Performance-based university research funding systems☆

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ABSTRACT

The university research environment has been undergoing profound change in recent decades and performance-based research funding systems (PRFSs) are one of the many novelties introduced. This paper seeks to find general lessons in the accumulated experience with PRFSs that can serve to enrich our understanding of how research policy and innovation systems are evolving. The paper also links the PRFS experience with the public management literature, particularly new public management, and understanding of public sector performance evaluation systems. PRFSs were found to be complex, dynamic systems, balancing peer review and metrics, accommodating differences between fields, and involving lengthy consultation with the academic community and transparency in data and results. Although the importance of PRFSs seems based on their distribution of universities' research funding, this is something of an illusion, and the literature agrees that it is the competition for prestige created by a PRSF that creates powerful incentives within university systems. The literature suggests that under the right circumstances a PRFS will enhance control by professional elites. PRFSs since they aim for excellence, may compromise other important values such as equity or diversity. They will not serve the goal of enhancing the economic relevance of research.

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1. Introduction

The Research Assessment Exercise (RAE) in the UK was launched in 1986, since then many countries have followed suit and introduced performance-based research funding systems (PRFSs). At least fourteen such systems were found in 2010. Such widespread adoption represents a shift in national research policies of some significance since universities are so central in national innovation systems. Going forward, to understand the evolution of national innovation systems one must address the design and execution of PRFSs. To advance our understanding of research policy and its effect on national innovation systems, we must build an understanding of PRFSs in general. This necessitates stepping back from the intricacies of individual systems and taking a broad perspective on PRFS characteristics and the challenges they face as instruments of research policy.

PRFSs are highly intricate, dynamic and embedded in national research systems; therefore any general understanding will only be possible through the collective effort of scholars who understand each system in depth. As experience with PRFSs has grown, along with the salience of the exercises for funding and success, a rich tradition of critique and discussion has emerged, particularly in the UK and Australia. This literature is nation-specific and usually discipline-specific. Building on the national literature, Geuna and Martin (2003), Dolan (2007) and the European Commission (2010) took an international perspective offering comparative descriptions of various systems. This analytical review attempts to further this collective effort by identifying common themes emerging from in-depth analyses of individual PRFSs.

Note that understanding the literature on PRFSs requires acknowledging the dual identity of university research. On the one hand, university research is part of the larger enterprise of the university and is shaped by university governance and university-related policy making. On the other hand, university research is a substantial element of every national innovation system, and so is of concern to scholars of innovation and to governments seeking to enhance the innovativeness of their economies. These two perspectives on PRFSs differ somewhat. The higher education literature treats the research mission of universities in a somewhat sketchy fashion towards the end of documents that are mainly concerned with accreditation, completion rates, harmonisation, etc. The innovation literature tends to ignore the educational mission of universities and the changes under way in the allocation

Table 1
National performance-based research funding systems for universities.

Country	System	Year implemented/major revision	Agency
United Kingdom	RAE moving to REF – research excellence framework	1986/current	Formerly Higher Education Funding Council for England (HEFCE), now Department of Business, Innovation and Skills
Spain	*sexenio*	1989	National Commission for Evaluation of Research Activity (CNEAI)
Slovak Republic		1992/2002	Ministry of Education
Hong Kong, China	RAE	1993	University Grants Committee
Australia	Composite Index, Research Quality Framework (RQF), Excellence in Research for Australia (ERA)	CI – 1995/ERA – 2010 (next scheduled for 2012)	Australian Research Council (ARC)
Poland	Parametric evaluation	1991/1998–99	Science Council – advisory body to the Minister of Science and Higher Education
Portugal	Research Unit Evaluation	1996	Science and Technology Foundation
Italy	Valutazione Triennale della Ricerca (VTR)/Valutazione Quinquennale della Ricerca (VQR)	Evaluated 2001–03 in 2006 (VTR), Evaluation of 2004–2008 (VQR) to be conducted	Agency for the Evaluation of University System and Research (ANVUR)/CIVR
New Zealand	Performance-based research funding (PBRF)	2003/current	Tertiary Education Commission
Belgium (Flemish Community)	BOF-key	2003/2008	Steunpunt O&O Statistieken (SOOS)
Norway	Norwegian model (new model for result-based university research funding)	2006	Ministry for Research and Education
Sweden	New model for allocation of resources	2009	Ministry of Education with some methodological support from the Swedish Research Council
Denmark	Implementation of the Norwegian model	Current	
Finland	Funding formula for allocation of university resources	1998/2010	Ministry of Education

of the teaching component of university funding. Although this paper takes the innovation perspective for the most part, the analysis draws from the higher education literature a framework for understanding the introduction of PRFS as part of new public management, a movement to reshape government.

This overview of PRFSs begins by defining and identifying existing systems, even systems that have not yet been discussed in the English language literature. The rationales underpinning PRFSs will be explored from the scholarly perspectives of the innovation and higher education literatures as well as from the perspective of policy makers. A typology of PRFSs is developed and then common challenges are identified. Issues of autonomy and control reoccur regularly in PRFS discussion and these are discussed before final thoughts on the future of these systems are offered.[1] I am guided throughout by the question: Are there common lessons for innovation policy to be drawn by stepping back from the details of individual systems to frame university performance based research funding systems more generally? The basis of the analysis is a literature review conducted in early 2010 that sought to identify all known PRFSs and draw out as much detail on their operation as possible in order to compare the rationale and design of PRFSs and their relation to funding systems.

2. Performance based research funding systems defined and listed

Research is evaluated in many places, by many types of organizations, for many different purposes. This heterogeneity can confound attempts to produce a coherent review. To avoid this, I begin by narrowly defining the PRFS and listing systems that meet or will meet the narrow definition. Systems included in this review met the following criteria:

- **Research** must be evaluated. Evaluations of the quality of degree programmes and teaching are excluded.
- Research evaluation must be *ex post*. Evaluations of research proposals for project or programme funding are *ex ante* evaluations and are excluded.
- Research **output** must be evaluated. Systems that allocate funding based only on PhD student numbers and external research funding are excluded.
- Government distribution of research **funding** must depend, or will soon depend, on the results of the evaluation. *Ex post* evaluations of university research performance used only to provide feedback to universities or to the government are excluded.
- It must be a **national** system. University evaluations of their own research standing, even if used to inform internal funding distribution, are excluded.

The first PRFS was introduced in 1986 in the United Kingdom – the Research Assessment Exercise (RAE). Use of PRFSs has expanded since, and by early 2010, 14 countries were found to have launched PRFSs that conform to the above definition or to be planning to launch a PRFS (systems in the design phase are included). These systems are listed in Table 1 which reports the country, the name of the system, year the system was introduced and the ministry or agency responsible. In general PRFSs are run by Ministries of Education or Ministries of Education and Research. In a few cases – Flanders in Belgium, Italy and Spain – dedicated agencies were established to run the evaluation, and in Australia the Research Council runs the system. The systems are not static. Most have undergone major redesign. In fact new versions of seven systems are under

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discussion or in the first stages of rollout. This means that it is important to be aware of the version of a system when reading about a PRFS.

The universality of evaluation combined with the variety in its implementation means that a number of countries have related systems or have discussed such a system but did not meet the criteria for inclusion. In France, the government established AERES, the Evaluation Agency for Research and Higher Education, to conduct comprehensive evaluations of university degree programs and research in response to the Bologna process. The peer review evaluations involve site visits and dialogue with the aim of improving the quality of the university system. In Germany the federal government seems to be pursuing some goals of performance-based funding, such as international excellence, by awarding large centres of excellence to universities based on assessment of proposals (CHEPS Germany, 2007, 37-38).The Netherlands implements an evaluation system based on peer review which is not used to inform distribution of funding (Geuna and Martin, 2003). In South Africa the Foundation for Research and Development conducts evaluations of individuals' research record. Peer-reviewed grants of quite lengthy duration are awarded based both on this *ex post* evaluation and on peer review of proposals.

3. Rationales

The rationale of performance funding is that funds should flow to institutions where performance is manifest: 'performing' institutions should receive more income than lesser performing institutions, which would provide performers with a competitive edge and would stimulate less performing institutions to perform. Output should be rewarded, not input. (Herbst, 2007, p. 90)

Although seemingly straightforward, the motivations behind PRFSs do contain a few nuances. Broadly speaking, different parties evoke seemingly different types of rationales when explaining the introduction of national research evaluation systems. Those primarily concerned with understanding research and innovation tend to speak of globalisation, competitiveness, and the knowledge economy. Those who study higher education and who are mainly concerned with education, accreditation and the like tend to trace the introduction of these systems to the spread of the tenets of new public management. Discussions of the introduction and evolution of individual systems tend to take a historical turn, focusing on changes in government, ministerial actions and stated rationales of particular governments (Jiménez-Contreras et al., 2003; Sanz-Menendez, 1995; Tapper and Salter, 2003). National governments themselves seem to uniformly aspire to achieve research "excellence" through their PRSF. Of course, each approach addresses the same phenomenon from a different angle. For example, Kettl traces the widespread introduction of new public management reforms to a shared set of political, social, economic and institutional challenges faced by many governments. These include the shift from the industrial economy to the information economy and globalisation (Kettl, 2000).

An example of the global competitiveness argument can be found in the introduction to the European Commission report, *Assessing Europe's University Based Research*:

. . .research performance is widely regarded as being a major factor in economic performance. Because of their interlinked roles in education, research, and innovation, universities are considered key to the success of the Lisbon Strategy with its move towards a global and knowledge-based economy. Improving the capacity and quality of university-based research is thought to be vitally important for innovation, including social innovation. . .

The economic dimension of (university-based) research in terms of expected economic and societal benefit and increased expenditure goes a long way to explain the heightened concern for quality and excellence in research, for transparency, accountability, comparability and competition, and for performance indicators and assessment. (European Commission, 2010, p. 9)

A very similar statement can be found on the UK government website introducing the new REF (Research Excellence Framework):

Through the REF, the UK funding bodies aim to develop and sustain a dynamic and internationally competitive research sector that makes a major contribution to economic prosperity, national well-being and the expansion and dissemination of knowledge. (HEFCE, 2011)

In contrast, higher education authors often view the changing relationship between universities and their government in the context of new public management reforms (for example, Herbst, 2007). Donald Kettl is a leading analyst of new public management, and in a nutshell his view is the following:

Over the past quarter century, governments around the world have launched ambitious efforts to reform the way they manage. Citizens have demanded smaller, cheaper, more effective governments while asking for more programs and better services. To resolve this paradox, governments are experimenting with many ideas to improve performance and production and to reduce costs. . . Reviewing the standard strategies and tactics behind these reforms, [Kettl's The Global Public Management Revolution] identifies six common core ideas (Kettl, 2005):
  – *greater productivity*
  – *more public reliance on private markets*
  – *a stronger service orientation*
  – *devolution to sub-national government*
  – *increased capacity to formulate and evaluate policy*
  – *enhanced accountability*

Performance-based funding systems for public research in universities can be interpreted in light of these six core ideas (Kettl, 2000):

- *Increasing productivity*: Output-based evaluation aims to increase research output without adding research resources to the system, thus increasing productivity.
- *Replacing traditional command-and-control systems with market-like incentives:* In many nations, universities were not autonomous and were often little more than extensions of their ministry. In Whitley's terms they were "administrative shells" (Whitley, 2008, p. 12), or as Herbst describes it "government agencies were practically distributing funds down to each individual faculty member. . . Until recently, we may claim in jest, a typical Rector's office just had a yearly budget to pay for various banquets" (Herbst, 2007, p. 87). Universities had no discretionary budget and did not control hiring, tuition, student numbers, etc. The shift to performance-based funding is part of a broader movement to make universities more autonomous and introduce more strategic university management. This also involves competition for funding – the market-like side of the reform.
- *Stronger service orientation*: This dimension refers to increased attention to the needs of citizens. In the research world this would be analogous to giving more weight to serving the needs of the high-technology economy and less to the self-governed programmes of work of the community of scholars subject only to peer validation (Marginson, 1997, p. 69).

- *Devolution*: The idea here is that programmes are more responsive and effective when managed closer to the provision of services. In the university world this means making universities autonomous, strategically managed entities rather having all key decisions taken by ministries.
- *Formulating policy*: This refers to a shift from formulating policy and delivering the service to formulating policy and contracting for the service. The government as purchaser of "education services" was explicitly articulated in the Australian context (Marginson, 1997, p. 71).
- *Enhanced accountability*: This means focusing on outputs and outcomes rather than processes and structures. Measuring research output and distributing funding on the basis of results is clearly meant to enhance accountability compared to the prior method of basing funding on numbers of faculty.

Note that although implementation of a PRFS is related to new public management, it is not an exemplar. Important new public management characteristics such as increased use of contracting play little or no role in PRFSs.

The rationales provided by individual governments for their PRFSs are worth examining briefly because they reveal national differences in priorities due to the pre-existing state of university research in each country. In the United Kingdom, greater selectivity in funding allocation was initially an explicit goal of the RAE. Selectivity was a government response to limited resources and the increasing costs of research. The goal was to maintain research excellence but at fewer places (Tapper and Salter, 2003). Sweden also looks to concentrate resources, believing that international competition requires concentration and priorities to maintain high scientific quality (European Commission, 2010). The goal of the Spanish *sexenio* as stated in law is to foster university professors' research productivity and improve the diffusion of this research both nationally and internationally. Fostering international publication was an explicit goal of Spanish science and technology policy more generally, and overall the policies have been successful (Jiménez-Contreras et al., 2003).

Excellence appears frequently as a goal. In Australia the stated goal of the new ERA system is to identify and promote excellence across the full spectrum of research activity, including discovery and applied research, in Australia's higher education institutions (ARC, 2009, p. 11). In New Zealand, the primary purpose of the PBRF is to ensure that excellent research in the tertiary education sector is encouraged and rewarded (New Zealand, Tertiary Education Commission, 2010). In Norway the goal is to increase research activities and allocate resources to centres performing excellent research (European Commission, 2010, p. 120). Sivertsen reports the goal of the Norwegian publication indicator to be "to measure and stimulate the research activity at the level of institutions and to enhance the focus and priority they give to research as organizations" (Sivertsen, 2009, p. 6). Government statements of PRFS rationale thus reveal several independent themes: resource concentration, encouraging international (*i.e.* English-language) publication and the general pursuit of excellence. While the resource concentration theme bears some similarity to the search for increased efficiency of new public management reforms, research excellence is more reminiscent of the newer "public values" movement (Stoker, 2006).

4. Typology and timelines

Performance-based research funding systems vary in their unit of analysis, methods of measurement, frequency and census period. Individuals, research groups, departments and universities are all possible targets for evaluation. Research groups are the unit of evaluation with the best theoretical support because research is conducted by groups, not by individuals or departments. Departmental level PRFSs are routinely criticised because of this (see for example Herbst, 2007, p. 91). The recent assessment of university research evaluation in Europe by an expert working group of the European Commission makes a best practice recommendation that groups, or "knowledge clusters", be the preferred unit of analysis (European Commission, 2010, pp. 38–39). However, research group evaluation is probably impossible to implement on a national scale because there are so many groups and their boundaries are fluid and indistinct. The Australian RQF proposed evaluation at the research group level. This elaborate exercise was the result of an extensive consultation and design exercise, but was abandoned by a new government before implementation in favour of the ERA, which emphasises simplicity. Because the ideal research group level evaluation is impractical, actual PRFSs will always be subject to criticism. However, departmental and university level PRFSs have proved their worth in practice and while imperfect, can be considered quite sound and usable.

The more practical and thus widely implemented unit of analysis is the department or the analogous field-in-university. The UK RAE evaluates university departments; the Portuguese evaluate research units; the Australian ERA and Italian VTR/VQR evaluate fields in universities. In the RAE the results by department are published but are aggregated to the university level in order to award a single block grant to each university. In Poland faculties within universities are evaluated and money is awarded to faculties directly by the Ministry of Science and Higher Education. The Slovak Republic also appears to conduct its evaluation at the field-in-university level.

A minority of systems evaluate individuals or universities. Two evaluate individuals – the Spanish *sexenio* and the New Zealand PBRF. The *sexenio* results are used to increase the salaries of individuals achieving a high grade. The PBRF results are aggregated into a rating for universities used to allocate block funding. Evaluations at the university level were produced by the old Australian Composite Index and have been adopted by the Norwegian and Danish PRFSs.

The methods used in assessment correlate with the unit of analysis. Peer review is used for individual evaluations in Spain and New Zealand. Peer review is also used for departmental and field evaluations such as the RAE, VTR/VQR and Portuguese evaluation. The RAE reviews are informed by narratives submitted by departments. In Portugal, evaluation committees visit all units, in addition to studying their activity reports. In ERA, fields have the option of using peer review or metrics. University-level evaluations rely on quantitative formulas. Such formulas use bibliometric output information but differ as to whether papers alone are counted or whether citation information is also included. The Australian Composite Index and the Norwegian and Danish systems employ paper counts only. However, Butler identified a weakness in simply counting papers, in that it encourages a move to lower quality journals to increase publication frequency (Butler, 2003). Therefore the Norwegian and Danish systems use an enhanced method in which 10% or more of journals are assigned to a higher quality category and given extra weight in the formula. Spain incorporates the Thomson-Reuters impact factor in its deliberations. Systems using citation information include ERA, the Slovak Republic, Sweden and Belgium (Flemish Community). Spain's *sexenio* includes self-reported impact information such as citations or journal impact factor. The formulas include a range of other measures in addition to publication output including: employment of graduates; external research funding; faculty characteristics and qualifications; faculty size; graduate students graduated; implementation/application of research; international memberships; student load.

PRFS timelines vary, both in the frequency of evaluation and the census period over which data is gathered. University level, indicator based evaluations tend to occur annually, with peer review evaluations less frequent. The Australian Composite Index and the Norwegian model require annual data submissions to calculate the following year's budget allocation. The second Australian ERA will be conducted in 2012, two years after the first. The Slovak Republic evaluates every three years (Geuna and Martin, 2003), Poland no less frequently than once every five years (in practice every four years), and Spain every six years (hence *sexenio*). Italy conducted an evaluation in 2006 using 2001–03 data and used the results to allocate funding in 2009 (European Commission, 2010, p. 116). Evaluations are not necessarily conducted on a regular schedule. The first two rounds of New Zealand's PBRF and Hong Kong's RAE were conducted at three-year intervals. The next are scheduled at intervals of six and seven years, respectively. The interval between RAEs has increased from three to four, five and then seven years.

Census periods reveal no pattern. The Australian Composite Index and the Norwegian model base calculations on one year of data. The VTR was based on three years of data, the VQR will be based on five years, Poland and Portugal four years, Hong Kong basically four years, the PBRF five years, the *sexenio* six years. ERA uses six years for bibliometric measures and three years for other indicators. RAE 2008 used publications from a seven-year period. The BOF-key is based on ten years for bibliometric measures and four years for non-bibliometric measures (see Poland, Ministry of Science and Higher Education, 2010; Hong Kong, China, UGC, 2006, p. 11; Hodder and Hodder, 2010; ARC, 2009, p. 13; Debackere and Glänzel, 2004, p. 268; CIVR, 2011).

Table 2 summarises this information in a broad typology of systems based on the unit evaluated and method used: individual/peer review, research group (theoretical, not realised), department or field in university/peer review, university/indicator based. A further subdivision based on type of bibliometrics used is included. The typology is simplified because non-bibliometric metrics are not considered, nor is the unit to which funding is allocated.

5. Challenges

PRFSs exhibit similarities in design because they face similar challenges. Peer review is held in high esteem as it is well accepted by the academic community in every country. However, being expensive and time consuming, it is used irregularly. As a result, funding decisions may be based on out-of-date information. Arguably departmental or field level PRFS using peer judgment

based on indicators represents the state of the art. ERA is implementing this method.

University-level evaluation is metric-based and conducted annually using bibliometric methods. As these are not much liked by the academic community, governments that propose them may face heavy criticism. In smaller nations, the ability to handle very large datasets has made possible departmental-level bibliometrics that are national in scope. However, the departmental affiliation of authors, as indicated on papers, is often ambiguous, and cleaning the data is onerous (Debackere and Glänzel, 2004). When funding is allocated on the basis of such data, they must be absolutely clean, because universities would invest much time in challenging their allocations if errors were found. A key advance in the PRFS bibliometric method is the introduction of weighted categories of journals. PRFS frameworks now assign higher weights to the top 10–20% of journals.

PRFSs are challenged by differences in the patterns of fields' output. Counting journal articles indexed in databases such as Web of Science or Scopus works for scientific fields but is inadequate for social sciences and humanities, both because the indexing of social science and humanities journals is inadequate and because scholars in these fields produce more than English-language journal articles (Hicks, 2004; Hicks and Wang, 2009). For these reasons the Norwegian model, though metrics-based, does not simply count indexed publications but is based on a national research information system of university submissions of outputs. Peer review systems convene field-based committees that generally have latitude for developing appropriate standards of judgment for their field (Poland, ERA, RAE, VTR). The ERA suite of indicators varies by field, with scholars in each field choosing the most appropriate metrics for their field. The Swedish formula contains an intricate field-weighting system. Spain's *sexenio* permits submissions to include a broader range of publication types in social sciences and humanities, though there are indications that this does not work very well in that the applications of social scientists are less likely to be approved than those of scientists, and success rates have not increased over time (European Commission, 2010, p. 122; Jiménez-Contreras et al., 2003, p. 138).

The state-of-the-art in PRFS design incorporates highly consultative processes in which the government gathers input from universities using comment periods, and evaluation processes are designed by expert panels made up of representatives of university or field-based associations. This was not the case initially; the first UK RAE and the Australian Composite Index were imposed. However, in the United Kingdom an extensive public discussion of the RAE ensued. Studies of effects were commissioned and the design

Table 2
Bibliometrically oriented classification of PRFSs.

Unit of evaluation	Method	Country and system	Frequency	Census period
University	Indicators – paper counts	*Australia Composite Index*[a]	1	2
		Denmark	1	
		Finland	1	
		Norway	1	1
	Indicators – paper and citation metrics	Flanders, Belgium	1	10
		Poland	5	4
		Slovak Republic	3	
		Sweden	1	
Department or field	Peer review	*UK RAE*	3, 4, 5, 7	8
		Italy VTR		3
		Portugal	3	4
	Peer review informed by metrics	Australia ERA	2	6
		Italy VQR		5
		Poland	5	4
Group/never implemented				
Individual	Peer review	Spain – sexenio	6	5
		New Zealand PBRF	3, 6	5

[a] Countries/systems in italics represent older versions of the PRFS.

process for the RAE's replacement included extensive formal consultation. Similarly in Australia the design of both the RQF and the ERA involved "exhaustive consultation with researchers and the 39 universities in the Australian system. There is a strong requirement of procedural fairness and transparency and acceptance by key stakeholders" (European Commission, 2010, p. 86). In Denmark years of discussion did not lead to a consensus, thereby preventing the introduction of a PRFS. Lately the discussion has moved forward and the introduction of the Norwegian system is being designed in collaboration with the research community (Fosse Hansen, 2009). In Poland the regulations governing the PRFS are being revised and comments have been solicited from the heads of academic units. The Norwegian model was designed by the ministry in consultation with the university sector, represented by the Norwegian Association of Higher Education Institutions (*i.e.* Rectors' Conference), and this body has on going responsibility for the publication indicator (Sivertsen, 2010, p. 2). The increased consultation in PRFS design may signal a shift from the new public management origins of the RAE and the Composite Index to the newer public values/networked governance model in which extensive consultation with stakeholders is preferred (Stoker, 2006).

Most systems emphasise transparency of methods and data. Instructions to universities concerning their submissions are easily available over the Internet as are the formulas used to convert measures into final rankings, grades or weights. The final grades are publicly available as well, again often posted on government websites. In Norway and the RAE 2008, all university submissions are public. The public nature of the results means that they are often used by others, picked up by the media and used in other funding decisions such as internal university allocation of funds or as one factor considered in awarding research grants. Individual grades are used in tenure decisions in Spain. In this respect, Australia lags the state of the art as all requests for access to ERA data have been refused and the weightings given to various components of information available to committees are not known.

Notable in PRSFs is a tension between complexity and practicality. The RQF goal of assessing at the level of the research group was too complex to be practical. The complexity of submissions required by the RAE increased over the years, and departments elaborated their submissions over time in an effort to become more competitive. This raised questions about the cost/benefit ratio of the exercise, and the UK government initially proposed a metrics-only future in the REF (Martin and Whitley, 2010). Complexity emerges in these systems as a response to consultation which produces pressures for fairness across heterogeneous academic disciplines. In Hong Kong extensive consultation prior to the 1999 RAE resulted in a broadening of the activities assessed from research only to include research-related scholarly activities: discovery, integration, application and teaching (French et al., 2001, p. 37). Presumably, complexity increases easily in the absence of any accounting of the full cost (see below).

To recognize that complexity increases over time is to acknowledge that PRFSs are dynamic systems. Heinrich and Marschke (2010) argue that public sector performance evaluation systems are inevitably dynamic, though not often viewed as such. They use a principal agent theoretical framework to interpret studies of performance evaluation in other areas of public policy arguing that:

> Performance incentive system designers also need to appreciate and confront the evolutionary dynamic that appears to be an important feature of many performance measurement schemes. As illustrated, an incentive designer's understanding of the nature of a performance measure's distortions and employees'

means for influencing performance is typically imperfect prior to implementation. It is only as performance measures are tried, evaluated, modified, and/or discarded that agents' responses become known.

> Of course, a complicating factor is that performance measures can be gamed. Agents (or employees), through their day-to-day experience with the technology of production, come to know the distinct weaknesses or distortions of performance measures and how they can exploit them. If it takes the agent time to learn how to game a new performance measure, an equilibrium solution may be a periodic revision of performance measures or a reassignment of agents. However, if both principals and agents are learning over time, the dynamic is likely to become more complex. And depending on the relative speeds of principal and agent learning and the extent to which performance measures degrade over time, this dynamic to measurement systems will not necessarily end. (Heinrich and Marschke, 2010, p. 203)

The PRFS experience supports Heinrich and Marschke's argument that performance incentive systems are dynamic: the RAE changes with every iteration, most recently becoming the REF; the Composite Index is discarded in favour of ERA; the VTR becomes the VQR. Butler's analysis of changes in Australia's publication profile after the introduction of the Composite Index provided particularly compelling evidence of agent learning (Butler, 2003). The adoption of tiered journal classifications in subsequent PRFS designs illustrates the response of principals. The discarding of ERAs tiered journal classification in May 2011 suggests that PRFSs are characterized by perpetual modification in response to university learning (Carr, 2011).

PRFS designers face a common set of challenges. A balance must be struck between peer review and metrics that will depend on the unit chosen for analysis, and although peer review is better accepted; metrics enable broader scale and more current results to be used in funding decisions. One size does not fit all: PRFSs must accommodate differences across fields, particularly differences between the sciences, social sciences and humanities. Lengthy consultation with the academic community and transparency of data and results are highly valued. Systems will be dynamic, and complexity will increase over time. As complex as these challenges are, every PRFS resolves them. This stands in stark contrast to the assessment of costs versus benefits.

6. The impossibility of assessing costs and benefits

An analytical comparison of PRFSs would assess costs and benefits of these systems. At present, this is impossible for two reasons. First, costs are not discussed. Second, there are no standards for reporting the amount of university funding dependent on the PRFS.

The costliness of the PRFS should be a concern for any government. PRFSs incur indirect costs for universities that compile submissions and direct costs for the evaluation of those submissions. The RAE and VTR incur heavy costs in faculty time because they are peer-review exercises. The RAE in 2001 involved 70 panels of 10 or more members convened to work on assessing 180 000 publications, which made the exercise expensive. Panels were expected to read papers, though given the impossibility of comprehensive reading, thoroughness varied (Harman, 2000, p. 115). One author noted that the exercise was conducted as if it was to appraise 50 000 individual researchers and their 180 000 pieces of work in order to make 160 funding decisions (Sastry and Bekhradnia, 2006), which seemed disproportionate. There were also indirect costs borne by departments whose efforts for preparing submissions increased with each round. A particularly clear cost statement was found for the Italian exercise which took place in 2006:

"The evaluation involved 20 disciplinary areas, 102 research structures, 18 500 research products and 6661 peer reviewers (1465 from abroad); it had a direct cost of 3.55 million Euros and a time length spanning over 18 months." (Franceschet and Costantini, 2009, p. 1)

The VTR panels were expected to assess the quality of each of the 17 300 unique written works submitted, 2900 of which were books. Two reviewers were assigned to assess each work independently. If every reviewer fully fulfilled their mandate, 5800 reviewers read a book in addition to the four articles they were assigned. Is it any wonder that the intervals between the RAEs increased over time or that a second VTR is only now being mounted?

Indicator-based systems also incur substantial direct costs. The direct costs of indicator-based exercises include establishing and maintaining a national research documentation system, buying citation information from database providers, data cleaning and validation, and indicator calculation. As these data systems are intricate and large, the costs are considerable. Auditing of submissions is also necessary because fraudulent submissions could be used to increase funding allocations. Audits of Composite Index submissions were conducted by KPMG and found a high error rate (34% in the second audit in 1997); 97% of errors affected final scores and thus funding allocations (Harman, 2000, pp. 118–119). If costs were articulated, some consideration could be given to cost/benefit ratios.

PRFSs are used in decision making concerning the distribution of block grants to universities. They replace methods of distributing block grants including using a historical basis, *i.e.* the previous year's allocation, or formulas based on faculty or student numbers. Knowing the amount of funding allocated using a PRFS is crucial to understanding the effect of PRFSs on universities and on the innovation system. Somewhat surprisingly it is difficult to obtain consistent information on this from the literature. The amount of funding distributed based on a PRFS can be defined in many ways, and there is no consistency among authors in their reporting. Reported figures include shares of:

- total university resources (government plus other funding);
- government funding for universities (block grant plus research grants and contracts);
- block grant or "general university funds" (GUF);
- research resources (total or government).

Introducing research performance into a funding formula likely entails splitting the traditional block grant into teaching and research components. The research component might include research output assessment as well as graduate student numbers and amount of outside funding raised. So despite the high profile of the PRFS, its role in allocating funding may be deeply buried in a complex formula.

It is not entirely obvious which figure is most relevant to assessing the impact of the PRFS on a university. Would it be the average across all universities, the share only in the most research-intensive universities, or the highest and lowest shares in the system? Are static snapshots less interesting than trends over time? Finally, the amount that moves between universities in any two years might be most illuminating. Ideally, each of these figures would be available for every university system for current and past allocations. Table 3 reports the limited information that was found.

Some information on time trends is also available:

- In Belgium (Flemish Community), the block grant for universities is divided into three parts: general, basic research (BOF) and applied research (IOF), and 45% of general and BOF are allocated according to a formula called the BOF-key. The weighting given

Table 3
Share of university funding dependent on PRFS.

Country	Share	Of what	In year	Source
Australia	6%	Total revenue[a]	2008	Australian Government Department of Education, Employment and Workplace Relations (2009), Table 1
Italy	2%[b]	Block grant	2009	European Commission (2010, p. 115)
New Zealand	10%[c]	Block grant	2010	Tertiary Education Commission (2010)
Norway	2%	Total funding	2008	Sivertsen (2009, p. 6)
Slovak Republic	15%	Total funding	2006	Strehl (2007, p. 41)
UK	25%[d]	Research support	2006	Various

[a] Total revenue from all sources including national and state governments, student fees, royalties, donations, industry, etc.

[b] This is calculated as follows: 7% of the block funding to universities (FFO, Fondo di Finanziamento Ordinario) is allocated according to a performance formula of which research comprises two-thirds of the total (and teaching one-third). Of this, 50% is in proportion to the grade received by the university from VTR in 2006

[c] In New Zealand the research output evaluation comprises 60% of the PBRF, which is one of six Tertiary Education Organisation Component (TEOC) funding elements

[d] The RAE informs the distribution of a block grant which comprised 36% of support for science and engineering R&D in UK universities in 2004–05 (Department of Trade and Industry [DTI], and Office of Science and Innovation, 2007). General support for university research is allocated largely, but not entirely, on the basis of RAE ratings. Other criteria such as supporting new subjects or making allowance for the higher cost of living in London also play a role. In 2006–07, the Higher Education Funding Council for England (HEFCE) allocated 70% of its general support using RAE-linked criteria (HEFCE, 2006). Just prior to 2008 approximately 25% of all research support in UK universities appears to have been allocated to universities based on the RAE ratings of their departments. RAE-based allocations are quite stable. By 2001 the marginal impact of the RAE on university finances was small. Sastry and Bekhradnia (2006) calculated that as a result of the 2001 RAE, only one institution saw its total revenues affected by more than 3.7% and the median impact was less than 0.6%.

to the evaluation of research outputs in the calculation of the BOF-key rose from 0.10 in 2003 to 0.30 in 2006 (Debackere and Glänzel, 2004, p. 268; Luwel, 2010).
- In Poland the proportion of research funding distributed in block grants is likely to decline as the government promises to increase the share dedicated to competitive awards (Pain, 2010).
- In the Slovak Republic, government funding for research in universities more than doubled between 2002 and 2005. At the same time, the share of block funding allocated according to evaluated research performance as well as the "quality of development projects" increased from 9.7% to 23.1% at the expense of historical allocation and allocation according to evaluated teaching performance (Strehl, 2007, p. 113).
- In the United Kingdom, the share of university resources from RAE-governed processes declined from 58% in 1984 to 35% in 1997 because the share of research funding from all other sources increased, including the share from competitive grants.

This information is difficult to summarise. However, the precise amounts of money moved may not in fact be terribly relevant. Analysts consistently emphasise the small amounts of money involved or the small amount that moves in any one year as a result of evaluation (Jiménez-Contreras et al., 2003; Sanz-Menendez, 1995; Sivertsen, 2010; Sastry and Bekhradnia, 2006; Rodríguez-Navarro, 2009). Universities have high fixed costs and require stable funding streams, and no government would benefit from a university

becoming bankrupt. Therefore, governments would be unwise to create a highly unstable funding system that would swiftly reallocate large amounts of funding and might bankrupt some institutions, though the Polish government has threatened to remove research funding from underperforming universities (Pain, 2010). The short-term financial consequences of a PRFS are likely to be less than is often feared, although small, consistent movements can accumulate over time. Only the UK system has been operating long enough to assess the possible financial effects of PRFS over the long term. Since the UK government had an explicit goal of selectivity, or concentrating resources in fewer universities, the appearance of this effect would not be unexpected.

PRFSs can create pressure to increase funding. Grade increases in the RAE between rounds were used to argue for more government money for research to reward improved performance (Tapper and Salter, 2003). Hong Kong faces the same phenomenon (French et al., 2001). If the success rate in Spain's *sexenio* increases, the government is automatically obliged to increase faculty salaries. It seems likely that pressures to increase university funding will spread with the spread of PRFSs. Universities that can demonstrate increased excellence, particularly in highly publicised, measurable, internationally comparable ways will have strong arguments when budgets are discussed.

It is possible that a PRFS will entrain other parts of the research funding system, with the result that the effect of the PRFS will go beyond the amount of money directly allocated. This will happen if grant review is not double-blind and the probability of a successful grant application is increased if the applicant is located in a higher-ranking department. This appears to be the case in the U.K. where there is a very close correlation between research council funding and RAE results (Martin and Whitley, 2010). In Spain a minimum number of *sexenios* are required for securing tenure or for becoming a member of the commission that grants tenure, thereby aligning the formation of an elite with the PRFS. Also, *sexenios* help with applications for competitive research funding thus aligning the two major research funding mechanisms (Jiménez-Contreras et al., 2003, p. 135).

Analysts who point to the small direct financial consequences attached to PRFSs do not therefore believe that they lack influence. On the contrary, they argue that the systems have strong effects on universities, though less through the incentives funding provides than through public judgments about relative prestige. Comprehensive assessment of universities and their departments creates intense interest among universities. Experience has shown that universities are extremely responsive to hierarchical ranking. One effect of the RAE was to create what McNay termed assured, aspiring and anxious universities (HEFCE, 1997, p. 47). Attention devoted to RAE submissions did not decrease, even though, as mentioned above, Sastry and Bekhradnia calculated that the median impact on total university revenue of the 2001 exercise was 0.6%. In preparations for the 2008 RAE, "research-intensive institutions indicated that they would seek the best ratings rather than the financial rewards" when choosing how to structure their submissions (Lipsett, 2007). Marginson noted in relation to the introduction of a university assessment in Australia in 1993: "Nothing less than the positional status of every institution was at stake; the process of competitive ranking had a compelling effect, leading to the rapid spread of a reflective culture of continuous improvement" (Marginson, 1997, p. 74). Harman related that in Australia allocation of funding based on the Composite Index had become "an important vehicle for developing status hierarchies" as data are published in newspapers and widely used (Harman, 2000, p. 116).

The attention paid to research output assessments that are not linked directly to funding confirms this. In the United States, the annual ranking of university departments by *US News & World Report* is extremely influential. Similarly in Australia, ERA was conducted before it was used to determine funding allocation, yet it was the focus of intense interest. The Shanghai Jiao Tong University Academic Ranking of World Universities and the THES-QS World University Rankings have been so influential that President Sarkozy has ordered France's science and higher education ministry to set "the objective of having two French establishments in the top 20, and 10 in the top 100" (Anonymous, 2010). That universities pay close attention to rankings and their attendant prestige is entirely rational since prospective students use rankings to decide on their destinations, especially at the graduate level, and since money follows students. In addition, the more productive, grant-raising faculty seek to work at more highly ranked institutions.

The emphasis in the literature on prestige rather than financial incentives as the main mechanism through which PRFSs work is consistent with conclusions of the new public management literature. Kettl (2000, p. 38), summarising a report from the OECD's Public Management Committee, explains that "public managers around the world have indeed been strongly motivated by incentives, but the incentives have had more to do with their jobs than with the often sporadic performance driven pay systems". Although PRFSs may not be sporadic in that the formulas are applied to every funding allocation, authors seem to agree that the amount of money moved as a result of research rankings is not all that great and prestige is a more important motivating factor, and the influence of independent rankings supports this. In public management, contestability, that is, the prospect of competition (Kettl, 2000, p. 40) is seen as central to the benefits derived from new public management reforms. Universities compete for prestige, and PRFSs harness this.

The dynamic nature of PRFSs further complicates the assessment of costs and benefits. Heinrich and Marschke propose that the assessment of costs versus benefits "will likely depend on where in [the] dynamic cycle the program is being evaluated" (Heinrich and Marschke, 2010, p. 203). For example, while the introduction of a PRFS might bring performance gains initially, after a few iterations, improvements without funding increases may no longer be possible and the costly exercises then return little to no benefit (Geuna and Martin, 2003; Hicks, 2008). The idea is that the PRFS initially harnesses latent capacity in the system without adding more research resources, but eventually that capacity is exhausted and further gains require more research resources. It would be rash to use this reasoning to remove a PRFS, however, because this analysis neglects the demonstrable benefits of introducing contestability and incentives into a system. The gains in performance are clear when contestability is introduced for the first time. But eventually improvements slow at a higher performance level. If contestability, which produced the higher-level state, were removed, one suspects performance might degrade. Strictly speaking, a government should maintain a PRFS if the difference in research excellence between the before and after states is achieved more cost effectively with a PRFS than by adding research resources. Although possible in theory, in practice it is impossible to make this calculation since the costs of PRFSs are not articulated, the benefits have not been quantified, and the result will change over time as principals and agents evolve their strategies in the never ending battle of wits that is a PRFS.

7. Autonomy versus control

Autonomy, self-governance and competition are sensitive issues for the academic community and the introduction of a PRFS creates tensions between autonomy and control. British and Australian commentators on PRFSs are sensitive to the subtleties of rhetoric and reality in relation to university autonomy so this theme is prominent in English-language commentary (Marginson, 1997).

Tapper and Salter argue that: "Ironically, such a model of governance may constrain higher education institutions more severely whilst giving the impression, or at least creating the illusion, that university autonomy has been retained." (Tapper and Salter, 2003, p. 11) For example, the Australian Composite Index is used to allocate a block grant; it would seem universities have autonomy in deciding how to spend the block of money they receive. However, this block grant is divided into seven parts, each of which is subject to a separate set of "broad" guidelines by the funding agency which thereby retains a large degree of government control over expenditure. Similarly, though scholars were consulted widely on ERA and had some say in the choice of indicators, it was within limits defined by the government. Herbst, an American, observes: "The move of European higher education systems toward managerial autonomy has strings attached: institutional autonomy appears to be offered with one hand – and taken back with the other." (Herbst, 2007, p. 79) In addition, the influence of a PRFS will depend on how universities allocate funding internally; conceivably university management could negate or enhance PRFS incentives (Frölich, 2008; L. Butler, 2010).

Although the autonomy of academic disciplines is not generally seen as threatened (rather criticism tends to centre on who controls the discipline because those who control the discipline, control the implementation of the PRFS), governments can limit the autonomy of disciplines in peer review evaluation processes by dictating the criteria reviewers must use. In Spain the criteria are set down in the regulations and are quite specific, reducing the degrees of freedom for reviewers and enhancing government control. In other countries less specific criteria provide scholars with more autonomy in their judgments (Jiménez-Contreras et al., 2003). When the RAE began, disciplinary committees had complete freedom to determine criteria; later the government introduced a standardised statement of criteria to ensure fairness across fields (Tapper and Salter, 2003).

The effect of PRFSs on the perceived autonomy of individual scholars is a source of perennial dissatisfaction and of the accusation that PRFSs harm scholarship and the research enterprise. The mechanism through which PRFSs restrict autonomy is by enhancing control of disciplinary elites. A great deal of this commentary implicitly assumes a prior state in which collegial relations governed the academic community through informal peer review. Others argue that this is an idealised view which neglects professional hierarchies and intellectual authority relations (Harley and Lee, 1997). Whitley develops this argument in expressing his concern about the possible deleterious effects of PRFSs on the vibrancy of the scholarly community and the knowledge it creates. In essence, he argues that strong evaluation systems will reinforce the influence of conservative scientific elders, thereby suppressing novelty, new fields, diversity and pluralism. This problem will be exacerbated if a country's scientific elite is cohesive and if they also control project-based funding through peer review. University autonomy will reduce this effect (Whitley, 2008, pp. 14–16). The problems generated by cohesive intellectual elites in control of a PRFS may be particularly visible in economics, with its striking division between neoclassical scholars and everybody else (Corsi et al., 2010; European Commission, 2010, p. 116; Harley and Lee, 1997; Lee, 2007). Rafols et al. have produced empirical evidence that "the rather narrow and idiosyncratic view of excellence" of disciplinary elites serves to suppress the rankings of interdisciplinary research efforts in a way not supported by citation measures (Rafols et al., 2011). This point is connected to the magnified effect of PRFSs through their effects on other parts of the funding system mentioned above.

Autonomy is a sensitive issue for scholars at both the institutional and individual levels, and one that is increasingly complex to navigate for a number of reasons including but not limited to

PRSFs (Henkel, 2005). At least in the literature in English, critics often focus on the shifts of control over academic work that accompany the introduction of a PRFS. Ultimately, the effects of a PRFS on institutional autonomy seem contradictory and ambiguous, and may become more so as extensive consultation with the academic community over PRFS design becomes routine. But under the right circumstances a PRFS will certainly enhance control by professional elites.

8. Thoughts on the future

The long-term future of a PRFS will depend on how well it meets the government's goals. Many governments have articulated a clear goal for their PRFS: the enhancement of research excellence. A competition for prestige among universities based on research performance will likely achieve that goal. Problems may arise however if governments realise that their goals, or values, are broader. First, a PRFS will not be a good way to encourage interaction with industry and application of research, activities with demonstrable economic benefits. Enhancing universities' contributions to the economy is a common policy goal that is not well addressed in current PRFSs. The Australian RQF included measures of broader impact, but this was dropped due to complexity. ERA does not include broader impact measures. The *sexenio* has been criticised for excluding consideration of broader impact (Sanz-Menendez, 1995). The UK REF is then leading the way by piloting broader impact assessment in the form of case studies.[2]

Equity and diversity are also important public values in relation to universities. Excellence and equity have always been in tension in research policy. PRFSs encourage excellence at the expense of equity. A more subtle conflict may arise in a PRFS because of the strong reliance on the academic elite in its design and implementation and the possibly enhanced effect if the rest of the funding system is entrained by the PRFS. Whitley suggests that novelty, innovation and intellectual diversity may be suppressed because elites tend to judge academic quality in part on how well work advances paradigms they themselves have established. In addition, the contribution of universities to national and cultural identity may lessen because these are devalued in systems that focus on research excellence at the international level (*i.e.* published in English). There may be circumstances in which any of these value conflicts becomes politically unacceptable. Two choices will present themselves, either further increasing the complexity of the PRFS to broaden the definition of performance (and so increase cost), or reducing the influence of the PRFS and adding another programme to distribute research support based on consideration of other values. The vision of an ever more burdensome PRFS, forced to serve goals for which it is less than ideal seems to hold less appeal than a suite of programmes, each optimally designed to serve a different goal. Many systems already have programs in place that ameliorate the effects of PRFSs such as granting schemes focused on interdisciplinary groups, or university-industry collaborations. Such diversity in the funding system should facilitate differentiation among autonomous universities managed strategically and enhance the ability of the system as a whole to serve a complex suite of public values.

Any consideration of the future of PRFSs should take into account relevant non-PRFS mechanisms. Since contestability seems to be at the heart of the benefits of a PRFS, it may be possible to encourage research excellence simply by relying on independent rankings. International rankings are proliferating. *Times Higher Education (or THE)*, Shanghai Jiao Tong, and emerging corporate

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[2] See special issue *Research Evaluation* on the state of the art in evaluation of broader impacts, September 2011.

products are discussed internationally, are analysed and compared, and are politically influential (D. Butler, 2010; European Commission, 2010; Anonymous, 2010). Their influence looks likely to increase greatly over the next few years. In providing contestability at the level of universities, such rankings duplicate one of the most important functions of PRFSs. (They do not however involve peer review or assess departments or fields.)

A government that chose to substitute international rankings for a PRFS might not even need to link funding to the ranking. A government could simply rely on media attention and student and faculty pressure to create incentives from rankings. This is in fact a notable element of the highly successful US university system, for which *US News & World Report* annual departmental rankings and National Academy decadal departmental rankings are highly influential. Substituting an international ranking for a PRFS would have the benefit of eliminating costs and shifting divisive and resource-consuming methodological arguments to the international scholarly community. However, universities can only compete effectively for prestige if they have institutional autonomy and discretionary resources (again this is the case in the US system). This recalls the new public management origins of PRFSs. The introduction of a PRFS tends to be just one part of larger changes and although independent rankings may substitute for the research evaluation component, without the larger changes universities cannot respond to incentives to increase their prestige. This suggests that the focus should not be the PRFS *per se*, but rather increasing contestability and institutional autonomy in a university system.

The future of PRFSs also depends on how successful they prove to be in comparison to the alternative centre-of-excellence approach in which governments award a limited number of very large, long-term block grants to universities based on competitive proposals. Germany, Japan and Poland use this approach. China has also taken this approach with its Project 985, though without the competitive proposal aspect. This is clearly a mechanism meant to concentrate funding and encourage international levels of excellence – the same goals that motivate PRFSs. A long-term comparison of the relative merits of centre-of-excellence and PRFS approaches might help governments understand and explore their options for increasing university research excellence.

9. Conclusions

Performance-based research funding systems (PRFS) are national systems of research output evaluation used to distribute research funding to universities. Fourteen such systems have been implemented as of 2010 in response to the knowledge economy, new public management and a universal desire for research excellence on the part of governments. This paper sought to step back from the intricacies of particular systems to draw out general lessons that can serve to enrich our understanding of how research policy and innovation systems are evolving. PRFSs were found to be complex, dynamic systems, balancing peer review and metrics, accommodating differences between fields, and involving lengthy consultation with the academic community and transparency in data and results. Although the importance of PRFSs seems to be based on their distribution of universities' research funding, this is something of an illusion, and the literature agrees that it is the competition for prestige created by a PRSF that creates powerful incentives within university systems. Institutional, professional and individual autonomy are important values in the academic community and the effects of PRFSs on autonomy are much discussed. The literature suggests that effects on institutional autonomy are ambiguous, but under the right circumstances a PRFS will enhance control by professional elites. PRFSs, since they aim for excellence, may compromise other important values such as equity or diversity. They will not serve the goal of enhancing the

economic relevance of research. Finally, there may be other methods to achieve research excellence and future research should seek to compare the effectiveness of the different methods in achieving the primary, stated goal of PRFSs – increasing the excellence of a nation's research.

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