

Australia Is Not Maximising the Return on its Research Investment

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Australia is losing about \$425 million dollars worth of potential return on its public investment in research every year. The Australian Research Councils spend about \$1 billion dollars yearly, which generate about 32,000 research journal articles. But it is not the number of articles published that reflects the return on Australia's research investment: A piece of research, if it is worth funding and doing at all, must not only be published, but *used, applied* and *built-upon* by other researchers. This is called 'research impact' and a measure of it is the number of times an article is cited by other articles ('citation impact').

In order to be used and built upon, however, an article must first be *accessed*. A published article is accessible only to those researchers who happen to be at institutions that can afford to subscribe to the particular journal in which it was published. There are [24,000](#) research journals in all, across all research fields worldwide, but most institutions can only afford a small fraction of them. In paper days, authors used to supplement this paid access to their articles by mailing free reprints to any would-be users who wrote to request them. The online age has now made it possible for authors to provide free 'eprints' (electronic versions of their own final drafts) to all potential users worldwide who cannot afford the journal version by 'self-archiving' them on the author's own institutional website.

The online-age practice of self-archiving has been shown to increase citation impact by a dramatic [50-250%](#), but so far only **15%** of researchers are doing it. A recent UK international survey has found that **95%** of authors *would* self-archive – but only if their research funders or their institutions required them to do it (just as they already require them to 'publish or perish'). The solution is hence obvious:

After lengthy deliberations first initiated in **2003** by the UK Parliamentary Select Committee on Science and Technology, [Research Councils UK](#) have proposed to adopt a policy requiring UK researchers to deposit, on their university's website, the final author's draft of any journal article resulting from RCUK-funded research. The purpose of the proposed policy would be to maximise the usage and impact of UK research findings by making them freely accessible on the web ("open access") for any potential users in the UK and worldwide who cannot afford paid access to the published journal version. How would a similar policy maximise the return on the Australian public investment in research?

It is not possible to calculate all the ways in which research generates revenue. A good deal of it is a question of probability and depends on time: Although everyone

thinks of an immediate cure for cancer or a cheap, clean source of energy as the kind of result we hope for, most research progresses gradually and indirectly, and the best estimate of the size and direction of its progress is its citation impact, for that reflects the degree of uptake of the research results by other researchers, in their own subsequent research. Citation impact is accordingly rewarded by universities (through salary increases and promotion) as well as by research-funders (through grant funding and renewal); it is also rewarded by libraries (through journal selection and renewal, based on the journal's average citation "impact factor"). Counting citations is a natural extension of the cruder measure of research impact: counting publications themselves ("publish or perish").

If citations are being counted, it is natural to ask how much they are worth.

The marginal dollar value of one citation was estimated by Diamond in **1986** to range from \$50-\$1300 (US), depending on field and number of citations. (An increase from 0 to 1 citation is worth more than an increase from 30 to 31; most articles are in the citation range 0-5.) If we update by about 170% for inflation from 1986-2005 (\$85.65-\$2226.89) and convert from US dollars to Australian dollars, this yields the range \$113-\$2942 as the marginal value of a Australian citation to its author today. Self-archiving, as noted, increases citations by 50-250%, but, as also noted, only 15% of the articles being published are being self-archived today.

We will now apply only the most conservative ends of these estimates (50% citation increase from self-archiving at \$113 per citation) to Australia's current annual journal article output (and only for the approximately 32,000 Australian articles a year indexed by the Institute for Scientific Information, which covers only the top **8000** of the world's 24,000 journals). If we multiply by the 85% of Australia's annual journal article output that is not yet self-archived (27,200 articles), this translates into an annual loss of \$1, 536,800 in revenue to Australian researchers for not having done (or delegated) the few extra [keystrokes](#) per article it would have taken to self-archive their final drafts.

But this impact loss translates into a far bigger one for the Australian public, if we reckon it as the loss of potential returns on its research investment. As a proportion of Australia's yearly \$1 bn research expenditure (yielding 32,000 articles x **4.7** = 150,400 citations), our conservative estimate would be 50% x 85% x \$1 bn = about \$425 million dollars worth of loss in potential research impact (76,160 potential citations lost). And that is without even considering the wider loss in revenue from the loss of potential practical applications and usage of Australian research findings in Australia and worldwide, nor the still more general loss to the progress of human inquiry.

The solution is obvious, and it is the one the RCUK is proposing: to extend research's existing universal 'publish or perish' requirement to 'publish and also self-archive your final draft on your institutional website'. Over **90%** of journals already endorse author self-archiving and the international author survey -- plus the actual experience of the two institutions that have already adopted such a requirement (CERN and University of Southampton ECS) -- has shown that over **90%** of authors will comply.

The time for Australia to close its own 50%-250% research impact gap is already well overdue. Australia should immediately follow the UK model, adopting the web-age extension of "publish or perish" policy to "publish and self-archive on the web. " This tiny and very natural evolutionary step will not only be of enormous benefit to Australia's researchers, its institutions, its funders, and its funders' funders (i.e., the tax-payers), but it will also be to the collective advantage of worldwide research progress and productivity itself.