledge management functions. In Finland, universities are obliged to upload the requested data in a centrally management information system KOTA, which is used to inform university assessments (Boer et al, 2015). Also in Poland the assessment process which underpins the PBF is managed by a central IT system (Pol-on) to eliminate the risks of human error or duplication of records for researchers working at more than one scientific organization (Klincewicz, 2015). In the Czech Republic research organisations are also required to input their research outputs in a centralized R&D information system (RIV) (Good et al, 2015). Sweden is developing a nation-wide CRIS to support the new version of the assessment framework in case this is implemented (Sivertsen, 2015). In most other countries CRIS are developed at the university level. Attempts are made to come to standardisation of the CRIS at a national and European level to facilitate compatibility. The development of CRIS and the various models that are being considered suggest that a) a considerable investment in resources, time and expertise is required to come to well-functioning national CRIS. That, at least in some systems, it requires the voluntary buy-in of individual universities to share data (with other universities and the governmental evaluators). That there are "real" privacy issues which need to be addressed before rolling out a national or European wide system (Sivertsen, 2015). And finally that apart from a) potentially facilitating the development of improved versions of the current Performance based funding systems, b) CRIS may help increase the accessibility of information to university administrators and in doing so increase their potential for strategic action. They also offer potential for analyses and evaluations of university funding and performance beyond those that are required for the assessments on which funding allocations can be made in Performance Based Funding Systems.

4.5 Performance contracts and the steering of research

The use of performance based funding in public research systems is often considered to be a manifestation of new public management. Hicks (2012) argued that one feature of New Public Management was yet not common in performance based public funding systems, namely the use of performance contracts. A recent study from the EUA (2013) indicates, however, that 15 of 22 countries studied had implemented a form of performance contracts including: AT; BE (Wallonia); DE; DK; EE; ES; FI; FR; IS; IT; LV; NL; PT; SE. Only in the case of Austria and The Netherlands, however, was this directly tied to funding allocation: in the Netherlands 7 % of organisational funding is allocated to universities on the basis of performance contracts which include commitments in the profiling of teaching portfolio's to achieve critical mass and avoid duplication (MinOC&W, 2012). Also in the other countries which implemented such contracts, however, they may have an influence on the strategies and directions in which universities develop. In the other countries studied, including BE (Flanders); CZ; HU; IE; NO; PL;SK governments have not engaged in agreeing on performance based contracts with their universities. Some analysts shed some doubt on the extent that all the countries which the EUA identifies as having Performance Contracts should indeed be classified as such.

As indicated, apart from performance contracts, governments may also use the Performance Based funding systems to steer their universities on other grounds than on output and excellence based criteria. In Norway, for example, government research funding is targeted at research within distinct priority areas (Sivertsen 2009, EC 2010). In other countries, including the Czech Republic and Poland, the PBFs include indicators that gauge interaction with industry. In the UK REF exercise and in the French PBF, universities are partially evaluated on the basis of the material they provided to indicate their broader societal impact. Belgium (Flanders) and Sweden include gender diversity measures among the indicators in their funding formula.⁸

⁸ A number of other countries are developing approaches to assess broader societal impact, though this is not necessarily tied to the allocation of funding at present see e.g. http://www.rathenau.nl/uploads/tx_tferathenau/ERiC_guide.pdf.

5 A preliminary analysis of the impact of PBF

The UK quality related funding based on the RAE/REF aims to improve the level of quality of the system by stimulating selectivity and concentration while ensuring moderation (not too large swings and especially drops in funding). Over the past two decades the rewards tied to the outcome of this exercise have increased. Initially units which performed well relative to the national average would receive additional funding. After 2002 it was only units which were considered nationally excellent. In the latest exercise only units that were considered world class or world leading received additional funding. As a consequence the PBF funding is being concentrated in fewer universities. In the last exercise, 10 out of 130 (English) universities received 50% of the funding. The top four actors received 30 %. 9 universities received no and 49 received only a small share of the PBF funding (Boer et al, 2015). Boer et al argue that "The process has increased England's overall publication levels by embedding a culture of research management across all HEIs, with every academic producing at least four peer reviewed articles per review period. It is thus fair to conclude that, judged on the basis of the scores and the absolute outputs, England's research assessment approach has been highly effective in raising research performance across the sector as a whole." This chimes with the public debate in the British system and it is clear that the British performance both in terms of output and impact is impressive, also considering the relatively low and decreasing levels of public R&D funding (Cunningham, 2015). Similar claims could be made for the formula based Belgium BOF key (though without the funding argument) and other long established systems of Research Performance Based Funding Systems.

However as shown in figures 1-3 in a comparative perspective the relative increase in performance of these systems might need to be seen in a different light, since it is not immediately clear whether the increase in the performance of these systems is better than that of systems which were late to implement RPBF systems or did not include them at all.

Most Performance based funding systems aim to provide incentives for increasing the output and scientific impact of university research activities. In this section we do not intend to compare the effect of the PBF with other measures that may be in place to stimulate this: such as changes in the share and design of project based funding systems or evaluation systems which are not tied to funding. It will, on the basis of the material we have presented here at present not be possible to make a full assessment of the effect of PBF on research system output. What is presented here is an overview of trends in several bibliometric indicators and thus allows for some comparison of countries over time and to explore whether the observed dimensions of change differ between countries which have or which have not implemented the PBF. Readers should note however that this is only a first preliminary qualitative analysis of the effect of PBF on research output and impact performance. Findings should be interpreted with caution.

Table 4 shows the evolution of public funding to publicly performed R&D (the performer category includes both PROs and Universities). The reason for taking PPS at 2005 levels as the unit of measurement is that it allows for a comparison between countries with different currencies which may have experienced different levels of inflation. One observes large differences in the absolute funding levels between countries. In this report we do not analyse these in depth. However, in the following figures we have ranked the countries according to their respective funding levels. What is relevant in this table is especially the evolution of public funding. One observes for most countries an expansion of the public budget as measured for these years in time. Exceptions are Bulgaria, Croatia, Italy, Latvia, Hungary and the UK which showed a decrease in the public funding of the public R&D system in the last period. This observation could be related to some of the observations we make in the following figures.

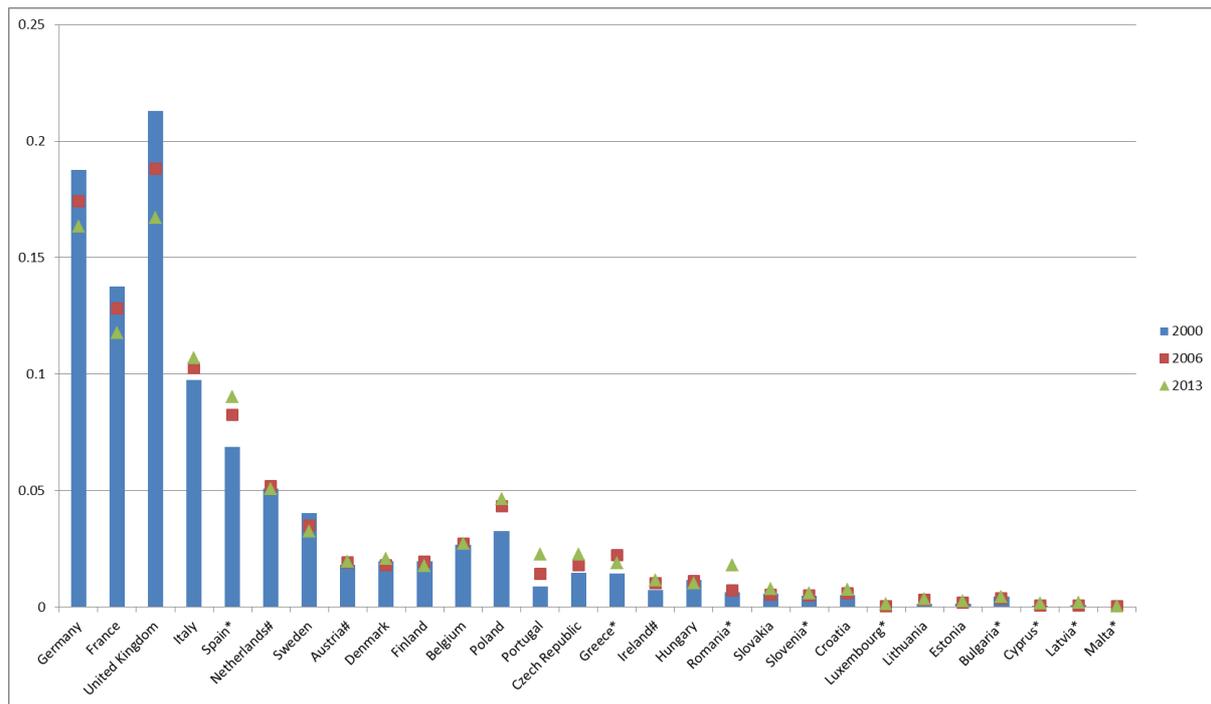
Table 4 Funding evolution in the MS (PPS 2005 prices)⁹ (Eurostat 2015)

	PPS 2005 prices			% Change	
	2000	2006	2011	2000-2006	2006-2011
Belgium	956.24	989.17	1283.48	3.44	29.75
Bulgaria	168.40	190.64	159.88	13.21	-16.13
Czech Republic	615.90	874.34	1137.08	41.96	30.05
Denmark	876.08	1039.95	1207.01	18.70	16.06
Germany)	13674.2	13770.1	18415.1	0.70	33.73
Estonia	44.96	93.96	135.56	108.99	44.27
Ireland	249.19	509.33	537.85	104.40	5.60
Greece	517.38	606.87	650.77	17.30	7.23
Spain	2657.94	4269.82	5189.97	60.64	21.55
France	9963.87	10472.93	11008.5	5.11	5.11
Croatia	217.98	245.80	206.92	12.76	-15.82
Italy		6704.35	6435.73		-4.01
Cyprus	20.72	38.83	47.94	87.38	23.46
Latvia	29.21	71.55	37.56	144.97	-47.50
Luxembourg	22.89	69.58		203.98	
Hungary	387.72	578.38	479.34	49.18	-17.12
Malta	9.92	11.79	16.61	18.86	40.92
Netherlands	3199.73	3313.52	3496.46	3.56	5.52
Austria	1378.94	1489.43	1866.16	8.01	25.29
Poland	1338.90	1388.67	2299.68	3.72	65.60
Portugal	732.08	748.81	992.50	2.28	32.54
Romania	80.93	342.85	419.42	323.64	22.33
Slovenia	161.15	200.56	217.11	24.45	8.26
Slovakia	107.98	178.95	293.17	65.72	63.83
Finland	931.64	1085.67	1247.28	16.53	14.88
Sweden	1604.34	1934.16	2244.50	20.56	16.04
United Kingdom	6213.82	7802.63	7371.84	25.57	-5.52

Figure 1 provides an overview of the relative share of Scopus publications made by researchers in the different 28 EU MS as share of the total EU publications. It is important to note that these are relative figures denoting the share of EU publications. One reason for applying this normalisation is that the bibliometric database on which this figure is based, has expanded over time and the number of records included worldwide for 2013 is larger than for 2000. That being said, the number of EU publications has also increased markedly over this period and the figure therefore does not (necessarily) show that the UK, GE and FA published less in 2006 or 2013 than they did in 2000. The figure only shows that their share of the total EU output has decreased. Countries like BE and NL which maintained a relatively stable share may thus in reality have seen their absolute output grow.

⁹ *The Netherlands and Sweden show 2001 and 2007 data instead of 2000 and 2006 data respectively. Greece shows 2001 and 2005 data instead of 2000 and 2006 data respectively. Malta, Austria and Croatia show 2002 data instead of 2000 data.

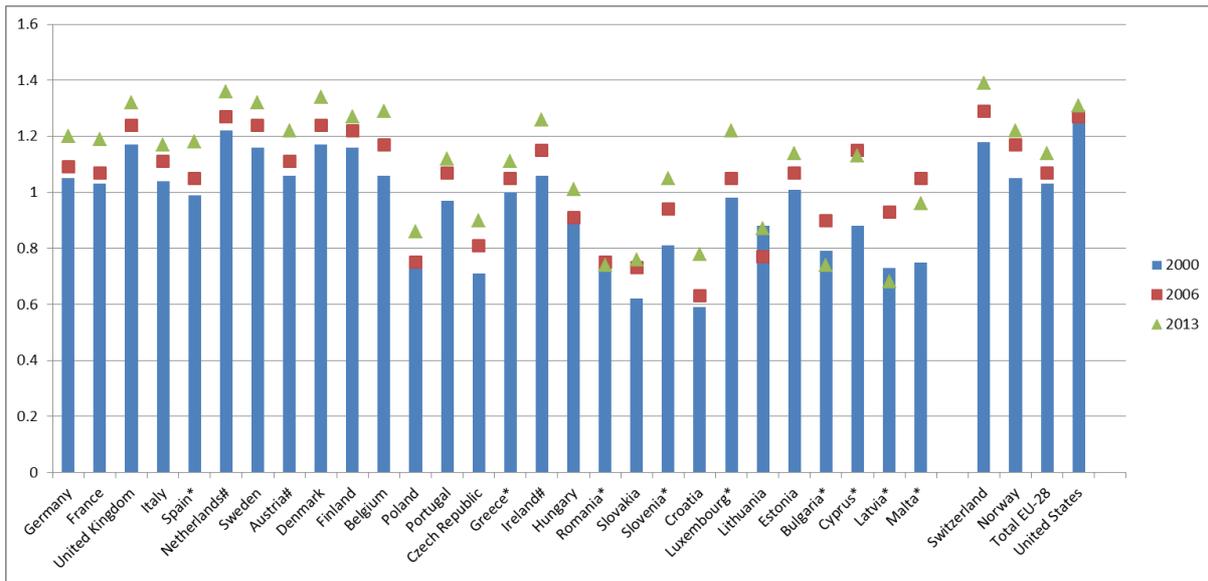
Figure 1 Evolution of MS share of the EU publication output 2000-2006-2013



The MS in figure 1-4 are ranked according to their public funding of publicly performed (universities + PROs) R&D in euros in 2011 (ESTAT, 2015). The * sign denotes the MS which did not implement a PBF yet, the # sign denotes the countries which do not base the underlying assessments on publication output.

Most of the Performance based public funding systems (whether they are peer review or formula based) include direct incentives tied to resource allocation to stimulate universities to publish in high impact journals (BE, PL, CZ, DK, NO etc). Even where this is not explicitly formulated such as in the case of the UK, studies have found that the results of the peer review correlate best with rankings of the journals in which the results of the unit under study were published. For this reason the first impact indicator that is being studied to assess whether it is clear that the performance based funding systems have an impact is the Average of Regulative Impact Factors of the publication output of a country. Figure 2 shows how the evolution of the Average Relative Impact Factor evolves between 2000, 2006 and 2013 (ScienceMetrix, 2015). As can be seen in virtually all countries the ARIF score has increased in the period 2000-2006 (the red square) and again in the period 2007-2013 (the green triangle) (annex 2 provides the percentage change). In some countries the scores change more substantially than in others.

Figure 2 ARIF evolution (2000-2006-2013) in the EU MS



While ARIF and field weighted citation impact are likely to be correlated in the aggregate they are not the same (in part due to the skewed intra-journal citation distribution). In order to assess whether the incentivisation of publishing in high impact journals is also associated with an increasing average impact per paper Figure 3 provides an overview of the change in the ARC as calculated by Science Metrix. Again one sees for most, save BG, LV, Malta and Romania, a consistent increase in the ARC over time. In the case of Malta, the indicator appears very volatile, probably due to the small size of the system. We will explore trends in these changes in more detail in a future analysis.

Figure 3 ARC evolution 2000-2006-2011 in the EU MS

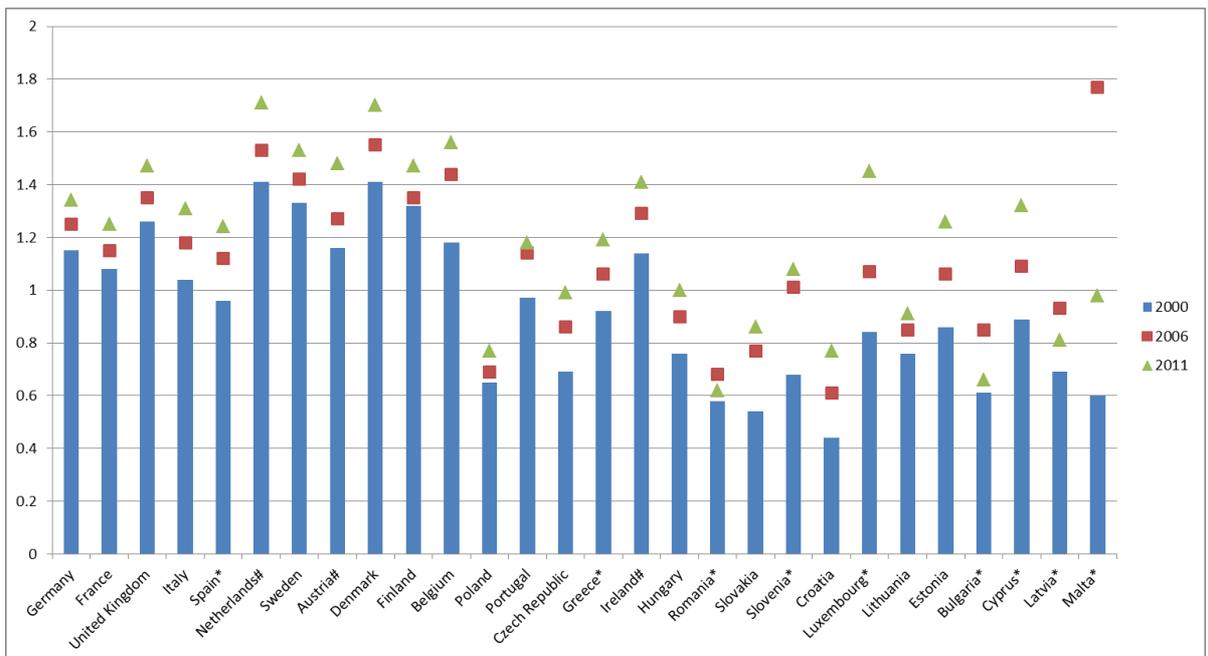
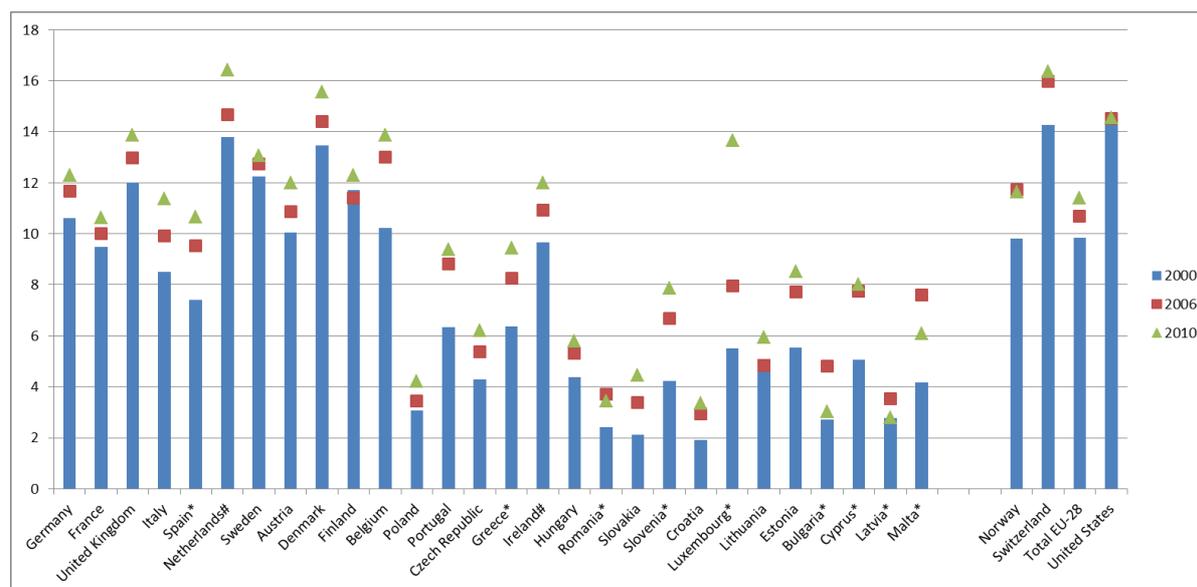


Figure 4 Share of publications among top 10% most cited (field weighted)¹⁰



A similar picture emerges from figure 4 as from figure 3: in contrast to the other MS, Latvia, Bulgaria and Romania do not realise a consistent increase in the quality profile of their publications.

Figure 1 provided an overview of the relative share of Scopus publications made by researchers in the different 28 EU MS as share of the total EU publications. It is clear that the publication share of the UK, Germany, Sweden and France is decreasing. France and Germany have only recently adopted PBF systems, The UK and France do not focus (much) on increasing output but more on high quality output in its peer review based PBF – as a result one would not expect the PBF system to stimulate a relatively large growth in output. Sweden introduced its new system with output/impact measures in 2009, but nonetheless saw its share of publications decrease further albeit slightly. The share of Belgium, the Netherlands and Denmark remained stable and as shown in figure 3 they are among the countries with the highest impact per paper as well. While Belgium and Denmark have formal incentive systems in place to promote scientific output, this is not the case for the Netherlands. In the Dutch case, however, there may be other incentives to promote high impact publishing, including the consideration of this parameter in the evaluation exercises – which as indicated is not inconsequential even if it doesn't have a direct link to funding. By contrast some of the Southern European (Italy, Spain, Greece, Portugal) and Central and Eastern European MS (especially Poland, Czech Republic and Romania) saw their share of EU publications grow. While Italy, Poland and Czech Republic have implemented Performance Based Funding systems, this is not the case for Greece and Spain. The latter, however, did implement other incentives to promote scientific output¹¹ such as the Sexenio programme and a greater

¹⁰ When comparing according to this indicator it is important to realise that the relative performance of a country like the UK, with a certain life and medical science specialisation, may be higher when a non-weighted version of this indicator would have been used.

¹¹ As a caveat to the scientific output measures one should mention that the bibliometric database on which these results are based has not been static over the past 10 years. ScienceMetrix did not restrict its analysis to English language journals only and the balance between English and non-English (including Spanish) journals has changed over time. That being said the share of Spanish language articles loaded before 2013 into the Scopus database is around 1 %, whereas German and French journals constituted 2.4

emphasis on publication indicators in evaluation exercises and promotion decisions. The growth or decrease of scientific output may also be related to increasing/growing public R&D expenditures, which were shown in table 4 to increase for most systems.

From figures 2 and 3 presented in the previous section it remains unclear whether or not the implementation of PBF has had an effect on impact indicators in Western European countries, since there appears to be little difference in the dimension of change between countries which have (BE, DK, EE*, FI, FA, GE, IT, NO,) and countries which have not put in place such incentives as part of the PBF (ES, IE, NL). Impact indicators have improved for most countries. It is therefore not possible on the basis of these figures to indicate that the implementation of performance based funding systems at different times over the past decade has had a greater positive impact than other potential measures.

It does appear clear than in most of the countries in which such a system has been in place for a considerable amount of time (e.g. UK or Belgium) the degree of change is relatively high in both periods and comparable with good performers who have not implemented publication incentives in their PBF. The Central and Eastern European countries that have not put in place (or fully implemented) a performance based funding system such as Latvia, Romania, Bulgaria do not show consistent increases in their system wide impact indicators as their 2013 (and 2011) values are below their 2006 values (ARIF, ARC and share of high impact publications). Countries which did implement such a system (CZ, SK, PL, EE), did see a steady, consistent increase in the impact of the output of their system.

Considering the stress on "high impact outputs" in the UK system one would have expected a particular strong increase there and a considerable increase of almost two percentage points in the 10 year period is visible. Spain, Italy, Portugal, Belgium and Slovenia achieve considerably higher growth but from a lower base. The Netherlands achieves a higher growth from a higher starting point. It is therefore not possible to conclude that the PBF systems in place in these countries have made these systems outperform those systems who have not included PBF. It is also not clear what has a larger effect on these indicators, formula based systems as in the case of Belgium or peer review based systems as in the case of the UK. In the Western European systems all incentive systems do appear to be associated with a (consistently) increased performance.

When assessing the effect of performance based funding regimes on the output of research systems it can be useful to consider the institutional structure of countries as a variable as well. One could observe that funding in the UK is increasingly concentrated in research universities, while the "new" universities (new since the 1992 change in the higher education system) receive very little of the performance based funding. To a certain extent this situation is not dissimilar in countries with a binary system (Kyvik, 2004) such as The Netherlands, Belgium and Switzerland where a very large share of research funding is allocated to the research universities and where the universities of applied science receive much less research funding. It is these countries with binary systems which perform very well on performance indicators. In comparison to large unified systems such as the UK, Spain and France, there may be less of a need for

and 3.8 % of the total respectively (personal communication with Elsevier Scopus: 22-09-2015). It is unclear how these shares have evolved over time but for the articles loaded between 2013 and 2015 the share of Spanish language articles was only slightly higher whereas the share of German and French journals had dropped considerably: a trend which may have started already pre-2013 and might explain part of the decreasing share of Germany and France in figure 1. The share of English language journals included in Scopus on the contrary was higher in the 2013-2015 loading period than it was pre-2013. By the way 24% of the publications loaded between 2013-2015 correspond to publications made pre-2013 due to back-filing of newly included journals.

increasing competition between universities in such countries because concentration is part of the institutional design of the system. Nonetheless also in many such binary systems (Norway, Belgium, Denmark and Finland) PBF systems have been implemented to foster competition between research universities.

As was indicated in table 3, in the case of Bulgaria and Latvia the real government funding of publicly performed R&D decreased in this period, while funding reduction are not necessarily expected to direct short term effects on publication output and impact, funding shortages might explain part of the observed decreases in the three impact factors. While funding levels decreased also in the UK, one does not observe a decrease in impact factors. It is clear that the UK has a declining share in EU publication, but the same is true for Germany and France which did not reduce their public funding (as measured in PPS – 2005 values).

6. Discussion

Butler (2003) analysed the impact of an earlier iteration of the Australian performance based funding system. She found an increase in the number of WoS indexed publications but highlighted that this may have come at the expense of the average impact of these papers. The incentive system of the PBF, should therefore be carefully thought through as they may have unintended consequences. Sivertsen (2010/2012) showed how the Norwegian system has had a positive impact on the output and impact of the Norwegian system (also include discussion of the Finnish paper). The provisional comparison between the output and impact of public sector research systems in the Member States provided in this paper does not provide a proof of the effectiveness of the PBF. There are many other factors which can explain the differences between e.g. Bulgaria, Latvia and Romania and the Central and Eastern European Countries that did introduce PBF. Nonetheless, the findings may inform/suggest a direction of action for the countries which did not consistently perform as well as the others. Performance Based Funding systems can be a strong instrument to foster institutional and behavioural changes which are conducive to a strengthening of the impact of the output of research performing organisations. The implementation of PBF (or other measures with similar targets) is one approach that could help these countries achieve similar improvements as witnessed for most other EU MS – though this should probably be coupled with a sustained increase in public funding of publicly performed R&D since chronic underfunding may play as big a part in their relative performance as a suboptimal institutional framework. Introducing PBF as additional to core funding would furthermore reduce institutional resistance against its introduction.

From the reported data it remains unclear whether peer review or formula based approaches have a greater impact on output and impact. The choice of methods (formula based, UK style peer review, bibliometrics informed peer review) to assess research performing organisations tends to be related to the level of analysis chosen (Hicks, 2012). Formula based approaches tend to be used for organisation wide evaluations, though field weightings can be included. Peer review based evaluation tend to be used for evaluations at the departmental or research group. In practice most countries opt for university or departmental level evaluations in order to reduce the scope and resource demands of the exercise. In the Polish PBF the unit of assessment is the faculty/department rather than the university as a whole. By taking into account field differences the Czech Republic, Slovakia and Italy approach this type of assessment even if they evaluate at the level of universities. From an evaluation point of view the research unit is often considered the most appropriate considering the differences in field dynamics and intra-organisational variations in the university. The UK REFs, for example do focus at the level of the research unit (Hicks, 2012; Cunningham, 2015; Boer et al, 2015).

While peer review tends to be held in high esteem in the academic communities and therefore has a relatively high degree of acceptance, it is not without its weaknesses. These weaknesses are partially practical. Peer review is difficult to implement in small countries in which the pool of experts may be insufficiently large. Relying on international experts, as is done in Estonia, can be a solution to this problem though it precludes the assessment of some types of research outputs made in the national language. Favouritism and a lack of transparency can hamper the openness and fairness that should be basic principles of the peer review process. Peer review is often also considered to be conservative, favour mainstream research and disadvantage interdisciplinary or heterodox approaches. This is partially due to the organised scepticism that is inherent in the scientific enterprise which can pose barriers to the acceptance of ideas or findings that contradict established ideas. Struggles over resources and influence between competing schools of thought/research for influence and resources can also play a role. As indicated, e.g. the French assessments include contributions to "frontier research" in their assessment. The extent to which this also

favours e.g. interdisciplinarity research or is more focused on cutting edge research within a disciplinary area is unclear.

Peer review is subjective by nature. To mitigate this, for example, the UK system requests two reviewers to assess each submitted publication. Frequently reviewers may be partially guided by the reception of the submission within the academic world. It is unclear to which extent reviewers are influenced by factors such as the prestige of the journal in which the article is published though even in pure peer review systems journal impact factors have been argued to be relatively good predictors of the outcome of the exercise (Taylor, 2011 in Rafols et al 2012; Boer et al, 2015). One of the most important drawbacks of peer review systems is the potentially very large investments required in terms of resources and scientific manpower. For example for the REF, tens of thousands of submissions are reviewed by 2 reviewers in addition to the time invested in the disciplinary coordination committees for each of the fields considered (see Hicks, 2012; Boer et al, 2015).

Considering the costs in resources and time involved in a peer review based assessment, peer review exercises tend to be implemented irregularly or with a considerable time interval between assessments. For example a number of years pass between the RAE/REF and the Italian evaluation exercises. In the case of Poland the assessment is carried out every four years (previously every five year). As a result, funding decisions may be based on out-of-date information. The UK system combines a retrospective approach with a prospective approach in an attempt to address this issue, most other systems use only a retrospective approach. The formula based approaches (e.g. BE (FL) and DK) by contrast can often be implemented on a year by year basis and also the strongly metrics based peer review approaches like the one in the Czech Republic is carried out on a yearly basis: the new to be introduced system would instead be based on a five yearly assessment.

6.1 Advantages and disadvantages of bibliometric approaches

The use of (more or less advanced) bibliometric indicators has various advantages over classical peer based assessment mechanisms in which individual experts are requested to evaluate organisations. These advantages include their 1) relatively low costs (in terms of resources and time): bibliometrics is often used to “short-cut” experts/expertise, for by allowing for an assessment of credit awarded by the scientific community as an indicator of scientific impact, non-expert evaluators can make an assessment of these publications without having knowledge of their content – though the extent to which they can do so in a meaningful is contested by detractors of bibliometric approaches; 2) their non-intrusiveness: the researchers and organisations evaluations do in theory not need to engage in administratively heavy procedures to provide proof of their research output. This is only in theory though as in a number of systems, universities and individual researchers do have to provide the material on the basis of which they should be evaluated rather than relying on bibliometric assessments by outside experts alone; and 3) their perceived objectivity as they do not rely as clearly on the subjective assessments of expert reviewers, but instead are an indication of the use which is made of the publication by the whole scientific community. Some analysts argue however that there may also be subjective value judgements inherent in the choice of any of the various potential bibliometric indicators that can be selected.

However, while potentially relatively low-cost, there are also a number of disadvantages of the sole use of bibliometric methods in assessments. The first is that while university level analyses are methodologically not too challenging, carrying out analyses at the departmental or research unit level can involve a considerable amount of investment in data collection and cleaning to ensure the data are assigned correctly (Glanzel & Debackere, 2004). When funding allocations are based on these assessments it is crucially important that stakeholders have faith in this assignment as they may otherwise challenge the outcomes of the assessments.

Other drawbacks include that some research outputs, especially in the Social Science and Humanities, which are not fully covered in the bibliometric databases, bibliometric impact measures are considered to disadvantage certain fields (Hicks and Wang, 2009). The use of journal indicators, including the impact factor¹² for research evaluation (as used in Poland, Czech Republic, Denmark, Norway and a number of other countries) is the subject of debate and criticism from within the bibliometric and wider scientific community (See e.g. DORA (2012), Hicks et al (2015)). As argued by Rafols et al (2012) and others the use of journal based indicators disadvantages a.o. interdisciplinary research. Findings on whether more sophisticated bibliometric indicators also have this problem are mixed (Rinia et 2002) though a recent HEFCE (2015) analysis suggests they have. The outcomes of bibliometric assessment are sensitive to the methodology adopted and the choice of indicators which in the absence of clear standards may remain a subjective decision to a certain extent. A consensus appears to be emerging among Bibliometricians on the more and less suitable forms of indicators.

The sole use and at times mis use of bibliometric indicators can create perverse incentives. For a recent assessment of the pro's and con's of bibliometrics in the context of the REF, see a.o. Wilsdon, 2015. Finally a number of analysts and evaluators as well as significant parts of the scientific stakeholder community, raise doubts about the extent to which bibliometric experts can be an adequate (partial) substitute of expert based peer review, which is, despite its potential flaws, held in higher esteem by many. Due to the dislike of bibliometrics by part of the academic stakeholders, some governments that propose to base PBF on them have faced heavy criticism from their internal stakeholders in the past.

6.2 Bibliometrics informed peer review

Partially for cost consideration and partially because of a recognition of the potential of bibliometrics to contribute to quality assessments, many governments have therefore implemented a mixed approach in which the Peer Review process is to a greater or larger extent based on or informed by bibliometric analyses (See e.g. Czech Republic, Slovakia, France). In the new UK REF, Peer review panels were given the option to receive the results of bibliometric analysis of the analysed departments – though departments are only asked to select a limited number of publications (per researcher). Some of the panels decided to make use of this, but were not given clear instructions on how to use these metrics. Hicks (2012) argues that arguably "departmental or field level

¹² Criticism towards this indicator highlights among others the skewedness of the citation distribution among articles within journals: publication in a high impact journal vs a low impact journal therefore does not necessarily say something about the impact of this publication. A counter-argument that is sometimes made is that the higher level of selectivity of higher impact journals can lead one to expect a higher average level of quality of the publications contained in these rather than lower impact journals – especially if one compares only within subfields of science. The argument that could be made in favour of journal based assessments is therefore that the assessment of the publication relies on the peer review based selection procedure of the journal in which it is published, which is potentially a proxy for both quality and potential impact. Experts and the broader academic community are arguing against the use of journal Impact Factor based measures in evaluations (Leiden Manifesto (Hicks et al, 2015) and DORA (2012)). For a national research funder there might nonetheless still be a rationale in promoting the publication of research output in higher impact journals or as a (potentially better) alternative in journals that were carefully selected by panels of field domain experts such as in the case of Denmark and Norway. Apart from the concerns raised in the above statements, placing too strong incentives on this type of indicator is thought to be associated with a number of individual level research and publication strategies which can be suboptimal at the systemic level.

[performance based funding systems] using peer judgment based on indicators represents the current state of the art". It is such systems which have been implemented in many countries in recent years. On the other hand the Wilsdon review (2015) carried out for the HEFCE does not agree that a systematic integration of bibliometric indicators in the REF would constitute an improvement in the UK context at present. In the UK the debate concerning the potential of metrics to replace or inform the peer review system has thus continued and will probably continue to do so in the future as well. It is also interesting to note that e.g. Sweden may introduce a greater peer review component in new iterations of its assessment exercises (which will probably remain bibliometrics informed). Performance Based Funding Systems thus do not clearly evolve in a specific direction.

6.3 University autonomy

The degree of "University autonomy" is affected by Performance Based Funding Systems in several ways (Herbst, 2007; Hazelkorn, 2010; Hicks, 2012). A certain degree of university autonomy is considered by many actors (including the EUA, 2013) to be essential for the functioning of research universities as it allows these organisations to engage strategically with their environments and build long term strategies for the improvement of their performance (see also Aghion et al, 2010). When reflecting on university autonomy it is useful to consider the notion of "organisational actorhood" and make a distinction between "internal autonomy", or the extent to which university leadership has control over the researchers working in the professional work organisation which a university is, and "external autonomy", which relates to the autonomy of university leadership in the context of environmental pressures including the autonomy that the organisation has vis a vis its principal (national or regional governments) (Cruz-Castro et al, forthcoming, Krücken & Meier 2006; Whitley 2008). In many countries performance based systems were implemented to increase internal university autonomy which was virtually in-existent in these systems in the not so distant past: policy organisations distributed funds directly to individual research groups or researchers without much interference or control by university leadership (Hicks, 2012, Herbst, 2007). Also, because the central assessment of research requires improved data collection, it can be beneficial for strategic planning and management at the organisational level and in doing so increase both internal and external autonomy (Hazelkorn, 2010). On the other hand, as suggested by the principal agent discussion above, Performance Based Funding also constrains the potential for strategic action by university leadership by giving greater control to policy makers over university behaviour by setting targets/indicators, assessing performance and rewarding "good" or punishing "bad" performance in the medium term. The introduction of Performance Based Systems in MS which currently did not have related traditions can introduce considerable instability and unpredictability, which hampers the ability of research organisations to plan strategically. In e.g. the Czech Republic, Poland and Denmark, research funders therefore decided to base a substantial part of the funding on previous funding distributions (Good et al, 2015; Klineciewicz et al, 2015; Schmidt, 2010). The performance based contracts described in the results section have on the one hand a constraining function. On the other, governments also commit themselves to e.g. the supply of certain levels of funding if agreements are met which can provide the stability that allows university leadership to engage in strategic planning to a greater extent.

6.4 Costs of PBF

Several analysts recommend the introduction of Performance Based Funding systems in MS which do not yet have these (ES, BG), since they are considered a (relatively) budget neutral way to improve efficiency (ERAC, 2014; Todorova & Perez, 2015; WorldBank 2014). As indicated in various places in this report, there are (considerable) costs, in money, time and resources, involved in doing the assessments on which the funding allocation decisions are made. The costs involved in the different types of exercises differs. Probably at the higher end of the scale are the large scale assessment exercises carried out in the UK and Italy. These are direct costs related to the running of the exercise: the set up and running of an evaluation agency, the data collection and analysis as well as the set-up of an information system for this purpose, the contracting of peer reviewers, etc. Consideration should also be given to the substantial costs borne by the research performing organisations in coordinating their research submissions. Since these costs relate to the management of outputs (an unproductive activity) rather than actual research (a productive activity), the assessment exercises are sometimes criticized for this (Hicks, 2012). The metrics based exercises as carried out in e.g. Poland, Czech Republic and Finland are expected to be less costly and can partially for that reason also be carried out on a more regular basis. However, also in these countries universities are responsible for submitting the material on which they are evaluated. Exercises such as the Belgian BOF-key allocations do not rely on the universities for the submission of their research output. This type of formula based funding allocation systems, while difficult to design and implement, is also expected to have relatively low running costs as it does not involve (large teams of) peer reviewers. However as discussed they may have unintended consequences. These types of systems therefore have to be very carefully designed and be open to fine tuning. The extent to which they are suitable to systems in different stages of developments should also be considered.

7. Conclusions

The implementation of Performance Based Funding (PBF) systems is considered a successful strategy to improve research cultures and facilitate institutional changes that can help improve research performance. This is attested by the fact that most EU countries have introduced, are introducing or are considering to introduce such systems. There may be alternatives to Research Performance Based Funding or performance contracts as suggested by systems as the US with relatively high levels of performance. However, the logic that placing incentives on certain types of behaviour (such as publishing in high impact international journals) and the concentration of resources in well-performing units to attain a certain critical mass can lead to sustained improvements in output and impact at the systemic level, seems hard to refute. The provisional analysis of the effect of the introduction of PBF on the output and impact of Scientific Research Systems suggests the introduction of performance based funding as an avenue of improvement for a number of Member States. All countries which did not experience a consistent improvement in impact scores did not have a PBF system in place. These countries recently also received recommendations by international organisations to implement a PBF system.

This analysis suggests that, at least for the indicators presented, none of the systems which have implemented a PBF have experienced strong negative effects of these systems on the indicators considered. These indicators, however, do not necessarily tell the whole story and in a mutual learning exercise it is crucial to get a clear understanding of potential downsides and perverse incentives generated by specific designs and implementations of Performance Based Funding Systems – including and beyond the issue of research excellence as measured, necessarily imperfectly, by these metrics. The overall increase in impact indicators in most member states may also be due to other factors including the globalisation of research fields and changes in funding levels.

The role of Performance Based Funding is likely to differ in relation to the institutional design of the system. Systems with large Public Research Centres such as the Academies of Sciences in Central and Eastern European countries need to decide whether to include these units. The rationale for and likely impact of performance based university funding is likely to differ between unified systems such as the UK and Spain and binary systems in which the concentration of research funding is implied in the separation between research universities and universities of applied science.

Other issues in which Member States differ include the share of organisational level funding which is allocated through PBF, the speed within which the system is introduced, the degree of stakeholder involvement, the impact different systems have on the autonomy of research performers, the criteria on which they evaluate and their likely impact on research excellence indicator as well as the other missions and behaviours which the government wants to promote in these organisations. An extended analysis of the impact of funding allocation regimes on research system performance will be carried out in a follow up to this report.

As suggested by the ongoing redesigns of the systems in for example the Czech Republic and Sweden, lessons can be learned from past experiences in EU Member States with PBF experience. Especially for those Central and Eastern European countries which at present have not implemented any such system and which are considering to do so, an overview of the pro's and con's of different designs is expected to be beneficial. Also systems in which the PBF are a recent or even a long established feature can benefit from further adapting or fine tuning their approaches.

Decisions to implement a PBF should include assessments of the costs of different systems. In these assessments the considerable costs which some systems bring to the research performing organisations which provide input to the assessments should not be overlooked. These costs should be weighted, in so far as possible, with the potential benefits the introduction of such systems can bring. Of crucial importance is a

consideration of the potential unintended consequences which difference incentives, indicators and methodologies can generate. A strategy to monitor the effects and impacts of the system should be in place and the administrating agency should be open/flexible to fine-tune the approach. It is important to involve stakeholders in deciding on the indicators considered. It should be realised, however, that in the absence of additional funding, there is likely to be a certain degree of institutional resistance from parts of the academic community and research organisations. This resistance in itself should not be an argument to forego on the decision to implement such systems though concerns can be taken into account.

Considering the relative differences in costs of time and resources, especially the allocation mechanisms based on funding formulae appear of immediate interest to countries which have not yet established PBF. However, as we have seen from e.g. Sweden and the Czech Republic, governments are re-evaluating the extent to which such approaches are most beneficial to their system. These reconsiderations are possibly in part due to institutional resistance from research performing actors in these systems, but possibly also due to a realisation of their potential unintended negative consequences or the perception that alternative incentives can help to improve the performance of their system more.

An important factor influencing the impact of a Performance Based Research System is the amount of funding that is allocated on the basis of assessment of the research output. The levels of performance based funding and the rate at which it is introduced or at which allocations can change is important as it affects the ability of research organisations to engage in longer term planning. In several countries, such as Poland, Czech Republic and Denmark the introduction of the system has been gradual in order to ensure the system remains in balance. Also in long established systems such as the UK, historical considerations play a role in funding allocation decisions in order to avoid large swings (especially falls) in the amount of funding granted to specific universities. An example which deserves further reflection is the Danish model in which each year a small share (2 percent) is re-allocated on performance based criteria while the rest is mainly allocated on the basis of the previous' years funding. Over time this resulted in a gradual increase in the "accumulated" performance based component of organisational level funding.

In the discussion this report elaborated on several of the advantages and disadvantages of both peer review and bibliometric approaches. This debate is too large to fully capture in this report, but some of the references provided can present relevant further reading. What is clear from past experience is that if bibliometric indicators are used to underpin funding allocation mechanisms, it is important to take into account field differences, paying special attention in this light to the Social Sciences and Humanities (see also the Belgian (Flanders) and Czech experience in Annex 1). Simple publication counts alone are not considered to provide the most appropriate incentives for an upgrade of research systems. Some of the debate and criticism towards journal based impact measures were provided, but research funders in a number of countries still consider these or alternative journal based measures to generate desirable incentives. As an alternative or in addition to Journal Based Measures, publication level citation based measures can be useful to consider in order to include a more direct incentive towards high impact publications. When introducing such measures they can be accompanied by other output and impact measures which can provide additional incentives and potentially mitigate some of the adverse side effects associated with the incentives which may be generated by a sole focus on bibliometric indicators.

The involvement of peers/experts remains the central approach to research assessment for many analysts who doubt the ability of bibliometrics to provide a complete or even meaningful assessment of the output of research systems. As was shown, metrics informed peer review exists in different forms in the member states that adopted them. While peer review has limitations of its own, these may be partially addressed by the

input from these publications analyses. Whether the benefits from full-fledged exercises outweigh their costs is an issue that needs to be decided on a country by country basis.

It may be important to start reflecting on the potential of alternative metrics and indicators and to pay close attention to the various mechanisms which are currently being developed to gauge societal impact (see e.g. the examples of UK, France and The Netherlands). Striking the right balance between scientific excellence and societal impact is among the main challenges in the reform of public sector R&D systems in Central and Eastern European, and indeed all, EU Member States. Whether the assessment exercises that underpin PBF allocation decisions are the most appropriate avenue for evaluating and incentivizing the societal relevance of public research remains an open question.

The impact of PBF and the research funding allocation system in general will be analysed in more depth in future iterations and follow up work related to this working paper.

Annex Country descriptions of PBF funding systems

1. Austria¹³

Timing and method

In Austria the financing structure of the higher education system changed considerably with the University Act of 2002 which bases performance based organisational and block funding to universities on three-year performance contracts between each university and the BMWFV. The 2002 regulations of this financing system have been revised in 2013 and now increasingly account for research, teaching and infrastructure demands at Austrian universities. It aims to make financing more transparent and flexible, e.g. easier and faster budget access when buying equipment or hiring professors. Furthermore, it seeks to improve the student-professor ratio, mainly by provision of additional public funds and by regulating organisational rules for capacity-constrained student access at university level and for fields of study with high demand e.g. computer sciences and pharmacy. Revisions will become fully effective by 2019, at the latest. By the end of 2014 this bottom-up "pilot regulation" for student access will feed into a first Austrian-wide university development plan ("Gesamtösterreichischen Universitätsentwicklungsplan") headed and drafted by the BMWFV in cooperation with the Assembly of Universities and the Austrian Science Council. The plan will become effective for the performance contract periods 2016-2018 and 2019-2021. The current contracting period is 2013 to 2016.

Modality of the assessment

Performance based funding to HEIs outlined in these performance contracts considers separate budget areas, namely 1) budgets for teaching, 2) budgets for research and advancement of the arts, and 3) budgets for large scale infrastructures. HEI performance assessments in all three budget areas are based on a variety of indicators. These indicators include 1) number of active students per scientific discipline, number of graduates per scientific discipline, 2) the number of PhDs, project volume financed by the Austrian Science Fund, project volume financed by industry or other sources, and 3) societal indicators such as the share of women in PhDs programs, participation in outgoing mobility programs, number of foreign graduate students.

Since the research part is either based on PhD completion rates which are not assessed or on input factors such as the volume of project funding received, Austria is not included among the countries that have adopted performance based funding according to Diana Hicks' definition (2012), because it does not include an assessment of the research output apart from PhD degrees awarded. Currently, more than 20% of total organisational funds to HEIs are competitively allocated according to this organisational funding model. The latter model will be fully implemented until the performance contract period 2019-2021. For the period 2016-2018 up to 60% of organisational funding to HEIs will be based upon this model. The share of organisational funds in Austria that is allocated competitively has been increasing in the past years and will continue to do so in the next few years (Cuntz, 2015).

¹³ Based on Cuntz, 2015.

For further information on the Austrian system, also see De Boer et al (2015).

2. Belgium

Timing and method

In 2003 Belgium (Flanders 14), pre-established 'pre-allocation keys' which are recalculated every year and published in the Belgian State's official legislative documents (Moniteur Belge – Belgisch Staatsblad). The Department of Education and Training provides organisational level block funding for universities and the Department of Economics, Science and Innovation (EWI) provides performance based funding through the Special Research Funds (Bijzondere OnderzoeksFondsen: BOF) and the Industrial Research Funds (Industrieel OnderzoeksFonds – IOF).

Project funding is allocated by the FWO. Finally there is the so-called 'Hercules-key' through which funding is allocated to support research infrastructures at universities and PRO's (Duchene, 2015).

Modality of the assessment

BOF funding is formula based according to the so-called "BOF-Key". The system was last adapted in 2014. The bibliometric analysis on which the BOF key is based is performed by the inter-university centre ECOOM. The data on degrees is collected in a central database on Higher Education in Flanders¹⁵.

Since 2012 (Decision Flemish Government dd. 21.12.2012), the BOF allocation formula takes into account five key indicators: master degrees, defended doctorates, gender diversity, publications and citations (Spruyt & Engels, 2013).

Table A1. Parameters included in the calculation of BOF allocation formula¹⁶

Year t	2013	2014	2015	From 2016
Structural part				
Weight Master and Bachelor Degrees	25,00 %	25,00 %	24,00 %	23,00 %
Weight PhDs awarded	35,00 %	35,00 %	35,00 %	35,00 %
Diversity parameter (gender distribution)	3,00 %	2,00 %	2,00 %	2,00 %
Sum	63,00 %	62,00 %	61,00 %	60,00 %
Bibliometric part				
Weight publications in WoS	15,36 %	15,77 %	16,19 %	16,60 %
Weight SSH publications in VVAB	6,28 %	6,46 %	6,62 %	6,80 %
Weight citations	15,36 %	15,77 %	16,19 %	16,60 %
Sum	37,00 %	38,00 %	39,00 %	40,00 %

Publications which are indexed in the WoS are grouped into categories based a.o. on whether or not an impact factor was assigned to them. The journals are assigned for

¹⁴ Public funding of research and innovation in Belgium has almost fully been devolved to the level of the regions. In this section we discuss the situation in Flanders which is not representative for the other Belgian region(s). Walloon does not have a system of performance based funding but does work with performance contracts.

¹⁵ <http://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14492#24>

¹⁶ Source: <http://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14492#24>

different disciplines to 20 equal sized categories on the basis of their average impact factor in a ten year period. Publications are then weighted on the basis of the category in which the journal in which they are published is placed in the manner indicated in table A2:

Table A2

20 equal sized categories of journals based on their impact factor	1	2	3	4	5-14	15-16	17	18	19	20
Weight	10	6	3	2	1	0,5	0,1	0,1	0,1	0,1

Source: Ministry of Education Flanders (2015)

In addition to publication data, citation data is also considered. For each broad discipline, citation data to the publications made by an organisation is analysed for a ten year time frame.

To account for the underrepresentation of SSH journals in the WoS, a new database was created with relevant SSH journals: the Flemish Academic Database for the Social Sciences and Humanities (VVAB). Publications in this database are considered since 2010 and their relative weight has increased since 2012.

When bibliometric assessment was first introduced in the allocation of the BOF key, 10% of the funding was based upon it (DeBackere & Glanzel, 2004). This had increased to 36% in 2008 (Hicks, 2012; DeBackere and Veugelers, 2014). Between 2013 and 2016, the bibliometric share increases from 37% to 40%. Quantitative measures of research output and scientific impact therefore determine a considerable share of the organisational funding provided to Flemish universities (DeBackere and Veugelers, 2014. Spruyt & Engels, 2013).

3. Bulgaria¹⁷

Timing and method

In Bulgaria according to previous versions of "The Higher Education Act" the state envisaged a subsidy for research, innovation and creative activities to HEIs not less than 10% of the education grant (Todeva, 2015). It should be noted that the version of the Law for Higher Education last amended 24 July 2015 does not specify a portion of the state grant to be allocated for the research activities of HEIs.

On 26 February 2015 the Parliament adopted a Strategy for the Development of Higher Education in Bulgaria 2014-2020. The Strategy foresees to strengthen the role of the quality of the education and the realization of the graduates in the allocation of funds to the HEIs.

Modality of the assessment

For 2014 all public universities and HEIs received in total €4.1m, or 2.77% organisational funding for research, distributed on equal basis to all state HEIs in addition to their education grant (Todeva, 2015). The organisational funding for HEIs is subject to a ministerial decision by MES.

The Ordinance № 9/8.08.2003 stipulates that the 10% share for research activities can be increased or decreased depending on the submission of yearly/ half-yearly reports by the respective HEI.

The education grant itself also has a performance based component, as it is constituted on the basis of the number of students, and a complex evaluation using numerous indicators for measurement of the quality of education based on the evaluation from the accreditation and teaching staff (30%), the evaluation of the volume and impact of research and publication outputs (25%). This includes citation impact by scientific field, citation impact without self citations by field, the number of publications cited at least once, the number of articles in scientific journals and the availability of PhD programmes / graduate schools. And finally, employment of graduates and links to the labour market (45%). (Law for Higher Education; Decree of the Council of Ministers № 15 of 30 January 2015).

There thus appears to have already been a performance based funding element in the allocation of organisational funding to Bulgarian Universities. However, when one considers the evolution of the budgets of universities over the past years one observes no, or very limited change, over time. This suggests that the performance based funding regime has not yet been fully implemented or has limited effect on the redistribution of resources. Plans are being developed to increase the role of PBF.

¹⁷ Based on Todeva, 2105

The recent Peer Review on Bulgaria states that: *"In several reports on Bulgaria, there are recommendations to change and introduce legislation to control the development of the Higher Education sector. One of the topics high on the agenda is performance-based funding. A World Bank report from 2013 recommends that 'funding would be allocated on the basis of regular, independent monitoring and evaluation of each PRO's performance'. (Worldbank 2013) As a first step towards a performance-based system, the Bulgarian government has drafted regulations for monitoring and evaluating the research performance of higher education institutions and research institutes (and as referred to above on the NSF). According to these regulations, there will be an annual evaluation of all institutions. According to the plan, a commission of 13 independent experts appointed by the Minister of Education and Science will be responsible for evaluating the research performance of all institutions, based on fixed metrics."* (Soete et al, 2015)

4. Croatia¹⁸

Timing and method

Up to 2013, 80 to 85% of academic (i.e. universities and research institutes) research activities were block-funded. The funding was allocated by the Ministry of Science, Education and Sport (MSES) and decomposed as such: 70% for salaries, 10% of direct organisational funding (overheads, phone, energy, etc.), 10% of research grants (material and operational costs) and remaining 10% other research-supporting activities (conferences, publishing, etc.).

The share of project based funding in GBAORD was rather low until 2013, and amounted to 6.2% in 2011 and 5.6% in 2012, while institutional funding amounted to 93.8% and 94.4%, respectively. The reforms started in 2013 will significantly increase the share of project-based funding in total public funding of R&D activities in Croatia, which already increased to 8.5% in 2013.

Amendments to the Act on Science and Higher Education, adopted in 2013, introduced significant changes to the overall Croatian R&D system. A new model for public R&D funding has been developed, focused on awarding multi-annual block grants for HEIs and PROs from the State budget by MSES. Funding is now awarded at a three-year basis, with funding amounts determined on the basis of institutional performance indicators. For the period 2013-2015, indicators have been evaluated during the first half of 2013, after which the exact funding amounts have been agreed between MSES and HEI/PROs. Decision on multi-annual institutional funding of research activities in public research institutes and universities for the period 2013-2015 has been adopted in June 2013.

Another new form of organisational funding has also been introduced in 2014. This refers to the Centres of Research Excellence, whose establishment will be funded by MSES from the State Budget. For the period 2014-2016, €0.330m annually has been reserved within the State Budget, which should be sufficient for the initial phase of establishing 7 centres. Additional financial resources for Centres are planned to be ensured from the EU Structural Funds.

Modality of assessment

The amount awarded depends on institutional performance indicators of scientific activity in the previous five-year period. These include four types of criteria weighted differently depending on their importance for research evaluation, as follows:

- Scientific productivity (with the largest weight of 60%): this criterion includes the number of scientific papers published in journals covered by the Web of Science and SCOPUS, number of citations and the number of employees who attained doctoral degree in a given period. The number and type of publications are further specified by the 6 scientific areas of natural, technical, biotechnical, biomedical, social sciences and humanities;
- National and international competitive research projects and mobility (25% of weight) includes the number of national competitive research projects (CSF and UKF) and the number of projects funded by foreign sources (FP6, FP7, ESF, HERA, COST);

¹⁸ Based on Racic & Svarc (2015)

- Popularization of science (5% of weight) includes participations in actions like Festival of Science;
- Commercialisation of science (5 % of weight) includes the number of contracted projects with businesses, government bodies and local authorities, civil sector and non-governmental organizations.

The allocation of total funds of € 6.6m per year to each institution depends on the institutional coefficient, calculated by a complex formula which includes the criteria defined above and a number of other elements combined with the specific coefficients and ratios such as: an average and basic value of scientific area, the coefficient for a particular area of science (natural sciences = 2.7; engineering = 2.5; biomedical Sciences =2.7; biotechnology = 2.6; social sciences = 1.2; humanities and arts = 1.2), number of researchers in full-time equivalent (FTE) by a field of science, etc.

Each institution has to deliver an annual report on its scientific activities in standardized format. This report is evaluated following the criteria previously exposed and used for the calculation of the organisational funding.

5. Cyprus¹⁹

In Cyprus, the government plans organisational funding annually through the state budget. It is exclusively based on education metric criteria (number of students and researchers) and is not associated to research performance indicators. It is directed to Higher Education Institutions and Public Research Organisations.

¹⁹ Based on Tsipouri, 2015.

6. Czech Republic

Timing and method

The public R&D funding has been traditionally dominated by institutional support. However, this is changing in the context of the Reform of the RDI System that has been launched in 2008. As a result, according to the official classification used in GBAORD the share of project funds increased markedly in the last few years, namely from 44% in 2009 to 51% in 2014. The GBAORD multi-annual budget plan approved by the government in June 2014 outlines that the share of project funding will oscillate in the narrow range between 51% in 2015, 52% in 2016 and 50% in 2017 (CRDI, 2014).

In the Czech Republic initial reform plans considered to allocate almost the full amount of organizational funding using performance-based formulae. However, a medium term modification of the evaluation methodology has been introduced for the period 2013-2015, so-called Metodika 2013 (CRDI, 2013), on the base of which organizational funding is going to be allocated until 2016. After 2015 a new system of RDI evaluation and distribution of organizational funding that is under preparation by the Technopolis Group is scheduled to be gradually implemented (Srholec, 2015; Good et al, 2015). The expectation is that this new (formula based) system will be based on quantitative output indicators to a lesser extent (Good et al, 2015).

Methodology

In the current system, Peer review is especially important in the social sciences and humanities. In the natural science fields the assessments are more based on journal (impact factor) based bibliometrics. A second part of the evaluation is based on high impact results, including ERC grants. Each organisation selects a number of high quality results in each scientific field under consideration. The number of results selected is related to the funding which the organisation received for that field in the preceding year. These results are peer reviewed and compared for every organisation. A third part of the evaluation concerns non-scientific outputs of R&D, including patents and plant varieties. The different categories considered come with a set number of points per item. The remaining points in this part of the assessment exercise are allocated on the basis of an assessment of income generated through applied projects and collaboration with industry. The whole assessment relies on panels of experts to make the assessment for each field.

Funding levels

The funding allocation decisions are based for 75% of the assessment of the scientific output, for 10% on the evaluation of high impact research outputs and for 15% on the assessment of applied research (Malek et al, 2014). In order to stabilize the funding flows, a consensus has been reached that at present only 20% of the money is allocated using the evaluation results, hence performance based, while 80% of the money is proposed to be divided in the same proportion as in the previous year, hence in the form of block funding based on historical considerations (Srholec, 2015).

7. Denmark

Timing and method

Up until 2009, the Danish government funded universities on the basis of a model that covered indicators for education, external funding and PhD graduates.

The education part of public funding is strongly based on education metrics and particularly on the number of students who passed an exam. The amount of funding per exam varies between different fields of study (Van Dooren et al, 2014).

The level of organisational level research funding is mainly based on historical grounds (98 % based on the previous year's budget). Each year, 2% of the research funding is retained in a "restructuring fund" and redistributed among the universities. Over the years the importance of this cumulative performance based element has become substantial..

The European University Association's DEFINE project estimated that the cumulative share of organisational level funding, in 2012 was for 54% based on historical principles, for 27% on research performance and for 15% on a PhD performance model and 4% on earmarked research funding. The Danish Ministry of Education estimated that in 2013 the historical principle based part was 50%, while 30 % was based on (accumulated) research performance based principles and 20 % came from investments in PhD programmes (De Boer et al, 2015).

Modality of the assessment

Until 2010, the redistribution was based on a 50-40-10 ratio. That is, 50% was based on the level of educational funding, 40% was based on the amount of external research funding, and 10% was based on the number of PhD graduates (Van Dooren et al, 2014, Kalpazidou Schmidt et al, 2006).

In June 2009, a political agreement was reached on a new distribution model for the allocation of organisational funding to universities. This new model also includes bibliometric indicators and was introduced stepwise over the period 2010-2012 at the expense of the weighting for external research funding. In 2013 it was agreed to continue the distribution model for five more years (Grimpe, 2015; Van Dooren et al, 2014).

From 2012 onwards instead of the 50-40-10 model, 45 per cent of the (2% of variable) funding funds was distributed according to earned education related indicators, 20 per cent was distributed according to research activity financed by external funds (project funding from research councils or EU funding), 25 per cent was distributed based on bibliometric indicators, while 10 per cent was based on the number of PhD graduates (Kalpazidou Schmidt, 2010; personal communication Kalpazidou Schmidt, 2015).

The principles for the bibliometric indicator are summarised in a report published by the DASTI in October 2009 (Grimpe, 2015). This system drew inspiration from the Norwegian system (Hansen, 2009b).

There are several publication types such as books, book chapters, journal articles, PhD- and doctoral-theses, and patents and each publication is worth points – at two levels

(the elite level and the other level) (De Boer et al, 2015). The system is journal based: publications are counted in around 20,000 peer reviewed journals and publishing houses. The journals and publishers have been selected by a sixty eight panels of researchers. They are divided into two groups, where publications in the top 20% receive a higher weight than publications in the other outlets (Fosse Hansen, 2009).

The most recent results for the bibliometric indicators are published on the homepage of DASTI (Grimpe, 2015). In addition to the performance based funding the government has also engaged in the signing of performance contracts with the Danish universities.

8. Estonia²⁰

Timing and method

In Estonia, annual organisational funding and support to the maintenance cost of R&D infrastructures is allocated on the basis of universities and PROs' R&D performance indicators (based on a regular evaluation of realization of strategic goals, co-financing foreign and domestic projects and opening up new research directions).

Modality of the assessment

To carry out this regular evaluation of R&D institutions, the Minister of Education and Research forms a 3-16-member evaluation committee composed of foreign experts. The evaluation of the applications for research funding is organized by the Estonian Research Council.

Funding levels

The criteria for allocating organisational level funds for RDI institutions are set in the Organization of research and development Act (introduced in 1997, last update in 2012). Baseline funding is allocated to R&D institutions if they have received a regular positive evaluation (50% in proportion with the number of high level publications in internationally recognised journals, the number of high level research monographs and the number of registered patents and patent applications; 40% in proportion with the amount of financing of research and development from other sources i.e. targeted research, commissioned by enterprises, municipalities, ministries etc; 10% in proportion with the number of Doctoral graduates). Infrastructure expenses and organisational research funding are allocated to institutions for which research and development activities have received a regular positive evaluation in at least one field.

The implementation of performance based organisational research funding has been challenging and still needs some adjustments (Ruttas-Küttim, 2015).

²⁰ Partially based on Ruttas-Küttim (2015).

9. Finland

Timing and method

Already in 1994, the Finnish government introduced performance agreements for higher education institutions. The formula based allocation of competitive research funding system that was in place since 1998 was changed in 2010 (Hicks, 2012) and again in 2013, while for polytechnics a new funding formula was introduced in 2014 (Boer et al, 2015). While the performance contracts and the funding allocation model cover many of the same indicators, not all the indicators included in the performance contract are used to based funding allocation decisions on and vice versa (Boer et al, 2015).

Modality of the assessment

The core funding of universities is based on a fixed formula. Before 2010, the key components of the system on which the allocation of organisational funding was based considered the following indicators: university's operational expenditure in the last year of the previous performance agreement period; new students and other targets set in performance contracts; education appropriation, research appropriation including graduate schools, number of PhD degrees and number of completed PhD degrees and societal services appropriation, project funding and the number of Centres of excellence, funded from the Academy of Finland, amount of external resources (Auranen & Nieminen 2010).

The formula was adjusted in 2013 and, in comparison to the formula used in the 2010–2012 performance period, puts more emphasis on quality, effectiveness and internationalisation. The funding formula comprises three main parts: education, research, and other education and science policy objectives (Boer et al, 2015; Pekka, 2015).

For universities the indicators are similar to those for the polytechnics, but have different weights, with the education, research and strategic development pillars accounting for 41%, 34% and 25% respectively. For universities, alignment with overall education and science policy goals is an important ingredient (25%) of the funding agreement. Here, the strategy of the university (10%), its orientation towards specific disciplinary fields (8%) and the carrying out of national duties (7%) are fed into the funding model. (source: www.minedu.fi in Boer et al, 2015; Pekka, 2015).

The government funding for polytechnics, universities of applied science, will be allocated on a 70-30% ratio on the basis of the number of degrees awarded and other performance indicators (Pekka, 2015). Performance indicators cover the pillars education (85%), research (15%), and strategic development (project funding). Indicators relate to degrees conferred, student progress, research productivity, external research funding (including by the Academy of Sciences and TEKES, a research council), contract income, and internationalisation (student mobility) (source: www.minedu.fi in Boer et al, 2015).

Funding levels

In 2013, the share of organisational funding for research in HEIs was 42%. According to the new performance and quality based funding model of universities the Government appropriations for universities (90% of HEI organisational level funding) are directed especially on the basis of completed qualifications and credits as well as scientific publications and competitive project funding (10% of HEI organisational funding is revised to better support improvement in the quality of teaching and research) (Pekka, 2015).

10. France²¹

The French Ministry of Higher Education and Research established the AERES National Agency in 2008 to undertake, at national level, the evaluation of research in both research organisations and universities. This organisation has been replaced in 2013 by the High Council of the Evaluation of Research and Higher Education (HCERES).

The main objective of HCERES is the evaluation of all French research teams and research Centres. The evaluations provided are based on a peer-review assessment that includes, but is not exclusively based on, bibliometrics.

The main criteria used in the evaluation are as follows (EC, 2010):

- Quality of research (mainly based on the scientific production of the lab);
- International recognition of the lab (by using some quantitative indicators, such as the number of citations etc.);
- Participation in national and/or international research networks or programmes; research grants obtained from ANR (Agence Nationale de la Recherche) at a national level, from the European Commission or from other European or international funding organisations;
- Risk taking in research, and openness to interdisciplinary interfaces (frontier research);
- Openness towards societal challenges;
 1. Investment in the dissemination of scientific culture; valorization (patents);
 2. Number of full research fellows (chercheurs) in the lab, compared to other members (university faculty) who teach and are active in research for 50% of their time (enseignants-chercheurs);
 3. In some domains (mathematics, for example), the supervision of PhDs is also taken into consideration in evaluating research.

The evaluation committees convened by HCERES are asked to identify excellence among the teams and to compare teams active in the same field of research by ranking them. Each team is usually given one of the following grades: A+, A, B and C.

The main consequence of this evaluation system is the allocation of funding to the research teams by the Ministry of Higher Education and Research and by the research organisations.

²¹ This section is partially based on European Commission (2010).

11. Germany²²

The legal basis for the allocation of public funds for R&D is the 'Freedom for Science'-Article 5(3) of the German constitution ('Grundgesetz' GG). Further, rules for joint funding by federal and state governments are laid out in Article 91b GG of the constitution and in the Federal Budget Code ('Bundeshaushaltsordnung,' BHO). Article 91b GG of the constitution has been changed based on votes of both chambers of parliament in December 2014. This change enables the federal government to be permanently involved in the funding of universities (Sofka, 2015).

Public funding for R&D has two primary components in Germany: organisational level (block) funding and project funding. Organisational level funding covers essential financial demands of universities in topics or fields for which third-party funding is hardly available, especially fundamental research. In contrast, project funding is directed at a particular goal with typically short to medium-term time horizons (see BMBF, 2012: pp. 53ff for details on 'how R&D funding in Germany works') (Sofka, 2015).

The German funding system is rather complex and precise shares of project vs. institutional funding of R&D are difficult to predict reliably. EUROSTAT data shows that 37.2% of R&D funding is competitively allocated while 63.7% stem from institutional funding (Sofka, 2015).

The funding of education and research at university is devolved to a large extent to the sixteen states (Länder) which are highly autonomous in matters of education policy. In summary, the Länder's public funding typically consist of three possible procedures:

An incremental/discretionary/non-competitive part which is mainly based on the previous' year funding and corrected for inflation. During the past years, this approach to funding has gradually become less important. In order to achieve goals of the state government, like internationalization and gender equality, the state government can financially award well-performing institutions. This type of funding is generally non-competitive (Van Daalen et al, 2014). .During the past decade, many Länder have introduced an indicator-based formula to determine the amount of public funding.

Van Dalen et al (2014) provide an overview of how formula based funding developed in 9 Lander over time. They observe an increase over time in the number of Länder that integrate an indicator-based formula into their funding program. Moreover, the individual shares increased as well for most Länder.

This indicator-based part of the annual budget consists of both a teaching and a research component. Typically, the research component carries more weight for (research) universities than for Fachhochschulen, but the exact ratio varies by Länder (e.g. Berlin applies a 50/50 ratio for universities and a 80/20 ratio for Fachhochschulen). The teaching component often consists of the number of students and graduations, whereas the research component is often distributed on the amount of external funding and the number of PhD graduations (Van Daalen et al., 2014).

During the past years, the funding of higher education has increasingly turned towards indicator-based funding. On top of this, Länder started to implement state-wide pacts and individual target-agreements as a complementary steering instrument. An important

²² This section is partially based on Sofka (2015).

thing to note about these target-agreements is that they are not directly linked to financial rewards and/or penalties (Van Daalen, 2014; see also De Boer et al (2015) for further description of the German situation).

12. Greece²³

Organisational funding in Greece is exclusively block funding and not based on any organisational assessment. There has been hefty opposition to evaluations and accreditations discouraging efforts to link assessments to organisational funding. Therefore, while both HEIs and PROs are subject to evaluations, the evaluation results are not linked to the budget allocation. An effort to link incremental funding to excellence in the '90s was abandoned very soon. As salaries are fixed based on formal criteria (rank and seniority) and investments and operational budgets are distributed with equal growth (or reduction) rates on the previous year's budgets there is no room for rewarding merit and excellence.

²³ Based on Tsipouri (2015)

13. Hungary²⁴

Timing and method

Several issues were elaborated and discussed in the past five years by the Hungarian Rector's Conference and other stakeholders to reform the higher education system and its financing. After the first reading by the government in mid-October 2014, the state secretariat of the Ministry of Human Capacities responsible for higher education published the draft higher education concept entitled "Changing gears in higher education. Directions of performance based development of higher education". This new concept foresees major changes in the way the HEIs are financed but does not specify how the new funding system, based on more concentrated resource allocation, will support the achievement of international quality standards in HEIs. The foreseen performance indicators of HEIs are: i) cost of teaching by specialisations, ii) cumulated number of credits, iii) increase of the competence level of students, iv) number of diplomas, v) drop-out rates and vi) scientific measures (i.e. number of publications in foreign languages, technology transfer projects, patent applications, PhDs awarded, scientific prizes).

Modality of assessment

The organisational funding allocation in Hungary is mostly based on educational metrics. Government decree 50/2008 (III.14.) regulates the calculation of the institutional funding of HEIs. The basic principles are the following:

- education support that is calculated based on the number of full time students inscribed, the type of education, level of education (i.e. BA, MA, PhD); the norms per student are differentiated by specialisations (e.g. medicine, engineering, humanities).
- research support that is calculated based on the number of teachers and researchers (FTE); number of state financed PhD students (FTE); number of qualified staff out of teachers (FTE); number of teachers that get qualified (i.e. PhD and higher scientific qualifications) in the current and previous two years; and the number of awarded scientific qualifications in the current fiscal year.
- maintenance support that is based on the size of the infrastructure.

Funding levels

The austerity measures had a major impact on the institutional funding of the higher education organisations which decreased by one-third between 2009 and 2013. The total sector got an institutional funding of €424m (HUF123b) in 2013 which corresponds to the budget of a bigger Western-European university. In 2014 the institutional funding of HEIs remained at the same level as they received a total of €469m (HUF136b). In 2015 the central budget will provide only HUF7b (a mere €23m) more compared to 2014 (a total of HUF143b). It should be noted that the decrease of institutional budgets was quite uneven among the HEIs, as the shrinking of their budget depended on the evolution of the number of students and the specialisation of the respective HEIs. The

²⁴ Based on Dory, 2015

priority was given to natural science and engineering specialisations, while the social science faculties suffered the most. At the same time, the HEIs got access to substantial funding from different Operational Programmes of the Structural Funds 2007-2014.

14. Ireland²⁵

Timing and method

There has been no legislative reform with respect to the legal framework for the allocation of funding for research and development via competitive or institutional funding channels in recent years.

The main element of organisational level funding is the block grant provided to the HEIs by the Higher Education Authority. The block grant covers core teaching and research activities within institutions; it is important to note that the internal allocation of funds as between teaching and research is a matter for each institution.

Modality of the assessment

The allocation by the Higher Education Authority of organisational level funding to the HEIs is determined on a formula basis. The allocation is based on a standard per capita amount in respect of weighted EU student numbers in four broad subject price groups. Student numbers in the four groups are weighted to reflect the relative cost of the subject groups.

Five per cent is "top-sliced" from the aggregate grant for all higher education institutions and reallocated on the basis of the number of PhD degrees awarded (75%) and the share of research income by academic staff member (25%) (Forfas, 2013). The research component of the block grant was estimated by Forfás (2013) at €162.5m in 2013.

Funding for PROs is normally determined on the basis of annual negotiations between the research organisations and their parent Government Department (ministry). Teagasc, the agriculture and food development authority, is the largest PRO and in 2013 had research expenditures of €63m — which represented almost two-thirds of GOVERD.

²⁵ Based on Martin (2015)

15. Italy²⁶

Timing and method

In 2013, organisational level funding for public HEI and research centres amounted to approx. €60m of which €38m (62%) were allocated to R&D activities and €22m (38%) to administrative activities (Italy Country Report, 2015). The share of institutional funding allocated on the basis of performance criteria rose from 7 % in 2009 to 13.5 % in 2013 and is set to increase further in the coming years (European Commission 2015a).

The Italian research system has traditionally been characterized by an institutional block funding allocation mechanism based on education metrics. Since 2014, important changes have been implemented towards more performance-based funding mechanisms on the basis of a metric informed peer review exercise called VQR which was coordinated by ANVUR and completed in 2013.²⁷ The ANVUR was created in 2010 following a law passed in 2006 with the aim to improve the performance of the Italian research system. A previous evaluation of universities, the VTR, for the period 2001-2003 was performed in 2006, but had limited financial consequences.

At the end of 2014 the new ordinary funding plan (FFO) for universities was published by the Ministry of Education, Universities and Research (MIUR), and the 'Stability law' on budget allocations for 2015 was approved by Parliament (MIUR, 2014). These measures introduce a €150m increase of FFO over 2013 values that however incorporates 'merit funds' and other resources that were previously in separate budget lines. At the same time the government spending review cuts €34m from university purchases of goods and services.

Modality of the assessment

The funding plan of MIUR introduces two new mechanisms for the distribution of funds among universities. First, 20% of the FFO is distributed among universities on the basis of a 'standard cost' per student, with a new (but not yet tested) mechanism of resource allocation. Second, 18% of the FFO will go to 'better performing' universities, and is distributed in the following way:

- for 70% on the basis of their performance in the ANVUR quality assessment review (ANVUR, 2013);
- for 20% on the basis of their recruiting policies (scientific production of the professors that are recruited or promoted assessed by ANVUR);
- for 10% on the basis of the relevance of international teaching activities, combining the presence of foreign students and the courses followed abroad by local students.

The ANVUR based its assessment on the best research outcomes obtained by each organisations (universities and research institutes in the seven years from 2004 to 2010). The approximately 195,000 publications by 130 organisations are evaluated partly by submitting them to international experts who appraise their scientific quality, and partly by analysis of the citations received from third parties and examination of the impact

²⁶ Partially based on Nascia (2015)

²⁷ <http://www.anvur.org/index.php?q=schema-dm-vqr-definitivo&lang=it>

they have made in their respective field of research. Secondly it considers the ability of the evaluated organisation to attract funding, the number of international collaborations, patents registered, spinoffs, museums and archaeological sites, third-party activities etc.²⁸ A VQR for the period 2011-2014 is currently being prepared.²⁹

According to the European Commission (2015a), effective implementation of the PBF regimes is made more difficult by the overall decrease in higher education funding and the restrictive rules that limit the yearly change in the amount of funds allocated to each university.

²⁸ <https://www.researchitaly.it/en/understanding/overview/assessment/>

²⁹ <http://www.anvur.org/attachments/article/867/FAQ%20VQR%2021092015.pdf>

16. Latvia³⁰

Timing and method

Public expenditure per student in Latvia is among the lowest in the EU, and the present financing model of universities lacks a performance-based component (EC, 2015b). The EU Council Country Specific Recommendation 2014 included a recommendation worded as follows: "Step up implementation of the higher education reform, in particular through the establishment of an independent accreditation agency and a financing model that rewards quality. Take steps for a more integrated and comprehensive research system also by concentrating financing towards internationally competitive research institutions."

Large-scale reforms of HEIs and PROs are currently under way to improve the quality and relevance of public R&D. As part of this process, research institutions have been assessed by international experts (in co-operation with the Nordic Council of Ministers and NordForsk, undertaken by Arnold et al (2014) and the results came out in 2014. According to the assessment, only 15 out of 150 evaluated research institutes and research departments of HEIs received the highest evaluation and were recognized as international players.

As a result, as a first step, after amendments in the Regulation on "Order of calculation and allocation of institutional funding to research institutes" the number of registered institutions was reduced to 90. The reform is currently continuing with further consolidation by merging the weaker institutions with stronger ones, by consolidating similar research structures and by limiting financial support only to PROs which after the consolidation process will have more than 25 FTE of research personnel (in several specific sectors 10 or 5)(Ministry of Education and Science, 2014). In addition, the government provided (on limited competition basis) an additional €9.9 m of funds to support excellent institutes to develop their strategy and to integrate weaker institutions until November 2015 (Avotins, 2015). The reform also entails an increase by 10% of the calculated basic infrastructure grant to those research institutions which received an evaluation score 4 or 5 (i.e. are among excellent science organisations) since 1 January 2015 and excludes those whose evaluation marks are 1 or 2 (starting from 1 January 2016). There is thus a certain performance based element in Latvian public R&D funding of PROs already.

In addition, a reform of the way universities are financed is being discussed. A new quality-targeting financing model is being developed, based on the recommendations from a recent World Bank study (2014), and some performance-oriented funding will be piloted in 2015-2016. The WB recommendations suggest a three pillar model which foresees a combination of stable financing (basic funding – pillar 1) with a performance based component using a formula with performance indicators (pillar 2), and an innovation component based on three mission target agreements with the Ministry of Education and Science (pillar 3). There are no official planning documents or Latvian Council of ministers regulations regarding the above-described model so it is not yet clear if it will be adopted or not.

³⁰ Partially based on Avotins (2015)

Modality of the assessment

Latvia's policy objectives suggest a variety of output-driven performance metrics that could be part of a formula. The following indicators with across-the-board relevance for universities are considered (but subsequently require a political decision concerning priorities): number of graduates, number of PhDs, number of incoming and outgoing students and staff, a bibliometric indicator and third party funding of research and teaching (World Bank, 2014)

17. Lithuania³¹

Timing and method

In 2009, the Lithuanian Government adopted the decision on the method for allocation of budgetary appropriations for R&D for public higher education and research institutions which stipulated that a higher share of organisational funding should be linked to research performance (this decision was amended in 2010 and 2012). The Decision established that in 2010, 40% and in 2011 and subsequent years, 50% of organisational funding will be allocated to public HEIs on the basis of results of assessments of R&D activities. The remaining 50% as of 2011 are allocated as block funding on the basis of the "normative number of staff" that is approved for each institution by the decree of Minister of Education and Research. The "competitive" half of institutional funding from 2012 onwards is reallocated every three years taking into consideration the results of assessment of R&D activities.

Modality of the assessment

The ministerial decree adopted in November 2012 stipulates that assessment of R&D activities is based on four criteria:

- a) funding received from participation in international research projects;
- b) funding received from R&D contracts with business companies;
- c) public funding from participation in joint R&D projects with business companies (funding of business subcontracts);
- d) results of evaluation of research production.

The latter focuses on publications and patents and is annually carried out by LMT in accordance with the principles of international peer review. These criteria are given unequal weights for assessment of R&D activities in different fields of science. For example, results of evaluation of research production are given the highest weight in social sciences and humanities (80%) as well as physical and biomedical sciences (55%). Assessment of R&D activities in other fields of science mostly depends on institutions' capacities to attract funding from privately and internationally funded R&D projects.

It was expected that linking public institutional funding with the capacity to attract additional funding should create incentives for institutions to increase the relevance of their research programmes.

³¹ Based on Paliokaite (2015)

19. Luxembourg³²

Luxembourg does not have a system of performance based funding, but does use "Performance Contracts". These contracts specify the proportions of third party, i.e., project, vs government, i.e., institutional, funding for Luxembourg's University and PROs. The research funding allocated through performance contract is based has been based on the following indicators for the last years:

Table A3: Performance Contract Indicators and Targets

Indicator	2011-2013 target	2011-2013 achieved	2014-2017 target
Number of scientific publications (having an impact factor over 2)	558	775	1,040
Number of doctoral theses completed	91	90	167
Number of patents applied for	23	34	45
Number of spin-offs created	6	4	10

Source: MESR

³² Based on Alexander (2015)

18. Malta³³

In Malta the allocation of public research funds for higher educational institutions, government departments and research organisations does not involve performance considerations, certainly not in any formal sense. There exists no algorithm for allocation of public funds, and there is no history of institutional performance assessments to feed into such a mechanism. Funding is allocated primarily on the basis of what was allocated in previous years, and there has been no mention of changing this approach either in the national strategy or in any other document

³³ Based on Warrington (2015)

18. The Netherlands

Timing and method

A study by researchers from the Dutch Central Plan Bureau (CPB) indicates that 23 % of Dutch science funding is based on a performance based funding systems. Roughly half (11%) of this is allocated on research related criteria. According to Hick's definition (i.e. PBF is based on ex post research output assessments), the Dutch system would not qualify as a PBFS. However because it does allocate funding on the basis of the number of PhD defences (a research related output) and because it appears to consider its own system as performance based, we do include it in this category in this report. It is, however, different in nature from the systems basing their funding decisions on publication output assessments.

Since the implementation of the new Law on Higher Education and Science (MoESC, 2012), in 2012 7% of funding for higher education institutions has been based on performance agreements. This reform replaced an earlier trial of contract funding, during which contracts were signed with the university of applied science sector as a whole (Boer et al, 2015). The latter experience with collective agreements has indicated that they were not sufficiently aligned to the strategic targets of individual universities. For some they were unrealistic, for others insufficiently challenging (Boer et al, 2015). The effect of the new system still needs to be assessed. The association of universities, VSNU, has already indicated in the press that it preferred not to continue the system of performance contracts.

Separate from the funding allocation system, universities are also regularly evaluated at the level of departments/schools. In 2015 a decision was made to change the research output criteria and no longer include the volume of publications as a criterion in evaluations due to concerns over the adverse effects of publication pressure. However funding allocation decisions are not directly tied to these evaluations and this therefore does not classify as performance based funding under Hicks' definition (2012).

Modality of the assessment

In 2012 **Dutch** universities and university medical centers received around 3.8 bn euros from the central government . 41 per cent of this organisational level funding is allocated on the basis of education related criteria. 44 per cent is allocated on the basis of research parameters (though as indicated the only clear research indicator is the number of PhD theses defended. The remaining 15 per cent is allocated to Academic Medical Centers. The following criteria are used to allocate the education and research part of organisational funding (Van Dalen et al, 2014).

Education funding: (1.6 bn in 2012) funding allocation is based on student numbers and degrees (65%). The remaining 35% of education funding is based on university specific percentages and amounts which are set by the government (Van Dalen et al, 2014) .

Research funding: The part of university funding which is allocated on the basis of research parameters includes criteria for degrees (15%), PhD defences (20% or 93 thousand euro per defended PhDs, around 5 % is spend on the funding of (often inter-university) graduate schools. The remaining 60% is allocated on the basis of block funding based on historical considerations, though 2 % is set directly by the government (Van Dalen et al, 2014) .

Apart from the research universities, the Netherlands also has a system of universities of applied science. These organisations are not very research intensive (in total these 37 universities spend around 100 million euro on research) and they are funded almost entirely on the basis of education related criteria.

19. Poland³⁴

Timing and method:

Poland introduced performance based funding models in 2008. Organisational funding is divided based on the outcomes of nation-wide organisational assessments, using criteria defined by the KEJN (Committee for Evaluation of Scientific Research Institutions) and takes place every four years. Criteria are linked both to research performance and education metrics.

Modality of the assessment:

The detailed assessments include: counts of publications taking into account impact factors of specific academic journals, patents, revenues from industry co-operation and external R&D funding, normalized by numbers of R&D employees of an organization, scientific awards of researchers, patents, and financial results of commercialization of research results. In 2013, the evaluation criteria were substantially modified to further promote organizations conducting world-class research, and the evaluation process is performed using a central IT system POL-on^[1] to eliminate the risks of human error or duplication of records for researchers working at more than one scientific organization. The first assessment was carried out in 2013. The assessment in 2017 will be carried out according to updated methodology prepared after consultations with stakeholders. Only a draft of this methodology is currently available^[2]. Most important changes stem from including the strategic objectives of the Ministry of Science and Higher Education such a quality, innovation, interdisciplinarity as well as openness and internationalisation of Polish science. More points will be granted for the participation in international research projects with a special stress on Horizon 2020, receiving the HR Excellence in Research logos, the indicator on economic benefits from commercialisation was complemented with the assessment of the usefulness of the solution for the Polish economy. Changes include also the specific publication patterns in the social sciences and humanities

Funding levels:

Based on the outcomes of the evaluation, organizations fall into specific research categories. The best performing research organisations receive + A or A category, good ones B and the least performing C category. The organisational assessments are carried out at the level of separate faculties (not entire universities, i.e. worse-performing parts of a university cannot benefit from successes of other departments/faculties).

These categories and the assigned amount of organisational funding is calculated based on the status and the number of full-time researchers employed by the organization (statutory funding), with dedicated part of funds assigned for young researchers and doctoral students and costs of infrastructure maintenance. The organisational funding is expected to be used for purposes related to research and publication of research results. Beneficiary organizations apply each year for the funding, outlining ongoing research projects which would be supported from the budget, and afterwards report the results accomplished.

A formally defined algorithm determines the level of organisational funding based on: (a) the outcomes of the most recent organisational assessment and (b) the level of funding,

³⁴ Based on Klinecicz, 2015. See also Soete et al, 2015.

[1] <http://polon.nauka.gov.pl/ankieta-jednostki>

[2]

http://www.bip.nauka.gov.pl/g2/oryginal/2015_06/edd7e651544a4961aab9a394eaea8e1b.pdf

which were granted based on previous assessment. However, part (b) of the algorithm has been gradually decreasing since 2010 and disappeared altogether in 2015 with the new ordinance on financing statutory activities of scientific units ^[3]. In 2014 the block funding was still at the level of 77% of the amount received in 2013. Therefore in order to alleviate negative consequences which may stem from the first parametric assessment in 2013 in the intermediate period (till 2017) there are maximum threshold for increasing or decreasing the funding for a research institute per number of full-time researchers.

The faculties receive this funding directly from the Ministry of Science and Higher Education.

[3] <http://www.dziennikustaw.gov.pl/du/2014/1941/1>

20. Portugal³⁵

Timing and method

In Portugal, the main type of funding for public research is traditionally based on a block-funding mechanism based on education metrics. This segment of the R&I system has however lost its relative importance over the decades. This long-term process has continued more recently, as the funds allocated under this item have declined from €176m in 2011, to €154m in 2013, and to €125m in 2014. The funding of these entities did not depend on efficiency or effectiveness criteria, but it is rather based on tradition and the number of tenured personnel in each lab (RIO Country Report 2014). Evaluations were carried out in 1996, 1999, 2002, 2007 and 2013.

Modality of the assessment

A new funding arrangement, which will be effective from 2015 onwards (and based on the 2013 evaluation), will produce a multi-tiered system based on a performance-based peer review process. A total of 322 R&D units were involved in an evaluation exercise aimed to provide funding to research units according to their academic performance. The evaluation criteria were the following: Productivity and contribution to the National Scientific and Technological System, Scientific and technological merit of the research team, Scientific merit and innovative nature of the strategic programme, feasibility of work plan and reasonability of the requested budget, impact of the scientific, technological and cultural output. Seven panels, with a total of 73 experts, were in charge of conducting the evaluation.

The research units were in 5 categories (outstanding, excellent, very good, good, and fair, poor) and was carried out in two different phases. 45% of the units evaluated did not pass to the second stage of the evaluation and are expected to receive less than €1k per researcher, per year. The remaining 55% of the 322 research units under evaluation, which integrate 10,992 researchers, making up 62% of the researchers in all the evaluated units, were selected for the second stage of evaluation. The results of the second stage of the evaluation process were disclosed by the Portuguese Foundation for Science and Technology (FCT) in December 2014, with 11 units ranked as 'Outstanding', 52 as 'Excellent' and 104 as 'Very Good'.

Funding levels

The funding to be assigned to the research units evaluated in the second stage is about €70m per year. The funding per researcher rises exponentially for the units in the two top levels, with those in the 'Outstanding' bracket expected to receive €13m per year (FCT website, <https://www.fct.pt/apoios/unidades/avaliacoes/2013/index.phtml.en>). The implication of this exponential rise, is that most of the research units will now receive much less funding than before, posing a severe strain on their survival

³⁵ Based on Mira Godinho & Corado Simoes (2015)

21. Romania³⁶

Timing and method

In 2013, 59% of public funding was allocated institutionally, increasing from approx. 45% in the period 2009-2012.

Institutional funding is directed towards:

- The programme of the Romanian Academy, having as recipients the institutes of the Romanian Academy. The allocation is highly proportional to the number of researchers (the full procedure is not available on the institution's website).
- The Nucleu programme, having as recipients the National R&D Institutes. Each institute has its own Nucleu programme (portfolio of projects), reflecting the specific R&D strategy of the institute, also including objectives related to the development of the economic sector/ branch corresponding to the institute's profile. The funding decision taken by MESR reflects a prioritisation of those specific Nucleu programmes, based on the joint analysis of the previous performance of the institutes and the relevance of their R&D portfolio in relation to the development priorities of the corresponding sector/branch (the full procedure is not available on institution websites).

Institutional evaluation is extensively discussed in Romania, but a coherent system with clear implications for Performance Based Funding has not been implemented yet. One exception is the evaluation procedure for the "entities part of the national RDI system", adopted by Government Decision 1062/October 2011. The procedure was applied only to the national R&D institutes (32 in number).

For the period 2014-2020, the National Strategy (2014) attempts to correlate the criteria and amounts for funding going to national R&D institutes, Romanian Academy institutes, and universities. A dedicated programme for institutional funding was included in the draft National RDI Plan 2014-2020, which can de facto integrate the resources now spent through the Nucleu programme and add a similar stream for universities, in correlation with the financing stream of the Romanian Academy. The actual structure of the programme was not available by March 2015 and no action plan has so far been adopted.

Modality of the assessment

In 2013, the evaluation following the adoption of the Government Decision 1062/October 2011 classifies the institutes in four categories –A, B, C, D-, in turn divided in sub-categories (e.g. A+, A, A-). The results of this first evaluation have been criticized for including all the institutes in the "A" category. No information is available regarding the funding implications of this classification.

The Romanian Academy uses a similar methodology for the periodical evaluation of its institutes. The results are not publicly available.

Universities do not receive institutional funding for RDI. However, education metrics are used for the evaluation of the quality of teaching activities. A system based on "quality indicators" (i.e., 17 composite indicators referring to the teaching process, teaching staff, research etc.) is used to determine the funding allocated to universities. While theoretically they could determine up to 30% of the funding allocated, their real impact has been rather limited. (UEFISCDI, CNFIS 2013).

An alternative model based on "university classification and programme rankings" was implemented in 2011 and 2012, but it was contested by several universities for its lack

³⁶ Based on Gheorghiu (2015)

of transparency (Hotnews 23 December 2013). The “university classification and programme rankings” were also not connected directly to R&D financing, but rather conditioned the right of universities to organise master and doctoral studies

22. Slovakia

The Slovak Republic uses two types of institutional funding: (1) block funding and (2) performance based institutional funding.. Performance based institutional funding allocation is based on a system of peer review (Hicks, 2012, OECD, 2010) coordinated by the Slovak Ministry of Education, Science, Research and Sports (MESRS) (Balaz, 2015). According to Hicks (2012 citing Geuna and Martin, 2003) the Slovak system is based upon a metrics informed peer review.

The 2014 formula for allocating performance based funding to universities (€118.5m) gives a 43% weight to the R&D quality of a university (as established by the last accreditation), a 22.5% weight to the share of a HEI in the national research/arts output, a 10% weight to the share of a HEI in the national number of PhD students, a 10% weight to the share of a HEI in domestic grants, a 10% weight to the share of a HEI in foreign grants and the rest is determined by other factors (Balaz, 2015).

A considerable share of the Performance based funding allocation is thus based on the results of evaluations carried out by the Accreditation commission. This Commission approved new, more stringent rules on 15 April 2013. The new rules put more emphasis on research excellence in terms of scientific papers published/cited in journals listed in the international scientific databases (WOS, SCOPUS), research monographs published with high-quality publishers and international patents. The last evaluation took place in 2009-2010 (Balaz, 2015).

In April 2104 the Accreditation Commission also launched a pilot project to identify the top research teams in Slovak universities. Universities with research teams that are deemed excellent may be allowed to ask for higher funding from public resources (Balaz, 2015).

23. Slovenia

Slovenia uses an ex ante evaluation mechanism for the allocation mechanism of project/institutional funding. The largest share of the basic research is funded through Research Group Programme funding, a system established in 1999 to secure stability in the funding of basic research (Udovic, 2015).

The funding is allocated on the basis of a public call issued by the Slovenian research agency, but since it provides long-term support (up to 6 years) it is more stable than typical research project funding. The SRA indicates this is a clear competitive funding scheme, since it uses periodical calls and the applications are submitted by existing as well as new research groups. The applications (research proposals) are evaluated with assistance of external evaluators (Udovic, 2015).

Since this appears more a centre of excellence approach with ex ante evaluations of proposals, the Slovenian system is not considered to be a Performance Based System under the definition that was applied in this report. (Udovic, 2015)

24. Spain

In Spain the Law of Science, Technology and Innovation (LCTI) of 2011 formally simplifies the allocation of performance-based funding for research by giving the responsibility for the allocation of funds to a new National Research Agency. This agency aims to be an autonomous entity that will assign R&D funds on the ground of scientific merit. To date, its creation is, however, still pending. Organisational level funding of university is mainly based on education metrics and the payment of salaries for the teachers and researchers who are hired on civil servant contracts (Fernandez-Zubieta, 2015).

From 1987 to 1993, an "incremental" criterion was applied for funding (based on the previous year expenditures and considering changes in teaching and administrative personnel). Since 1995, regions have been responsible for university funding and applied different versions of these mechanisms (Pérez Esparrells & Utrilla de la Hoz, 2008 in Fernandez-Zubieta, 2015). According to the EUA (2015), one of these regions, Catalonia, has implemented a Research Performance Based Funding System.

The "Severo Ochoa Centres of Excellence" and "María de Maeztu Units of Excellence" Support and Accreditation is a programme of the Secretary of State for Research, Development and Innovation of the Ministry of Economy and Competitiveness that aims to promote excellence in scientific research in Spain. It selects a limited number of existing centres and units that perform cutting-edge research and are among the world's best in their respective areas. The impact and international scientific leadership of these centres and units are essential criteria. Selection is based on an ex ante evaluation of proposals and though the assessments of these proposals take into account current/past performance it is therefore not considered a PBF instrument. The evaluation and selection process is based on international peer review by three field specific committees.³⁷

Hicks (2012) and OECD (2010) consider the Spanish Sexenio programme as a sort of Performance Based Funding. Since it assesses voluntary applications from individual researchers, who when successfully assessed on the basis of a.o. research output criteria, receive a (modest) salary increase it is not considered a form of performance based funding in this report which restricts itself to organisational level funding.

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http://www.idi.mineco.gob.es/porta/site/MICINN/menuitem.7eeac5cd345b4f34f09dfd1001432ea0/?vgnnextoid=cba733a6368c2310VgnVCM1000001d04140aRCRD&lang_choose n=en

25. Sweden

Since the 1990s Sweden has had a research funding system in which the larger share of funding to public research institutions and particularly universities is allocated through competitive means (comprising project funding and organisational level funding linked to organisational assessment). A new system for the allocation and redistribution of the appropriations for research and postgraduate education to the university sector was introduced in Sweden in 2009 (Jacob, 2015).

The proportion of public funding that was annually redistributed along the new model was initially 10%, and increased to 20% from 2014 onwards. The aim of the model is to reward quality in research and give higher education institution managements the incentives to take measures to increase quality and relevance of the research undertaken at their institutions. This is done by allocating parts of the research appropriations on the basis of quality, based on two indicators: publications/citations, and external funding of research (Jacob, 2015). The assessment of research output is based on a field normalised bibliometric assessment (Kalpazidou Schmidt, 2010; Hicks, 2012).

This system also gives incentive to the universities to cooperate with the private sector since the more external R&D funds they receive from i.e. Swedish firms, the more they receive from the state through the redistribution of appropriations. The impacts are visible: as a result of the introduction of the new system, external funding from foreign firms to Swedish universities, which has been more or less constant up to 2008, starts to grow steadily. Other indicators considered include e.g. gender balance among academic staff (Jacob, 2015).

At present Sweden investigates possible future developments of the resource allocation system, which would rely on peer/expert review as well as performance/output with the surrounding society. According to this model proposed by the Swedish Research Council and currently under scrutiny, No data or indicators will directly control resource allocation, but rather all evaluation material will be assessed by panels that set grades and submit explanatory statements for their grading (Jacob, 2015).

In order to translate the evaluation results to resource allocation, the Swedish Research Council proposes that a weighting of 70 % (scientific/artistic quality): 15 % (quality enhancing Factors): 15 % (impact outside academia) is used in the calculation model together with a so-called combined volume measure, taking into account the HEI's share of the total block grant and each research area's share of the given HEI's research staff. The calculations for the three components scientific/artistic quality, quality enhancing factors and impact outside academia will be combined to give the total sum of the performance-based funding allocated to each respective HEI. The HEI is then free to allocate the funds internally as it sees fit (Jacob, 2015).

26. UK

Timing and method

The main tool for the government to steer universities, in particular in their research, lies in the grants made through the Higher Education Funding Council for England (HEFCE). The HEFCE block grant is allocated to HEIs on the basis of a mixture of formula and specific allocations. The teaching part of this grant is driven by student numbers, while the research element is largely performance-driven. The reduction in the teaching part of the grant is compensated by a substantial increase in student fee income for all HEIs. There are no individual institutional level performance contracts (De Boer et al, 2015).

Organisational level funding in the UK is almost always allocated based on organisational assessment and is therefore performance based. The main stream of support is that allocated to the universities in the HE Sector, in the form of a grant from the Higher Education Funding Council for England (HEFCE) and its equivalent bodies in the devolved administrations. This is allocated on the basis of the Research Assessment Exercise – RAE, a peer review process which produces ‘quality profiles’ for each submission of research activity made by HEIs. There were four RAEs (in 1992, 1996, 2001 and 2008). It has since been supplanted by the Research Excellence Framework (REF) which will be used for funding allocation from 2015 onwards. This performance based organisational level funding, represents about 6% of total England HEI income, and 20% of research income from all sources (Cunningham, 2015).

Modality of the assessment

Once funding levels for institutions (which are made on a subject oriented ‘cost-centre’ basis and which may apply at a sub-departmental level) have been set, these are used for the annual allocation of funding until the next round of assessment. Each unit is judged on the basis of its research quality, and those judgements are translated into figures on which performance-based allocations are made. Initially, units were given a single score, but from 2008 units were given a profile, which is the percentage of the unit judged to be at each of five levels (not excellent, nationally excellent, internationally excellent, world class, world leading) (Boer et al, 2015). A unit's research output is assessed through a system of peer review. For the 2013 REF, panels were able to use bibliometric data to help inform their decision-making, although every research output (journal article) submitted is read and assessed on the basis of its intrinsic quality rather than its bibliometric score (Boer et al, 2015). No top down instructions were provided on the use of these indicators and the use the panels made of them was different.

The first element is the assessment of the research outputs from eligible researchers. Each unit selects which staff members to submit from those staff employed at that university at the census point. A selected staff member can submit up to four publications to which they have contributed in the review period. Each of these is reviewed by at least 2 panel members (Boer et al, 2015).

The second element that is assessed is the research environment offered by the unit of assessment. The environment score is currently calculated on the basis both of the number of research students (PhDs) within the department as well as a report in which the unit presents its strategy (Boer et al, 2015)

The third element of the calculation is societal impact. Prior to 2013 the third element covered ‘Esteem Indicators’. One of the main changes implemented in the REF was that for the first time each unit also submits an Impact Case Study (Boer et al, 2015)

The overall assessment is based for 20% of the societal impact, for 65% by the quality of the output and for 15% on the statement on the research environment (the different elements are combined into an aggregate score (Boer et al, 2015).

Funding levels

The funding weight for research outputs in 2014/15 is calculated on the basis of 3 points per 5% rated as world leading (4*) and 1 point per 5% rated as world class (3*). Units whose profiles falls in the other levels do not receive points tied to additional funding. In order to reflect the differences in expenditures in different fields of research, the scores are weighted by field. Laboratory subjects, including engineering, receive a weighting of 1.6. Subjects such as history receive a weighting of 1.3 whereas e.g. research in the humanities receives a weighting of 1. The total performance based funding an institution receives is calculated as the sum of the total adjusted funding weights of its constituent departments. This institutional funding weight is then used to calculate the share of the £1bn mainstream performance based funding. The remaining funding is distributed separately (Boer et al, 2015).

27. Some data for comparison with third countries

Most of the US states have introduced some form of performance based funding for their universities. However, in most of the states this is based on education metrics only and would thus not be considered under the definition that we have adopted in this project:

<http://www.ncsl.org/research/education/performance-funding.aspx>

Some (former) members of the Commonwealth, including Hong Kong (RAE), Australia (ERA) and New Zealand (PBRF) have a long tradition in performance based funding of universities (Hicks, 2012; De Boer et al, 2015, Buttler, 2003, 2010).

Norway, already mentioned as an example in some parts of the text is one of the European countries with a long tradition in performance based funding of universities (for further information on this system see a.o. Sivertsen, 2010, 2015, Schmidt, 2010, Frohlig and Sivertsen (2010) Michelsen & Aamodt 2006).

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