Using professor-level bibliometric and grant-success data for comparing system performance on university research

A comment for the Higher Education Quality Council of Ontario on its consultation paper, *Performance Indicators for the Public Postsecondary System in Ontario*

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* This comment represents the views of the author and not necessarily those of the School of Public Policy and Governance or the University of Toronto.

** This paper was submitted to the government on July 30, 2012. The November 27 revision includes adjustments to the Ontario-California comparison in section 2 based on more recent Nobel Prize and Statistics Canada data and helpful comments from Ken Snowdon (2012) in his communication to the author on November 26, 2012.
Purpose of this comment

On July 6, 2012, the Higher Education Quality Council of Ontario (HEQCO) released a consultation paper entitled Performance Indicators for the Public Postsecondary System in Ontario proposing indicators under the four domains of access, quality, social and economic impact, and sustainability/efficiency.

Only one of the thirteen proposed indicators addresses research performance. The proposed indicator for system research performance is “Ontario’s share of Tri-Council (NSERC, SSHRC, CIHR) funding” which is intended to measure the “competitiveness of the Ontario postsecondary system in research” using federal granting council data. Given that granting councils summarize their awards on a provincial basis, this indicator would be almost costless to compile if HEQCO chose not to look at details on grant success at the level of institution, field or individual researcher.

This comment references my July 30 submission to Ontario’s PSE Transformation Review entitled A new process for assessing and funding research performance in universities: How research contribution units could be calculated using on-line resources (appended as an Annex) and proposes that the Ontario should develop a more elaborate approach to measuring research performance than simply comparing provincial totals of federal granting council awards. Ontario needs indicators of research performance would enable the province to make system-level comparisons among comparable types of institutions, including those outside Canada where federal granting council statistics are not useful.

Magnitude of research spending and variations in research performance

Many Canadians would be surprised at how much their provincial governments spend in support of university research and they would be surprised at the extent to which the majority of important research is produced by a minority of university faculty.

On the first point, the submission estimates the amount of provincial spending on research by noting that in 2010-11 the total operating grant was $3.3 billion and tuition revenue was $2.4 billion for a total of $5.6 billion. The operating grant provides support for research facilities and staff engaged in research. A major expenditure is on the time provided to full-time faculty to engage in research. Given that the salaries for full-time faculty in 2010-11 were $2.1 billion and given the norm that about 40 percent of a professor’s time is devoted to research, one can estimate that that the cost of faculty time made available for research is about $854 million. When other research-related operating costs are included the total is likely in the same range as the $1.5 billion that Ontario universities receive from federal research grants and contracts.

On the second point, although all professors are expected to engage in scholarly activity to support their teaching and to contribute to the scholarly environment at their university, all professors are not equally capable of turning scholarly activity into substantive research contributions. The submission notes that dramatic differences in research productivity among
faculty members within a university have been recently highlighted by Richard Vedder and his colleagues who analyzed the distribution of external research funding for faculty at the University of Texas at Austin, and by Alex Usher and his colleagues who analyzed the distribution of h-indices of Canadian university faculty in the same field. The submission looks at research output in a one field (political science) as measured by the number of publications and the number of times the publications have been cited by others. The results are consistent with a 70-30 distribution where 70 percent of the research contributions are produced by 30 percent of the professors.

Ontario should develop a more sophisticated set of indicators for measuring the performance of this substantial annual expenditure. Indeed, as suggested in the submission, the use of reliable measures of research performance in resource allocation could improve Ontario’s research output for any given level of resources without sacrificing teaching quality by creating incentives to increase specialization and differentiation.

**Hypotheses underlying professor-level bibliometric and grant-success indicators**

The submission outlines how professor-level bibliometric and grant success information could be collected and normalized for such factors as field of study, size of institution, and rank of researcher. Although the process outlined in the submission is designed primarily to make institutional comparisons within a university system, Section 11 notes that the methodology could be used to make comparisons of a provincial system with other systems or to make comparisons of specific institutions or groups of institutions with selected comparators in other jurisdictions.

A comprehensive professor-level database could be developed and maintained by a small research assessment office in the ministry or in HEQCO.

The proposed approach rests on two testable propositions. The first is that the distribution function for research productivity among professors in any field can be empirically determined and then used to assign a number of research contribution units (RCUs) to each professor based on their ordinal rank in the distribution. Institutional comparisons of research contribution can then be made by summing the field-normalized RCUs of all full-time professors in the institution.

The second testable proposition is that for each field an algorithm can be designed that is capable of generating a valid ordinal ranking of faculty research contributions from information on grant-success, publications and citations available over the web from granting councils and bibliometric services. RCUs for all full-time faculty in the university system could be calculated and annually updated by a small research assessment office using the on-line resources provided by granting council websites and bibliometric services.

The submission proposes a six-month pilot project to test these two propositions and to refine a methodology for calculating each professor’s RCU and each institution’s total research
contribution. If the pilot phase proves the two propositions to be valid, a full database could be constructed relatively inexpensively by the end of 2013.

**Conclusion**

The proposed approach to indicators of research performance would enable the province to make system-level comparisons among comparable types of institutions, including those outside Canada. For example, using bibliometric measures, comparisons of research performance could be made between the most research-intensive Ontario universities and American public universities such as the University of Michigan or those in the University of California system. Similarly, comparisons using both bibliometric and grant success indicators could be made of the research performance of Ontario medical-doctoral universities relative to those in Quebec, BC and Alberta.

Such a database would provide valuable information for system management and for institutional planning whether or not the government decides to use such data in a research performance fund as recommended in the submission.
ANNEX

A new process for assessing and funding research performance in universities:
How research contribution units could be calculated using on-line resources

A submission to the Ministry of Training, Colleges and Universities
in response to the invitation in the paper
Strengthening Ontario’s Centres of Creativity, Innovation and Knowledge

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July 30, 2012 (revised November 27, 2012)²

¹ The views expressed in this paper are those of the author and do not necessarily represent the views of the School of Public Policy and Governance or the University of Toronto. The author would like to thank Ken Norrie, Michael Skolnik, Mark Stabile, David Trick and Richard Van Loon for comments on earlier drafts of this paper.

² This paper was submitted to the government on July 30, 2012. The November 27 revision includes adjustments to the Ontario-California comparison in section 2 based on more recent Nobel Prize and Statistics Canada data and helpful comments from Ken Snowdon (2012) in his communication to the author on November 26, 2012.
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Executive Summary

All Canadian governments face the challenge of finding smarter ways of allocating public resources to achieve public purposes. Smarter resource allocation mechanisms can help achieve the Ontario government’s commitment to “find ways, through reform, to deliver government services more efficiently” (Premier of Ontario, 2012) and “transform the public and broader public sectors” (Minister of Finance, Ontario, 2012).

On June 28, 2012, Glen Murray, Minister of Training, Colleges and Universities, released a discussion paper on postsecondary education entitled Strengthening Ontario’s Centres of Creativity, Innovation and Knowledge to begin “the process of transforming this sector” (p. 6). The discussion paper states that the government wishes to develop “a transformation strategy for PSE in Ontario that leverages innovation and productivity” (p. 22). This submission responds to the discussion paper’s request for submissions “to help identify actions that will make our system more productive and that will improve quality” (p. 22).

This submission proposes a new process for assessing the research performance of universities, which could lead to a more productive allocation of operating resources for the twin public purposes of university education and university research. The new process builds on the proposals made in Academic Reform for separating the operating grant into teaching and research components, each with a performance funding element (Clark, Trick and Van Loon, 2011).

To provide a sense of the scope for improvement, the submission compares cost and performance metrics in the Ontario and California public university systems. The two systems are closer in size than many think, with California’s having only 28 percent more students than Ontario’s. The California grant per student is nearly the same ($7,900 annually compared with $7,700 in Ontario) and revenue from tuition is about 50 percent higher ($8,400 per student compared with $5,700).

California gets more teaching per dollar than Ontario. Universities receive 22 percent more grant and tuition revenue per student and have a comparable number of full-time faculty per student, but full-time faculty on average do 32 percent more teaching. Semesters are two weeks longer. As a result, the average California student receives 55 percent more teaching from full-time faculty than her counterpart in Ontario.

In California, a much lower proportion of faculty is paid to spend as much time on research as on teaching but this does not seem to hurt its comparative research performance. California has five public universities – Berkeley, UCLA, San Diego, Santa Barbara, and Davis – in the Times Higher Education top forty; Ontario has one. Its professors have earned 27 Nobel prizes since 1995; those in Ontario, none. It would be hard to challenge the conclusion that California’s public universities produce substantially more research than Ontario’s.
Remarkably, the total cost of faculty time for research appears to be less in California than in Ontario. Given Ontario faculty’s 40-40-20 split between teaching, research and service, the cost of faculty time available for research can be calculated as 40 percent of the total spending on salaries and benefits for full-time faculty – about $850 million. In California, if one assumes a 40-40-20 split for the 8,452 tenure-track faculty at the ten University of California institutions and a 60-20-20 split for the 9,502 tenure-track faculty at the 23 California State University institutions, the same calculation, even including an allowance for grant-funded “summer month” salary, comes to about $830 million.

Ontario would get more value for money by redirecting dollars for faculty research time to the most productive researchers. Research performance differs dramatically among faculty. Indicators can be generated from readily available data on publications, citations and external grants. A preliminary look at Ontario professors of the same rank in the same field suggests a 70-30 distribution where 70 percent of the research is produced by the most productive 30 percent.

Ontario would get more research and more teaching for its tax and tuition dollars if, like California and most OECD countries, it had a funding mechanism that encouraged the minority of faculty who are productive researchers to do more research and the majority to do more teaching.

The submission proposes that up to $750 million of the $3.3 billion annual university operating grant be allocated to institutions on the basis of the total research contribution of their faculty. The research contribution of each professor would be calculated from publication, citation and grant-success data normalized by field of study. These calculations would be performed by a small research assessment unit using publicly available data from international bibliometric services and the national granting councils.

This proposal will not be welcomed by everyone in Ontario’s university community. But Ontario taxpayers and students should welcome a process that could generate both more teaching and more research from their limited budgets.

1. Outline of the submission

The submission has 12 sections. Section 2 compares Ontario metrics with those of public universities in California to suggest how much it should be possible to improve the value for money in both teaching and research. Section 3 notes that most OECD jurisdictions have some form of performance-based funding to encourage specialization and differentiation and it summarizes how traditional research assessment exercises work the UK, Australia and New Zealand. The next two sections set out a new process
designed to be more timely, more transparent, and much less costly than traditional research assessment exercises.

The new process rests on two testable propositions. The first, described in Section 4, is that the distribution curve of research productivity among professors in any field can be empirically determined and then used to assign a number of research contribution units (RCUs) to each professor based on their rank in the distribution. Institutional comparisons of research contribution can then be made for purposes of distributing research performance funds by summing the field-normalized RCUs of all full-time professors in the institution.

The second testable proposition, described in Section 5, is that an algorithm can be designed for each field that is capable of generating a valid ordinal ranking of faculty research contributions from information on grant-success, publications and citations available over the web from granting councils and bibliometric services. RCUs for all full-time faculty in the university system could be calculated and annually updated by a small research assessment office (RAO) using the on-line resources provided by granting council websites and bibliometric services.

Section 6 outlines a six-month pilot project to test these two propositions and to refine a methodology for calculating each institution’s share of any portion of the operating grant that a government wished to distribute on the basis of research performance. If the pilot phase demonstrates the two propositions to be valid, a full database could be constructed relatively inexpensively in time to allow Ontario to introduce research performance funding into the allocation of its operating grant for the 2014-15 fiscal year.

Professors and university leaders are human and will naturally respond to the ideas in this submission with an eye to how performance assessment and funding changes would affect them. Professors who think they might be assessed below average and university leaders who think their institutions might lose funding will react differently from those who believe that they and their institutions are or are capable of making a higher than average research contribution. The new process cannot avoid the angst of differentiation.

For this reason the second half of the submission addresses differentiation and its implications explicitly. Section 7 illustrates how greater specialization and differentiation could increase the output of both research and teaching in a university system without increasing system resources. Section 8 describes how the production characteristics of the university’s two public purposes are dramatically different. Education tends to be local and non-competitive. Research tends to be global and very competitive. Furthermore, it is argued that research performance is not the same as scholarly activity and that changes in funding arrangements could be designed to ensure
that scholarly activity throughout the professoriate is strongly supported at all universities. Section 9 examines how much a provincial government spends on the research part of the university mission, particularly the salary costs of providing faculty with time for research, and suggests the appropriate size for a research performance fund. Section 10 looks at the institutional incentive effects of substantial research performance funding. Section 11 notes that the methodology described in the paper could be used for making comparisons of research performance between university systems and between groups of universities whether or not it is used for performance funding. The submission ends with a section recapitulating how the new process addresses many of the shortcomings and concerns associated with traditional research assessment exercises.

2. Using California public universities as a benchmark for value for money in teaching and research

The premise of this paper is that the Ontario university system can do better in terms of the teaching and research value produced per dollar of government and student expenditures. How much better? The public university system in California provides an ambitious benchmark. Although it is not realistic to imagine transforming Ontario’s current 20 universities into an explicitly two-tiered sector like California’s, a look at the combined output of the University of California (UC) and California State University (CSU) systems illustrates the impressive levels of teaching and research output per dollar that public university systems are capable of producing.

The size of California’s public university system is closer to Ontario’s than one might think. Although California has 2.8 times Ontario’s population, community colleges provide the first two years of baccalaureate education for many of its university students and there are many private universities. As a result, the public university system – combination of UC and CSU – is less than one-third larger than Ontario’s system of 20 universities in terms of enrolment and state grant (see Exhibit 1).

Exhibit 1 uses the latest available data from both systems so Ontario is 2010-11 and California is 2011-12. The Ontario trends were quite stable in the 2009-12 period and none of the observations made below is likely to change substantially when 2011-12 data become available.

We can see that annual state contribution to university revenue is nearly the same per student as the province ($7,861 compared with $7,703). The grant per student at UC is 30 percent higher than in Ontario and that for CSU is 18 percent lower. The tuition and fee contribution is 49 percent higher ($8,422 compared with $5,665). The total of grant, tuition and fees per student in the combined California system is 22 percent higher than in Ontario (67 percent higher in UC, 10 percent lower in CSU).
In California, much less of the total academic salary budget is devoted to tenure-track faculty (57 percent in UC, 71 percent in Ontario). Average salaries of tenure-track faculty in California are only 85 percent of those in Ontario. Tenure-track salaries take 23 percent of the total grant, tuition and fee revenue compared with 37 percent in Ontario.

In California, students receive more teaching from full-time faculty. The combined California system provides approximately the same (2 percent more) ratio of full-time faculty per student but more faculty whose main job is teaching. In addition to 8,452 full-time “ladder rank” professors, UC employs 999 full-time “lecturers” (not including the 4,731 “other teaching faculty”) and CSU employs 1,827 full-time lecturers in addition to its 9,502 full-time tenure-track faculty. Across the two systems, full-time faculty do 32 percent more teaching on average than in Ontario. As a result, and including provision for the longer semesters, the average California student receives perhaps 55 percent more teaching from full-time faculty than her counterpart in Ontario.

This suggests that California gets more teaching value per dollar than Ontario.
Notes to Exhibit 1

Note 1. Ontario enrolment is from Council of Ontario Universities (COU, 2012). California enrolments are those provided in the system budget documents (University of California, 2012a, p. 150; California State University, 2012a).

Note 2. Ontario number is total MTCU grants (COFO-UO, 2012a). California numbers are from the system budget documents (University of California, 2012a, p. 145; California State University, 2012b).

Note 3. Ontario number is from COFO-UO Financial Reports (COFO-UO, 2012b). California numbers are from system budget documents (University of California, 2012a, p. S-5; California State University, 2012b).

Note 4. Ontario number is the 2010-11 total for full-time full, associate and assistant professors (15,155) from Statistics Canada (2012) minus the 102 full-time teaching stream faculty (including the undetermined number of those who have tenure-track status in their institutions) with the titles of full, associate and assistant professor (calculated from Vajoczki et al. 2011, pages 18 and 21). The UC number is the sum of the full-time faculty in three groups: ladder ranks (8,452), acting ranks (47), and lecturers (999). It does not include the category “other teaching faculty” (4,731) (University of California, 2011a). The CSU number is the full-time tenure-track fall 2011 headcounts (California State University, 2012c).

Note 5. Ontario number is calculated from Vajoczki et al. (2011, pages 18). The UC number is the sum of the full-time faculty in two groups: acting ranks (47) and lecturers (999) and does not include other teaching faculty (4,731) (University of California, 2011a). The CSU number is the full-time lecturer fall 2011 headcounts (California State University, 2012c). As noted in footnote 3, both the Ontario and UC numbers likely underestimate the numbers of teaching-stream faculty. Collecting and publishing better aggregate statistics on teaching stream faculty should be a priority for both systems.

Note 6. Relative teaching loads by full-time faculty are calculated from weighted averages with weighting of 1.0 for Ontario tenure-track faculty, 1.0 for UC ladder rank faculty, 1.5 for CSU tenure track faculty and 2.0 for Ontario teaching-stream faculty and for California lecturers.

Note 7. UC and CSU operate on a 15-week semester system (California State University, 2012d); Ontario universities operate on 12 or 13 week semesters.

Note 8. Ontario number is the sum of Academic Ranks and Other Instruction and Research salaries and wages from COFO-UO Financial Reports (COFO-UO, 2012c) minus the salaries for full-time teaching stream faculty who are assumed to have an average salary of 0.67 tenure stream faculty given their relative ranks as displayed in Vajoczki et al. (2011, pages 21). The UC number is Academic Salaries in the UC budget (University of California, 2012a, p. 38). The CSU number is Faculty Compensation in the CSU budget (California State University, 2012e). This latter number somewhat understates the academic compensation at CSU because it does not include student teaching assistants.

Note 9. Ontario number for Academic Salary is the salary total for Academic Rank - Full-time in COFO-UO Financial Reports (COFO-UO, 2012c). UC number is calculated as the full-time ladder rank headcount times the average ladder rank salary ($916,638,725/7,541) found in Appendix A of the report of the Senate-Administration Taskforce on Faculty Salaries (University of California, 2012b). CSU number is calculated from the table of headcounts and average salaries (California State University, 2012d).

Note 10. Ontario number is 40 percent of full-time tenure-track faculty salaries grossed up by 18 percent (the ratio of employee benefits to total salaries and wages). UC number is 40 percent of full-time ladder rank salaries grossed up by 18 percent for benefits (assumed to be the same percentage as Ontario). CSU number is 20 percent of full-time tenure-track salaries grossed up by 18 percent for benefits (assumed to be the same percentage as Ontario).

Ken Snowdon (2012) has suggested this analysis understates the number of teaching-stream faculty in Ontario. This is likely true but it is offset by the comparable decision, in this revised version of the paper, not to include any of University of
California’s 4,731 full-time “other teaching faculty” (University of California, 2011a) in the analysis.3

Now let us look at value for money in spending to support university research. In California, a much lower proportion of faculty is expected to devote the same time to research as teaching. Does this affect system research performance?

California has five public universities – Berkeley, UCLA, San Diego, Santa Barbara, and Davis – in the top forty of the Times Higher Education World University Rankings (2012). Ontario has one. Professors in California’s public universities have earned 27 Nobel prizes since 1995. Ontario universities have not had a Nobel winner since John Polanyi in 1986. Few would challenge the conclusion that California’s highly differentiated university system produces substantially more research than Ontario’s.

Remarkably, it seems that the absolute cost of faculty time for research is greater in Ontario. Given the 40-40-20 split in faculty time between teaching, research and service, this can be taken to be 40 percent of the total spending on salaries and benefits for full-time faculty. This works out to $854 million for Ontario. In California, if one assumes a 40-40-20 split for the 8,452 tenure-track faculty at the ten UC institutions and a 60-20-20 split for the 9,502 tenure-track faculty at the 23 CSU institutions,4 the same calculation yields $674 million. On a per student basis the state of California spends only 60 percent

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3 Ken Snowdon (2012) has suggested that the 535 number from the Vajoczki et al. (2011) study underestimates the number of full-time teaching stream faculty because it does not include data from universities who declined to participate in the survey. It is true that two relatively large institutions that have teaching stream faculty, Queen’s and Ottawa, did not share their numbers with the HEQCO-sponsored researchers. Snowdon suggests that a better number would be at least 1,000, since the Statistics Canada 2010-11 tables for full-time teaching staff in the category “Rank or level below assistant professor” totals 1,111.

If the number 535 were replaced by 1,000 in the calculations, the operative paragraph on page 7 would read:

“Across the two [California] systems, full-time faculty do 28 percent more teaching on average than in Ontario. As a result, and including provision for the longer semesters, the average California student receives 46 percent more teaching from full-time faculty as her counterpart in Ontario.”

On the other hand, the number of California teaching-stream faculty in our calculations would increase if there were a way to assign some of the University of California’s 4,731 full-time “other teaching faculty” listed in headcounts (University of California, 2011a). They are not included in the analysis because, as Snowdon has pointed out, most of them likely teach in clinical settings in the health sciences faculties. Although these full-time “other teaching faculty” presumably provide valuable teaching for UC students in medicine, nursing, and other health sciences professions, clinical faculty numbers are particularly difficult to compare across jurisdictions.

4 This is almost precisely the split found for CSU tenure-track faculty in a comprehensive 2001 survey of faculty time use in the CSU and comparator universities (California State University, 2003).
as much for “faculty time available for research” as Ontario. Even if allowance is made for grant-funded “summer month” salary provided by federal granting councils, the total public cost in California is still below that in Ontario.\(^5\)

This suggests that California gets much more research value per dollar than Ontario.

There are factors other than system design and financial incentives that influence research productivity in a university system. As noted earlier, the purpose of this section of the submission is not to argue for a wholesale redesign of the Ontario university system to replicate California’s. Nevertheless, these comparative numbers do suggest that there is substantial scope to improve the teaching and research performance of Ontario universities by encouraging more specialization and differentiation.

### 3. How traditional research assessment exercises work

In contrast to Ontario, governments in most OECD jurisdictions encourage specialization and differentiation through funding mechanisms that provide higher base funding to institutions deemed the most capable of high research performance. The OECD has summarized the international experience in a report on performance-based funding of research in public universities (OECD, 2010). It highlights the processes used in Australia, Austria, Belgium (Flemish Community), Czech Republic, Denmark, Finland, nine German states, New Zealand, Norway, Poland, and the United Kingdom.

The UK relies on a periodic research assessment exercise (RAE) that engages expert panels to review submissions for each field (called units of assessment) from each university and has conducted an RAE every 5 to 8 years since 1992. The last round was in 2008 and the next, renamed the research excellence framework, will take place in 2014. The final product of each panel’s review is to be based on an assessment of research quality at the level of individual professors. Each university’s “quality profile” in each field is expressed as the percentage of its researchers that fall into each of five quality ranks for “originality, significance and rigour” of research. The ranks are: 4* (world-leading); 3* (internationally excellent); 2* (recognized internationally); 1* (recognized nationally); and Unclassified (below standard or not meeting published definition of research).\(^6\) Australia and New Zealand use similar exercises.\(^7\) There will be 36 units of assessment.\(^8\)

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\(^5\) If one assumes that 70 percent of UC ladder-rank faculty are able charge an additional two months summer salary to a grant, it would add an additional $160 million and bring the total public cost to $834 million.

\(^6\) The overall quality profile for each unit will be based on a weighted average: 65 percent for quality of outputs (“originality, significance and rigour”), 20 percent for impact (“reach and significance”) and 20 percent for research environment (“vitality and sustainability”). This is a
The process proposed in this paper differs from these research assessment exercises in that it would not require submissions from universities. Rather, it would generate ordinal rankings of all professors in the provincial university system in each field primarily using web-based bibliometric indices and granting council awards in the public domain. The methodology and results would be transparent to the university community and the process could be conducted annually at a fraction of the cost of research assessment exercises.\(^9\)

\(^9\) More quantitatively precise formulation than that implicit in the 2008 RAE’s advice to field panels to “take account of all components of a submission: research output, research students and studentships, research income, and research environment and esteem indicators.” University submissions for the 2008 exercise were to “list up to four items of research output by each submitted” but the panels were encouraged to “assess each submission in the round’ and “not make collective judgements about the contributions of individual researchers, but about a range of indicators relating to the unit, research group or department that is put forward for assessment” (RAE, 2006, 3).

\(^7\) Details of New Zealand’s performance-based research fund (PBRF) can be found on the Tertiary Education Commission’s web site, [http://www.tec.govt.nz/Funding/Fund-finder/Performance-Based-Research-Fund-PBRF/](). The PBRF’s purpose is “to ensure that excellent research in the tertiary education sector is encouraged and rewarded. This entails assessing the research performance of [tertiary education organizations] and then funding them on the basis of their performance.” It involves an “assessment of the research performance of staff” by peer review panels. The exercise leads to a “Quality Score” for each university (e.g., Otego 4.23; Auckland 4.19; Canterbury 4.10 (Tertiary Education Commission, 2009).


\(^9\) The Director General’s Report (2009, 32) for the last RAE states: “In total arrangements were made for just over 1,000 days of panel meetings, hotel accommodation for 1,100 panel members, secretariat and RAE team staff, and nearly 100,000 transactions with panel members to dispatch outputs.” The government’s budget (not including submission preparation time in the universities) was £12 million stretching over 6 fiscal years (2009, 45).
4. Using “research contribution units” to account for variability in research performance among faculty in the same field

All professors are expected to engage in scholarly activity to support their teaching and to contribute to the scholarly environment at the university. But, for better or for worse, all professors are not equally capable of turning scholarly activity into substantive research contributions in the form of new ideas and knowledge for use of scholars and others beyond the particular university and local community. Creating new knowledge for the world is fearsomely difficult, often requiring extreme specialization and willingness to play a very competitive “first to publish” game.

The actual research contribution of professors in any field could be expected to follow a distribution. To illustrate this, 20 associate professors of political science were selected at random by the author from the departmental lists of three Ontario universities and a preliminary calculation was made of their h-index (a measure that combines number of publications and number of citations) using searches with Google Scholar. The results for the 20 professors were: 16, 14, 10, 10, 7, 9, 9, 6, 6, 5, 5, 5, 4, 4, 4, 2, 2, 2, 1, 1, 0. This suggests a power law distribution. Indeed, a plot of these h-index values raised to the 1.5 power matches very closely a 70-30 power law distribution where 70 percent of the research contributions are produced by 30 percent of the professors. Many natural phenomena such as the distribution of wealth in a society have been observed to follow such power-law distributions (Reed, 2001).

The first testable proposition is that the distribution of research productivity among professors in any field can be empirically determined and a derived research contribution unit (RCU) can assigned to a professor based on rank in the ordinal distribution. The pilot project would estimate the distribution function for a sample of fields where quantitative indicators of research contribution are reasonably well accepted.

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10 The dramatic differences in research productivity among faculty members within a university have been recently highlighted by Richard Vedder et al. (2011) who analyzed the distribution of external research funding for faculty at the University of Texas at Austin, and by Alex Usher and his colleagues who analyzed the distribution of h-indices of Canadian university faculty in the same field (HESA, 2012b, June 14).

11 This is a very preliminary distribution. The professors were selected randomly but not in a statistically determined sample of departments and the h-index calculations may have missed some publications, for example, if they were published under a differently spelled name.

12 The number of publications and citations increases with the value of the h-index in an exponential fashion (see Section 4). The appropriate exponent could be determined through testing against expert opinion and other indicators. It is likely more than 1 and less than 2.

13 One set of power-law distributions are called Pareto distributions in honour of Vilfredo Pareto who found many phenomenon that mimicked his observation that in the early twentieth century that 80 percent of the land in Italy was owned by 20 percent of the population.
The RCU concept is best illustrated using deciles. If empirical analysis finds that research contribution in any field has a “70-30” power law distribution, then each decile’s portion of the total contribution would look like that in Exhibit 2. For this distribution, 33 percent of the research contributions of professors in that province in that field are produced by the most productive decile and the research contribution declines by 32 percent with each successive decile. Each professor in the top decile could be assigned an RCU of 3.27 because professors in the top decile produce, on average, 3.27 times as much research contribution as would be the case if all professors made the same contribution. Each professor in the second decile could be assigned an RCU of 2.22 and those in the third decile an RCU of 1.51 and so on. The government could assign a dollar amount to an RCU, depending on the amount of the operating grant it chose to allocate as a research performance fund. In Exhibit 2, a $50,000 RCU value is shown for illustrative purposes.

Since the distribution function is actually continuous, rather than stepped in deciles, a mathematical formula could assign RCU values to professors without the discontinuities between deciles. For example, in a field with 1,000 professors, the top half of the top decile could be assigned an RCU of 4 and after that the RCU could decline with each case so that the RCU of the 51st ranked professor would be 99.7 percent of the 50th, the RCU of the 52nd would be 99.7 percent of the 51st, and so on.

5. Using field-specific algorithms to generate ordinal rankings from on-line sources

The second testable proposition underlying the new process is that a ranking algorithm for each field could be derived from web-accessible data on grant success, publications and citations available from granting councils and bibliometric services. The algorithm could be different for each field, drawing on the most appropriate sources and combining grant, publication and citation information in the way most appropriate to the field. The information could be included in a database managed by a research

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Exhibit 2. Research contribution and RCU assignment for a 70-30 distribution function

<table>
<thead>
<tr>
<th>Decile of Research Performance</th>
<th>Percentage of Population’s Output</th>
<th>Research Contribution Unit (RCU)</th>
<th>Provincial grant value (RCU = $50,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.7%</td>
<td>3.27</td>
<td>$163,500</td>
</tr>
<tr>
<td>2</td>
<td>22.2%</td>
<td>2.22</td>
<td>$111,180</td>
</tr>
<tr>
<td>3</td>
<td>15.1%</td>
<td>1.51</td>
<td>$75,602</td>
</tr>
<tr>
<td>4</td>
<td>10.3%</td>
<td>1.03</td>
<td>$51,410</td>
</tr>
<tr>
<td>5</td>
<td>7.0%</td>
<td>0.70</td>
<td>$34,959</td>
</tr>
<tr>
<td>6</td>
<td>4.8%</td>
<td>0.48</td>
<td>$23,771</td>
</tr>
<tr>
<td>7</td>
<td>3.2%</td>
<td>0.32</td>
<td>$16,165</td>
</tr>
<tr>
<td>8</td>
<td>2.2%</td>
<td>0.22</td>
<td>$10,992</td>
</tr>
<tr>
<td>9</td>
<td>1.5%</td>
<td>0.15</td>
<td>$7,475</td>
</tr>
<tr>
<td>10</td>
<td>1.0%</td>
<td>0.10</td>
<td>$5,083</td>
</tr>
</tbody>
</table>

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14 One of the issues to be examined is the extent to which professors in different fields engage in interdisciplinary research, and whether this should be accounted for in normalizing by field.
assessment office (RAO). In the rare cases of a subfield where no appropriate quantitative data exists, ordinal rankings could be generated by an expert panel convened by the RAO to review CVs.

In fields where much of the research activity is supported by federal granting councils, a professor’s success in winning peer-reviewed granting council awards can be a good indicator of recent and anticipated research contribution. On their public websites, the three federal granting councils provide viewers with the ability to search databases of grants received each year by individual, university, field and subfield. The search results list the name of the project, the researcher, the amount of grant and the year. We could begin with the hypothesis that the best single performance measure from this data would be total grant dollars obtained within the last three years. Variations, such as the dollar value in last two or five years, or the number of grants in these periods, could also be tested. Once the best grant-success algorithm is selected, it would be easy for the RAO to generate an ordinal grant-success ranking of all professors in the field and update it annually.

Publication and citation counts have long been used to compare research achievement for purposes of hiring and promotion. The Science Citation Index was created in 1961 and an equivalent index for the social sciences was created in 1966 (HESA, 2012a). Some of the factors to be taken into account in using these counts to rank individuals are: the number of publications, the number of authors on a publication, the type of publication (e.g., article, review, book), the type of journal (including its “impact”), the number of citations, the extent of self-citation, the nature of the publication in which the citation takes place, the number of years the researcher had been publishing, and the field of study.

Interestingly, in a 2008 survey of Canadian social science and humanities researchers, only 5.2 percent of respondents characterized their research as “exclusively disciplinary” while 27.7 percent characterized it as “extremely interdisciplinary” (SSHRC, 2008, page 114). It is, of course, possible to do interdisciplinary research within broad field categories such as political science.

15 A small research assessment office (RAO) could be established in or alongside the Ministry of Training Colleges and Universities or the Higher Education Quality Council of Ontario. Here is a sketch of how it could work. The RAO would be headed by the Research Assessment Director. The RAO could engage field advisory panels which the Research Assessment Director would chair. The RAO would be charged with 1) maintaining a database of all full-time faculty employed in provincial universities, including their field and professorial rank (assistant, associate or full professor); 2) annually updating each professor’s score on the selected bibliometric and grant-success indices; and 3) using these, if necessary supplemented with other data suggested by a field advisory panel, to generate an RCU for each professor, based on their ordinal ranking on the combined indices relative to all other professors in the field in the province.
There are many candidates to choose from in developing an algorithm to generate an ordinal “bibliometric ranking” of professors in a field. For example, the recently developed Leiden Ranking, which aims to compare the “scientific impact” of universities, uses the Thomson Reuters Web of Science database for the period 2005-2009 to calculate measures such as 1) total citations; 2) average number of citations of the publications, normalized for field differences, publication year, and document type; 3) proportion of publications that belong to the top 10 percent most frequently cited.\(^{16}\)

The Council of Canadian Academies has recently released the report of the Expert Panel on Science Performance and Research Funding (SSHRC, 2012). It examines in great detail the merits of different bibliometric indicators to compare the research quality of a field at the national level in order to adjust the allocation of research funding among scientific fields. This is a somewhat different purpose for performance assessment than that addressed in this submission but some of the panel’s cautions – such as “context matters,” “do no harm,” and “transparency is critical” – are useful in designing any research assessment process.

Another recently-developed indicator is the h-index, which is used by the publicly-accessible bibliometric service, Google Scholar. The h-index is an attractive candidate for the purposes of ordinal ranking because it combines publication and citation information into a single number: the h-index of a researcher is the number of papers authored or coauthored by the researcher with at least h citations each (Hirsch, 2005, 2007).\(^{17}\) Google Scholar generates six different indices: 1) total citations from all publications; 2) citations in the last five years; 3) h-index calculated using all years of

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\(^{16}\) The Leiden Ranking 2011/2012 is based on publications of article, letter, and review (not books) and includes only publications in the sciences and social sciences, not the arts and humanities because “in these domains the bibliometric indicators of the Leiden Ranking do not have sufficient accuracy” (Leiden Rankings, 2012). See also Waltman et al, 2012.

\(^{17}\) Although designed with physical sciences in mind, Jorge Hirsch (2005) suggested that the index could be applicable to other fields. Responding to several articles about the strengths and weakness of the index and proposals for its refinement, Hirsh (2007) offered an analysis of the ability of the h-index to predict future scientific achievement. He concluded that “the h-index and the total number of citations are better than the number of papers and the mean citations per paper to predict future achievement, with achievement defined by either the indicator itself or the total citation count.” The literature to date on the h-index has focused on its use in hiring, tenure and promotion decisions at the level of individuals. A Canadian consultancy, Higher Education Strategy Associates (HESA), has assembled a database of h-index numbers for the majority of faculty members employed in Canadian universities. On March 27, 2012, the Globe and Mail used HESA data to list Canada’s highest scoring researchers by field of study (HESA, 2012a; McLaren, 2012). In a series of “One Thought to Start Your Day” blog posts from June 11 to June 15, 2012, HESA showed how the h-index data for most Canadian faculty members could be used to compare research performance among Canadian universities in particular fields (HESA, 2012b).
citation; 4) h-index calculated using citations in the last five years; 5) number of publications cited 10 or more times (i10-index) in all years; and 6) number of publications cited 10 or more times (i10-index) in the last five years.

There are, of course, many questions associated with the use of Google Scholar to generate h-indices. Google Scholar continues to refine its search engine but it is not flawless. Searches under some author terms sometimes miss some citations. Sometimes items are listed that do not qualify as scholarly publications. If the h-index were to be used to generate RCUs, individuals and institutions would want to have the opportunity to verify their scores. It would be easy to ask each professor to produce a Google Scholar profile (see example in Exhibit 3) to ensure that the Google Scholar search by the RAO had not missed any publication. Each professor can do this in a few hours by searching in Google Scholar for the title of each of the articles in her long-form CV.

A single bibliometric ranking could be generated by using a primary index and then applying secondary indices to break ties in order to produce a ranking without instances of identical scores. For example, if the primary index was the 5-year h-index, ties could be broken by using 5-year citations, and any further ties broken by using all citations. It is unlikely that a primary grant-success index, such as total dollars in last three years, would generate many ties but if it did the ties could be broken with a secondary index such as dollars in the last year.

The public nature of the data used in the RAOs’ calculations could allow for a transparent process of verification. The RAO could e-mail each professor (or each department chair) with the grant-success and bibliometric information obtained from web-based sources and specify a deadline for correction or addition. The information used in the calculation of the institutional RCU totals would be made available on the RAO website to the maximum extent allowable under the freedom of information and privacy laws of the province and the licence agreements with the bibliometric services if these were used.
A single aggregate ranking that takes account of both the grant-success and bibliometric rankings could simply use the better of the two, using one to break ties. The algorithms for each field could be refined over time by having the panel experts review the ordinal rankings and judge the extent to which they align with subjective assessments of relative research contribution.

In those few subfields that had to rely on CV reviews, the principle of web accessibility could be maintained. The RAO would download CVs and other material available on a specified date from university web sites and the field advisory panel would use them to generate ordinal rankings of the professors in that subfield based on the panel’s assessment of the national and international impact of their contributions.
6. Refining the approach with a pilot research project

In order to refine this approach, it is proposed that a six-month pilot project be undertaken to:

- determine whether web-based bibliometric services, combined with web-accessible granting council data, provide a reliable and acceptable way of measuring research contributions of faculty and departments;
- analyze the research contributions of a province’s universities, departments and faculty using granting council data and web-based bibliometric services to see how they might be compared on ordinal and cardinal scales;
- develop and test a funding model that would use measures of faculty research contribution as a new parameter in the institutional funding allocation mechanism; and
- consider carefully how such a funding model would affect decisions by faculty, departments and universities and whether it would support the objective of improving the research and teaching performance of the system as a whole.

The pilot project would begin with a literature review of bibliometrics – what metrics are currently used in what processes (e.g., hiring, tenure and promotion) in what fields. It should also include a literature review of the experience of other jurisdictions – particularly the UK, Australia and New Zealand – in using research performance measures in allocating government funds.

The project could hire a dozen or so part-time research assistants to gather preliminary web-based grant success and bibliometric data at the individual level in a sample of different fields. The project could recruit a small number of experts in each field to help judge the extent to which the quantitative metrics provide valid performance indicators of research contribution. The project would want to look at different definitions of fields and subfields to maximize the extent to which like is being compared with like.

Using such expertise and the measures assembled, the project would try to estimate the distribution function of research contribution of the total population of Ontario professors in the field\textsuperscript{18} with sampling techniques. The project would want to look at the differences in indicators of research contribution among professorial ranks (assistant,
associate and full professor) and the merits of incorporating rank into any resulting allocation algorithm (taking account of salary differences).^{19}

The project would then try to develop a funding algorithm for a research performance fund, and test various models with experienced Ontario university administrators, perhaps including focus groups and surveys, to try to produce incentives that will actually change behaviour in ways that are desired.

7. How the new process could enhance both research and teaching through specialization

The principle of comparative advantage predicts that a university system would produce more research and better teaching if there were specialization. This is illustrated in Exhibit 4 where a simple “70-30” power law distribution model draws out the implications of variability of research productivity among professors. In the model, 33 percent of the research contribution of professors in that province in that field is produced by the most productive decile and the research contribution declines by 32 percent with each successive decile. Because teaching effectiveness is uncorrelated with research productivity (Hattie and Marsh, 1996, 2004; Halliwell, 2008), the best assumption is that if all professors spend the same amount of time on teaching, then the teaching output for each decile of the research productivity distribution would be the same, namely one tenth of the total.

The results for uniform teaching time are shown as Scenario A in Exhibit 4: all faculty spend the same amount of time on research and teaching using the standard 40-40-20 split between teaching, research and service. In Scenario B, the 30 percent most research-productive faculty shift half of their teaching time to research, resulting in a 20-60-20 workload and remaining faculty shift half of their research time to teaching resulting in a 60-20-20 workload. Scenario B in Exhibit 4 illustrates that the specialization scenario delivers 20 percent more research and 20 percent more teaching than uniform work load scenario.^{20}

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^{19} Michael Skolnik has noted that data from part of the project could be used by other researchers to examine various types of correlation and multi-variate analyses using such variables as age, years of experience, rank, teaching load, salary, gender, and grant and contract funding, aimed at trying to examine the determinants of research performance. This could open up a large and interesting body of research by being able to utilize a readily obtainable dependent variable to measure research performance.

^{20} The gains can be pushed even higher with more specialization: 30 percent more research and 30 percent more teaching is produced in a scenario with a 5-75-20 split for the first decile, 10-70-20 split for the second, 35-45-20 for the third, 50-30-20 for the fourth, and 70-10-20 split for all the others. However, the distribution of time among professors in most provinces, including Ontario, likely already a degree of specialization, with the most productive researchers having lower than
The gains from specialization are highlighted in papers by the Higher Education Quality Council of Ontario (HEQCO) that argue that enhancing differentiation is likely the best way for the province to simultaneously improve its research and teaching performance (Weingarten and Deller, 2011; Weingarten, 2011).

The allocation of a portion of the operating grant on the basis of research performance would result in some institutions receiving more per faculty member than others do. The institutions receiving less per full-time professor from the research portion of the operating grant have a financial incentive to focus more effort on teaching. They could gain more operating dollars per professor from the teaching portion of the operating grant by having full-time faculty do more teaching and by winning a greater share of any performance funding that is based on teaching quality.

Research performance funding would therefore act both as “research enhancement funding” (because it would serve to increase the research contribution that the provincial university system makes with the dollars available) and also as “differentiation enhancement funding” (because it would be the chief policy instrument for enhancing differentiation in the university system). Over time, the distribution of part of the operating grant based on research contribution would encourage each university to specialize in fields where it could attract the best researchers and to allow the best researchers to increase the fraction of time they devote to their research. It would simultaneously act as a financial incentive for each university to encourage professors who, despite being commendable scholars, are less productive researchers to average teaching, so the available gains would not be as great as in this model in which the base case has a uniform time distribution for all faculty.
shift some of their research time to teaching while still allowing sufficient time to maintain their scholarly engagement.

8. *Distinguishing research performance from scholarly activity*

Many professors and university administrators worry that greater specialization and differentiation would undermine the scholarly character of faculty work at institutions that received a lower proportion of available research funding. In judging the merits of this concern it is useful to distinguish between scholarly activity and research performance.

We can all agree that all university professors should act like scholars and actively engage in scholarly work. All professors should exhibit scholarly habits of mind, display a desire to inquire and understand, and share a commitment to transmit knowledge to students and the broader community. All professors should engage in activity that contributes to the scholarly culture of their university. This scholarly activity supports the university teaching function by enabling professors to stay abreast of their fields, by providing an opportunity for students to engage in research inquiry, and by helping to create a scholarly educational environment throughout the university.

But the two principal university outputs – knowledge transfer (teaching and community engagement) and knowledge creation (research) – have dramatically different production characteristics. Most of a professor’s knowledge transfer activity is *local* (with specific students at specific courses at a specific institution and community) and non-competitive (the value of Professor Smith’s knowledge transfer work is not substantially affected by the quality of Professor Jones’s teaching down the hall). In contrast, most of a professor’s knowledge creation activity is *global* (research output is available to the world) and very competitive (Professor Smith’s discovery is not a discovery if Professor Jones publishes first and Professor Smith’s theory is not particularly valuable if it is demonstrably inferior to the one just published by Professor Jones). Not all scholars can be expected to be capable of high research performance. A university professor can make a very valuable scholarly contribution to his or her

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21 Partial exceptions are found in the non-local contributions to knowledge transfer that some professors make through: 1) producing teaching materials, including textbooks; 2) participating in national and international professional bodies; and 3) providing commentary through public media with an audience broader than the local community.

22 There are, of course, complementary as well as competitive aspects of research, which is why citations are an important index of research performance, because of the power of cumulative activity to advance knowledge.
university, to students and to the community without ever developing an international reputation for research.23

The Commission on the Reform of Ontario’s Public Services has recommended that these two public purposes should be distinguished and that funding be tied to performance measures (Commission, 2012).24

9. Provincial spending on the operating costs of research and the potential size of a research performance fund

The public good nature of research – the fact that most of the beneficiaries of knowledge creation performed in the university lie outside the jurisdiction paying for the research – raises the question of who benefits, who should pay, and how much. Although it is reasonable to expect student tuition to contribute to the cost of maintaining a scholarly learning environment at a university, it is not reasonable to expect tuition to contribute a substantial amount to the specialized and intensive research activity that leads to knowledge creation. Research is best viewed as a public good that should be financed by the highest level of government willing to pay. In 2010-11 the Ontario university revenue from federal grants and contracts was $1.54 billion (COFO-UO, 2012b). Although it could be argued that the federal government is better

23 Most critics of proposals to increase the teaching orientation of the Ontario university system by shifting some effort of some faculty from research to teaching fail to make the distinction between scholarly activity and research performance. They assert that reducing the amount of time on research would damage teaching quality because university professors have to be active researchers to enable university-level student learning. Such concerns are unfounded (Clark et al., 2009). Extensive research on the linkage between research productivity and teaching quality has found the two to be essentially uncorrelated (Hattie and Marsh, 1996, 2004, Halliwell, 2008). We would all agree that excellent university teaching requires professors to be good scholars. Good scholars need time to devote to scholarly activity. But it is mistaken to conclude that this scholarly time needs to include months of the year trying to make an original research contribution or that time devoted to research needs to be anywhere near the same as the time devoted to teaching.

24 The Commission provided the following suggestions on the use of performance measures in funding university research and teaching: “The government should provide grants to post-secondary institutions in a way that allows them to maintain best practices, pursue continuous improvement and improve quality across the board. Setting outcome targets based on the individual mandates of each institution is integral because it is unreasonable and potentially unproductive to expect all institutions to deliver the same results. For some institutions, government might bias the performance matrix towards research output and productivity. For others, the performance matrix might be biased to excellence in undergraduate teaching” (Commission, page 241). The Finance Minister’s Budget Statement said: “Ontario needs to take strong action to balance the budget and build a better future. … To achieve these goals, we will transform the public and broader public sectors and, in so doing, how they serve Ontarians” (Ontario Ministry of Finance, page 1).
placed than the provincial government to pay all the costs of research, including the
operating costs for facilities and professorial salaries, the federal government has
traditionally seen its role as one of providing peer-reviewed, non-salary grants\textsuperscript{25} and this
is unlikely to change in the near future. The considerable support that the provincial
government provides to knowledge creation through contributions to the operating
costs of universities, including faculty salaries, can be viewed as part of the federal-
provincial arrangements for financing public goods in a federal state.\textsuperscript{26}

As we saw in Exhibit 1, the cost of faculty time available for research can be
estimated at $854 million. We should probably think of this as coming from the
provincial grant, rather than from tuition revenues. This means that roughly 25 percent
of the provincial operating grant in Ontario is currently devoted to providing faculty
with the time to do research. The total provincial contribution to university research is
substantially more than this. In addition to $374 million in sponsored research (COFO-
UO (2012a), the Ontario government contributes to the salary costs of support staff,
equipment and the operation and maintenance of facilities. The contribution by the
provincial government to the operating costs of research in Ontario universities is thus
likely in the same range as the $1.5 billion federal contribution to sponsored research.

This submission proposes that Ontario should allocate a substantial portion of the
provincial operating cost contribution, say $750 million per year, on the basis of the
research performance of faculty. (A similar amount could be assigned to a teaching
performance fund along the lines of the “Teaching Enhancement Fund” proposed in
Clark et al., 2011,\textsuperscript{27} with the remainder of the $3.3 billion operating grant allocated on the

\textsuperscript{25} The federal government provides provinces with a per capita Canada Social Transfer (CST)
which, in theory, includes a component for postsecondary education. However, this is a block
transfer that requires no real link to university operating funds. With the introduction of the
Canada Research Chairs program and the Indirect Costs of Research programs in the last decade,
the federal government is paying for more of the operating costs of research than it did
previously, but the provincial government still makes a much larger contribution to operating
costs, which include those associated with the university research mission.

\textsuperscript{26} An argument can also be made for the Ontario-specific benefits in the form of attracting and
retaining world-renowned researchers who enhance the province’s reputation as a place to do
directive work and who are available to interact with Ontario citizens, entrepreneurs, and
businesses. This can be a hard argument to make in tight fiscal times. Perhaps this is why critics
of proposals to shift some effort of some faculty members from research to teaching do not
usually make claims about the value to Ontario of the foregone knowledge creation.

\textsuperscript{27} Clark, Trick and Van Loon (2011) proposed that Ontario could improve the quality and cost
effectiveness of undergraduate education by redesigning its operating grant to fund teaching and
research separately, with performance funding built into both components. They proposed that
the teaching grant would be allocated such that, when combined with students’ tuition revenues,
every university would have equal funding per student, weighted by program and level of study.
This grant should include support for the time that every faculty member requires to undertake
current basis of enrolment weighted by field of study. The $750 million research performance fund would be equivalent to roughly $50,000 per full-time faculty member, given that there are approximately 15,000 full-time tenure-track faculty in Ontario universities.

10. Incentive effects

A government could obviously choose to distribute a smaller amount of the operating grant on the basis of research performance, and could assign any amount to an RCU. A government may want to align the amount distributed according to research performance with the amount distributed according to teaching performance.

The operation of a $750 million performance fund would have the effect of moving up to $50,000 per low RCU faculty member to universities with a higher proportion of professors in the upper deciles of research performance. The incentive effects on the research-teaching mix are readily apparent. Professors in the top decile attract enough research performance funding ($163,000 in the example shown in Exhibit 2) to pay most of their salary and benefits. A university could afford to hire such professors without increasing enrolment.

Let us look more closely at the financial incentives on a university of having a professor whose research performance is less than that of the average professor in the field, who attracts, say, $30,000 less from the operating fund once the research performance fund is introduced. The university could compensate for this $30,000 revenue reduction through some combination of increasing its share of the teaching performance fund, increasing the proportion of courses taught by sessionals, increasing the average class size, or increasing the teaching load of full-time faculty.

The scholarship that informs university-level teaching and would be supplemented by a “Teaching Enhancement Fund” allocated on the basis of institutional proposals as part of accountability agreement process. The research grant would have two components. The first would provide every university with a basic amount of research funding to support the additional time that faculty spend on scholarly activity beyond that directly connected with their teaching, without regard to field of study, in the form of a flat amount per full-time faculty. The second component would be a performance-based “Research Top Up” to be allocated in proportion to the institution’s “receipts from the national granting councils and other performance-based criteria.”

In Ontario, the bulk of the operating grant is calculated on the basis of enrolment weighted by “basic operating units” (BIUs). For example, first year undergraduates in arts and sciences carry a BIU weight of 1; PhD students carry a BIU weight of 9.

Estimates using typical numbers in the Ontario university system suggest that the $30,000 could be made up by replacing a full-time professor with sessionals in 1.33 courses, or by having the full-time professor take 25 percent more students in each of her classes, or by increasing the number of courses assigned to the professor by 1 one-term course per year (a 25 percent increase). These numbers are based on the average cost of teaching a course by a full-time faculty
institution could increase its funding per professor from the teaching grant by increasing the number of students per professor (if the number of faculty were held constant enrolment would have to increase by about 5 students\textsuperscript{30} for each $30,000 reduction associated with the operation of the research performance fund) and/or by increasing the institution’s share of any teaching performance funding. The latter funding could enable to institution to increase quality by substituting sessionals with full-time faculty or by increasing the faculty to student ratio from what it would otherwise have been.

In sum, the operation of such incentives would lead to a redistribution of teaching time and research time among the professoriate in the provincial system of universities. Universities would encourage the most research productive professors to increase their time on research and would encourage other professors to increase their teaching loads from the current norm of 2 + 2 to something closer to 3 + 2 or even to the 3 + 3 that was the norm thirty years ago before governments and universities began to create incentives for all faculty to spend more of their time doing research.\textsuperscript{31} The net result would be a university system that produced substantially more research and substantially more teaching from the same overall expenditure.

11. Use of research performance measures for system comparisons

The processes described in this paper are designed primarily to make institutional comparisons within a university system. However, elements of the methodology could be used to make comparisons of a provincial system with other systems or to make

\textsuperscript{30} We can estimate the required enrolment increase to enable the professor to “earn” the $30,000 associated with the loss of operating budget associated with his lower than average research performance by teaching an additional one-term course. If the average class size is 50 and about $6,000 of the per-student revenues (currently an average of about $13,400 coming from tuition and operating grant) is associated with the course expense, then an increase in enrolment by 50 would yield $300,000 to be “earned” through teaching. The increase in enrolment required to pay for the professor’s $30,000 in increase in teaching earnings would therefore by about 5 ($300,000/$30,000).

\textsuperscript{31} The recent survey of faculty on university quality and faculty priorities conducted by the Ontario Confederation of University Faculty Associations suggests that many faculty members might support the idea of increasing their allocation of effort toward teaching if they believed that this aligned with their institution’s priorities. The survey found that faculty value teaching more than they believe their institutions do: 47 percent of faculty ranked teaching as the most valued aspect of their academic career (compared to 48 percent for research) whereas only 30 percent of faculty believed that their institutions ranked teaching as most valued (compared to 61 percent for research) (OCUFA, 2012).
comparisons of specific institutions or groups of institutions with selected comparators in other jurisdictions.

For example, it would be relatively easy for the RAO to generate bibliometric data for faculty at other North American universities and grant-success data for other Canadian universities. Comparisons could then be made, for example, between the bibliometric and grant-success performance of Ontario medical-doctoral universities with those in Quebec, BC and Alberta. Comparisons could be made on bibliometric measures between the most research-intensive Ontario universities and American public universities such as the University of Michigan or those in the University of California system.

12. Criticisms of research assessment and performance funding that are at least partially addressed in the new process

The new process addresses many of the criticisms raised about previous designs of research assessment exercises.

Costs and paper burden. Because the RAO’s data collection uses readily available public information, its data-gathering costs would be very low. A very attractive feature of the new process, relative to a UK-style research assessment exercise, is that it places no burden on universities to generate submissions and, after it is set up, requires relatively little cost to operate. The process has the added advantage of providing an incentive for all professors and all universities to make have current information on their web sites.

Differences among fields. The new process uses a comparison-within-field approach that does not require the same performance measures in each field. More areas of assessment (fields and subfields) could be used than those in traditional research assessment exercises without substantially increasing the cost or complexity. All that is

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32 If a Master’s-level research assistant paid $30 per hour could enter the bibliometric and grant-success data at the rate of 5 professors per hour, the cost of gathering the data for 15,000 professors would be about $90,000. The cost of annual updates would be even less. One could imagine the RAO work in Ontario being done by the half-time work of a director-level public servant designated the Research Assessment Director, supported by one analyst, and a budget of $100,000 for research assistants, $50,000 for web services and $50,000 for the travel costs of advisory panel members for total costs of less than $500,000 per year.

33 For example, one could imagine the following kind of rules: 1) annual RCU calculations will be based on material on university web sites on May 1 each year. 2) The bibliometric data would be generated by HEQCO from Google Scholar searches during the month of May, and would begin by looking at the Google Scholar personal profiles developed by individual professors if the professors choose to create such a profile. (The advantage of each professor creating her own profile is that she may know of publications that were under another name or set of initials that a semi-automated process run by HEQCO would not pick up.)
needed is sufficient numbers of professors in the province – say, more than 20 – for distribution models to apply.

Spurious quantification. Although faculty in most fields instinctively resist the idea that their creative contributions can be characterized by a quantitative performance measure, all professors are accustomed to having their performance compared in an ordinal fashion with others during hiring, tenure and promotion processes and in grant applications or award adjudications. In the methodology proposed in this submission, all that is needed to generate the RCU$s to be used for calculating the distribution of the research performance fund is the ordinal ranking of each professor’s contribution relative to others in that field in the university system.

Gaming the system. Although professors and institutions would obviously look for ways to increase their scores in the new process, it is relatively difficult to do. The granting council award statistics are what they are. Bibliometric indices are subject to gaming behaviours like self citation, citation by friends, splitting papers, and the like. But if one reflects on what it would take to increase an h-index – say from 13 to 14 to move into the top decile in politics and international studies – it would actually be quite hard to do by any means other than producing a new scholarly publication that would be cited in 14 other academic articles. Algorithms can be designed so that they are not sensitive to a few outlying cases. For example, in the algorithm described in this paper, extremely high performance measures for a few professors who are already in the top five percent would not affect their RCU number or the institution’s total RCU$s.

Undervaluing scholarship. The new process need not impoverish the scholarly endeavours of faculty who are not active researchers. Research contribution is not the same as scholarly endeavour and the purpose of the new process is to compare research performance, not scholarly value. A professor can be active in scholarly activity and make important scholarly contributions in the classroom, the university and the community without making a substantial contribution to world knowledge. The proposed resource allocation mechanism could make adequate provision for all university professors to engage in such scholarly activity whether or not they make significant contributions to research and whether or not they have earn enough RCU$s to enhance their university’s research-related allocation from the operating grant.

Distorting academic priorities. The new process distributes resources at the institutional – not the individual – level. Many of the problems associated with the use of research performance measures to make decisions about individuals are not problems when making comparisons at the institutional level because the law of large numbers causes many anomalies to average out. For every case at institution X where the performance measure underestimates research performance (e.g., for professors not receiving much grant funding or publishing many articles but who make a profoundly
important contribution through a few great books) there will likely be a case at the same institution where the indicator overestimates the contribution (e.g., where most of the author’s articles are published in and cited in low impact journals). In any event, provosts, deans and department chairs would continue to be free to exercise their judgement to hire and promote a scholar who they believe is a better researcher than the RCU might suggest.

University autonomy and field priorities. The new process would not, in itself, change the priority associated with different fields of study within the university. The process uses measures that are determined on a field-by-field fashion and the distribution of system RCUs is determined by the distribution of faculty positions across the fields. The new process would allow a government to assign different weightings to RCUs in different fields. But such a resource allocation decision – how much research Ontario should support in each field – would have to be tackled more explicitly than it is today. The new process would operate in a publicly transparent way and all calculations would be made public and available for comment by interested parties.

Managing adjustment. Finally, concerns about adjustment impacts can be addressed. Unlike research assessment exercises that operate every five to eight years, the proposed process would be conducted annually. There would not be rapid year-to-year fluctuations because an institution’s share of the research performance fund is based on a large number of data points (RCUs of all professors) and these will not change quickly. As for the initial adjustment, the new system could be phased in over a number of years. For example in Ontario the government could increase the amount of the operating budget going to the research performance fund by $100 million per year until it reaches $750 million.

These advantages will not persuade everyone. At the end of the day, the new resource allocation process is intended to be one of the “ways, through reform, to deliver government services more efficiently” and, in so doing, “transform the public and broader public sectors.” Those institutions and professors who do not see such reforms and transformations as being in their interest are not expected to be impressed by ideas for making the process more timely, more transparent, and less costly. Taxpayers and students, on the other hand, should welcome a smarter process for allocating funds to achieve public purposes in the university sector, one that would generate both more research and more teaching from available public resources.
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