5. Hypercompetition: Observations and Remedies

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In response to the Te Ara Paerangi Future Pathways Green Paper Consultation, this paper reviews the case that the current funding environment is hypercompetitive, with negative implications on research and the well-being and diversity of the research workforce. Evidence for hypercompetition includes impacts on the workforce such as accumulating precarity across PhD student and post-doctoral funding, poor diversity outcomes that resist policies aimed at improvement, and funding rates in the 10% range for contestable proposal systems. It may be important to avoid positive feedback causing the rich-get-richer Matthew effect, such as avoiding overlap between funding mechanisms that can amplify a cycle of more researchers applying to contestable funding, undermining the potential to increase funding in response to low funding rates. Recommended solutions include well designed base funding, fellowships, reform of competitive funding mechanisms, and smaller funding packages, along with direct collaborative or international exchanges. Ensuring more effective and equitable future research funding through more anticipatory science policy may be achieved by improved monitoring focusing on the success, connectivity and responsiveness of independent research organisation and the early career tracks of researchers.

Introduction

The Ministry of Business, Innovation and Employment (MBIE) is currently undertaking an extensive consultation process on Te Ara Paerangi - Future Pathways Green Paper. This consultation process aims to design a pathway for major changes to research institutions and funding in Aotearoa, New Zealand. In response to the consultation, this paper reviews the case that the current funding environment is hypercompetitive, with negative implications on research and the well being and diversity of the research workforce. International literature suggests that hypercompetitive funding schemes generate working conditions in which bullying in the workplace is rife, diversity improvements stall, and conditions for early career researchers are not consistent with attracting and retaining a highly qualified workforce. We examine available data on career path, workforce and funding characteristics relative to the literature suggesting growing concerns about the sustainability of careers under hypercompetitive conditions.

Career tracks and precarity

A consequence of the hypercompetitive funding schemes is the precarity of employment for early career researchers (ECR: includes PhD students, as well as postdoctoral and research fellows) in the science workforce.[1,2] The pandemic's halt to international mobility has drawn stark attention to the contrasting predicaments of PhD students and precarious postdoc and research fellow contracts, and the role of hypercompetitive funding. Figure 1 shows the strong upward trend of doctoral enrolments in recent years. Unfortunately, the ratio of doctoral completions is nearly twice the multiplier expected if each doctorate takes three years (Figure 2) and has varied considerably, partly due to increases in international student numbers.

After graduating with a PhD, ECRs often rely on funding grants to support their salaries and keep themselves employed in New Zealand, while many used to migrate overseas to negotiate this career stage. When a funding grant is unsuccessful, a researcher is either left without a job, or has to seek funding elsewhere. The emotional toll taken on young researchers cannot be overstated, as they are left feeling like they have failed and concerned as to how they can support their family. Perhaps the greatest concern raised is the degree to which they should have been better informed about the potential for poverty traps within research roles. The reality described below and experienced by students – years of precarity with gaps in employment or incomplete remuneration – does not align with training stipends, which are largely paid below minimum or living wage levels.

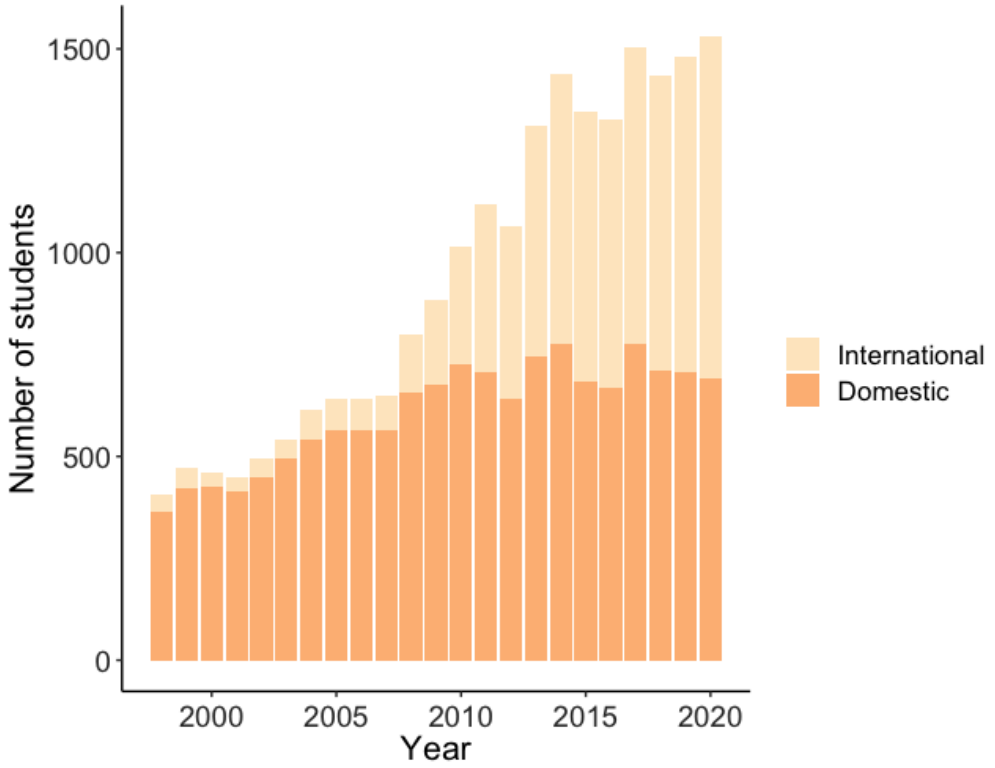

Figure 1: Doctoral completions in New Zealand Universities from 1998 to 2020.

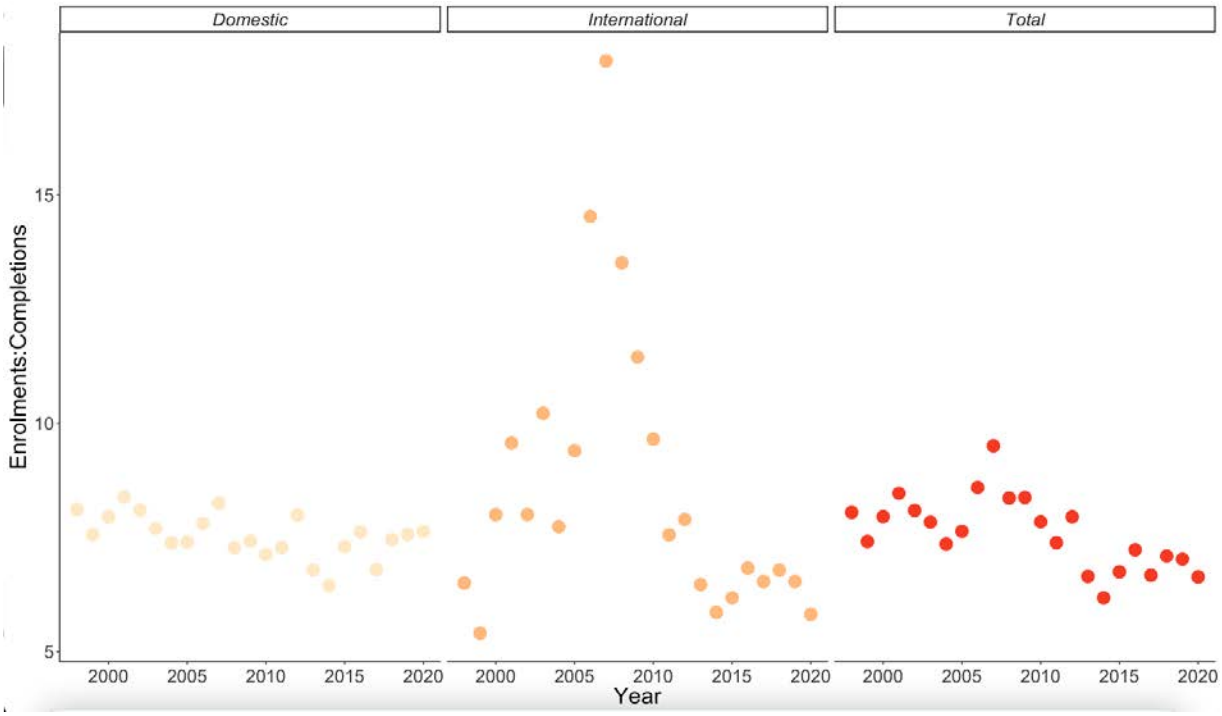

Figure 2: The ratio of enrolments:completions for doctoral students at NZ universities each year. The spike in international enrolments in 2006 reflects the lowering of international student fees for PhDs to match domestic fees.

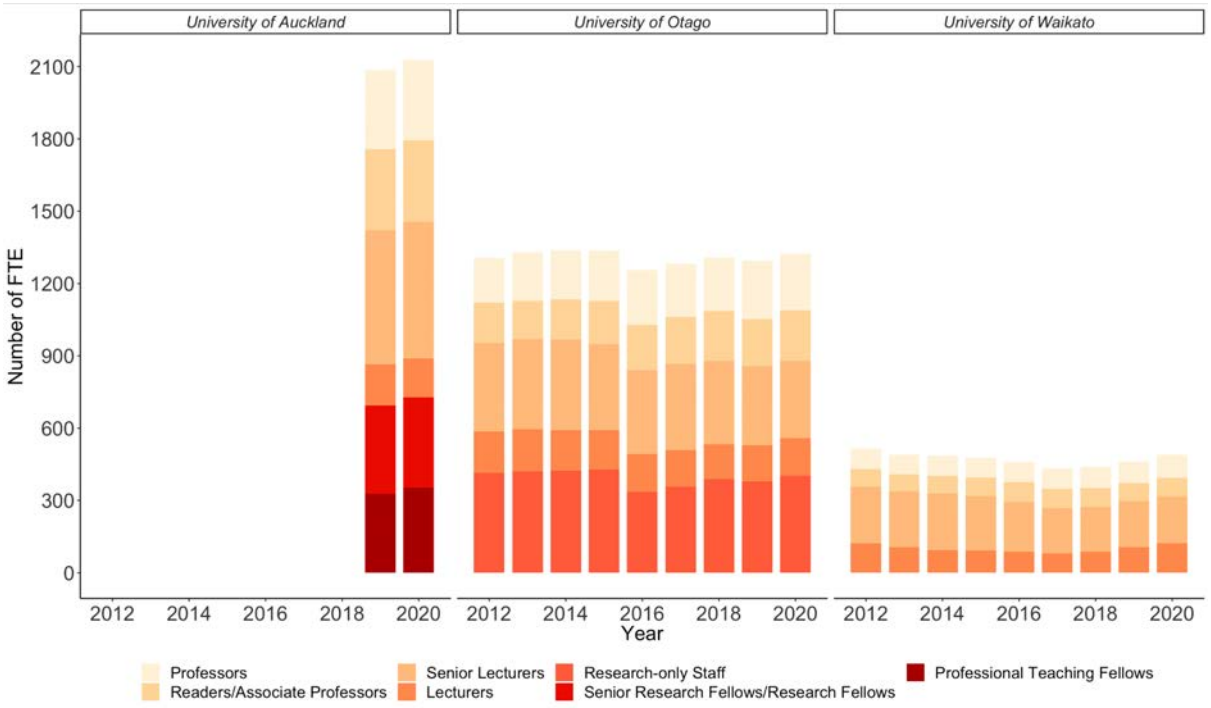

Figure 3: Number of academic FTEs employed at New Zealand Universities, taken from annual report data from three Universities: University of Auckland, University of Otago and University of Waikato.

Data from university annual reports indicates that the number of PhD students completing their studies each year is increasing rapidly (Figure 1), suggesting more potential

postdoctoral fellows are entering the workforce and applying for the limited contestable funding. Although the number of researchers eligible for postdoctoral fellowships is increasing, the number of staff employed as FTEs in permanent academic positions (lecturer and above) is remaining fairly stagnant (Figure 3), suggesting that more researchers are being fed into a pipeline that does not generate permanent academic or research positions for them. Little is known about their career paths.

A further concern created by contestable funding is the realisation of the Matthew Effect: the "rich get richer".[3] To procure further funding on a research grant that is running out, significant outputs need to be achieved from the current grants (publications, significant data outputs, etc.). A research group that is well funded will have greater resources to provide evidence on the importance of their research compared to a smaller research group with less money. For many disciplines, three years is not sufficient to generate reasonable data to justify further funding grants, but this is the maximum length of time provided on grants such as the Marsden and Smart Ideas funds. In particular, it now appears plausible that the successful calls to increase the size of the Marsden Fund and other contestable funding pools have combined with PBRF incentives to train PhDs not well matched to Aotearoa's unique workforce needs.[4] The problem could be amplified if PBRF goes beyond providing incentives, to providing funded support for proposal preparation.

Career dilemmas and traps

The hypercompetitive research environment can lead to researchers cutting corners to make their research more attractive. To receive promotions and gain permanent employment, an ECR's performance is measured by the number of publications they produce through their research. These publications can hold different weights when published in a "high impact" journal, such as *Nature* and *Science*. *Alberts et al.* has quoted "the inflated value given to publishing in a small number of so-called 'high impact' journals has put pressure on authors to rush into print, cut corners, exaggerate their findings, and overstate the significance of their work".[5] Such findings lead some high profile scientists to stop publishing in such "luxury" journals, but this is a privilege awarded to those who have already generated a significant career out of research.[6,7] For a newly graduated PhD student, the number of publications, especially in high impact journals, is a key metric used to develop their CVs and to get promoted/secure permanent employment.

For a PhD student that is soon to be entering the workforce, this paints a grim picture. The skills that are taught to these students are effective research skills, designed to push them towards the academic pipeline, but their career prospects after this are not particularly promising. There is an observed increase in the number of PhD students that are enrolling every year with no major job prospects towards the end.[8]

The effect of COVID-19 can be observed on a plot of yearly doctoral enrolments for 2020. Understandably, there is a dip in international enrolments as New Zealand closed its borders in 2020. There is also a dip observed in domestic enrolments. This plateau was bound to happen, as the growth of doctoral students was becoming unsustainable in the long run, and a carrying capacity must be reached.[9] Better understanding across the transition from growth to carrying capacity could be achieved by passive monitoring of collaboration size and connectivity using citation networks (as proposed by Te Pūnaha Matatini's Kindness in Science Project).

Diversity and Inclusion

A hypercompetitive environment breeds exclusivity: only those willing to participate can stay in the game. This breeds a toxic work environment as success rates decrease.[10]

Female ECRs are less likely to participate in the hypercompetitive environment, which can be attributed to a number of factors[11]. This is observed in the published statistics of successful Marsden funding rounds that indicate that after an increase in female principal investigators from 2000 to 2014, this value has plateaued between 30 and 35%. Similarly, Māori researchers are connected to their whānau and community, often performing cultural double shifts[12] limiting their response to hypercompetition, with a similar result. There is little room for career breaks in a hypercompetitive environment, as often a high throughput of funding and publications is required to be successful for further funding. Female, Māori and Pasifika researchers are more likely to take substantial career breaks, primarily for parental or family-related leave, and be unable to travel overseas where stable postdoctoral roles are more obtainable.

For the academic workforce in universities, this is observed as a skew in the positions populated by male vs female. The data collected from annual reports from the University of Otago indicate that men dominate at the higher level positions such as Professor and Associate Professor. Meanwhile, women dominate in the “research-only” and “teaching” related roles. The implication that women make up a majority of the “research-only” workforce but only ~40% of the successful funding grant applicants shows that they are not receiving adequate funding to move through the ranks in an academic workspace.[13]

This indicates that there needs to be a larger push to increase diversity in the system as leaving the system as it is will not fix any problems. Recent work by Steeves et al. has suggested the need for ‘Kindness in Science’, which creates a relatively simple solution to increase diversity in the workplace whilst approaching the issues with an intersectional lens.[14]

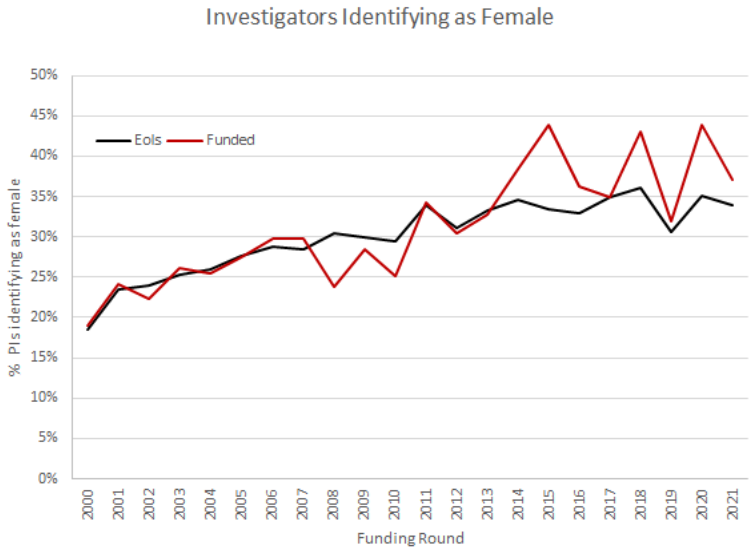

Figure 4: The percentage of responding female Principal Investigators in the Marsden Fund for the 2021 round.[15]

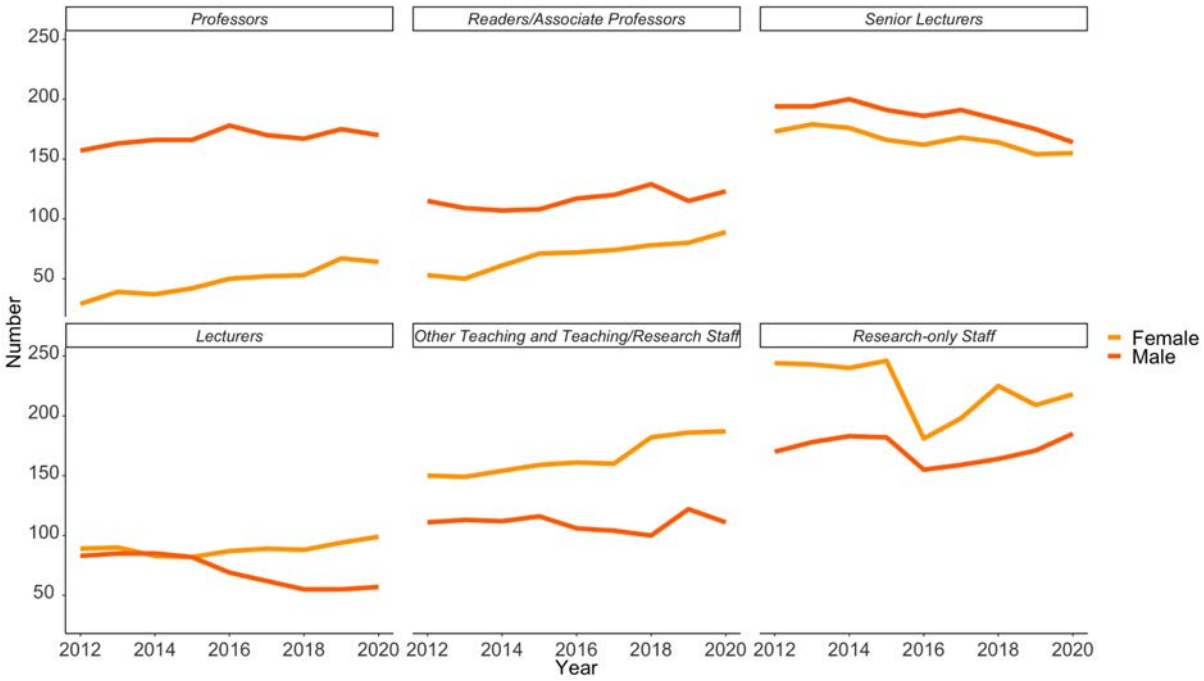

Figure 5: Gender of FTE in academic positions at the University of Otago from 2012 to 2020.

Funding mechanisms and rates of Success

An underlying source of hypercompetition has been the fundamental decision to create a fully contestable research system.[16]

One of the most highly sought after funding grants within the science community is the Marsden Fund, established in 1994 and distributed by Te Aparangi Royal Society. The fund is designed to fund excellent fundamental research with two main funding grants: the Fast-Start grant for ECRs ($120,000 per year up to three years) and the standard fund (flexible up to three years, typical awards can range from $500 to $900,000).[17]

As the number of proposals every year has increased, the amount of funding available through the Marsden Fund has been increased, from $33 million in 2006 to $78 million in 2021. Despite this increase in funding available, the success rate has remained largely unchanged at 10-12%. It is unclear whether a larger cash injection would lift the success rate of such funding grants, with the possibility that institutional funding such as PBRF simply supports more researchers to submit more applications.

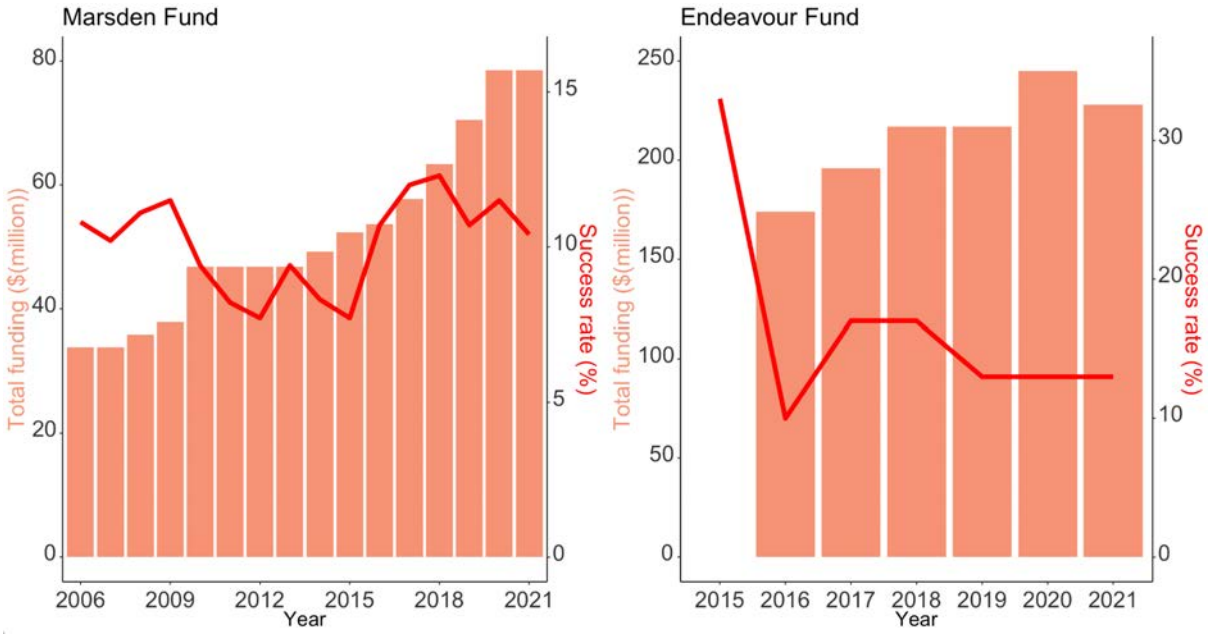

Figure 6: Success rate of Marsden and Endeavour funding grants compared to the amount of funding available. Endeavour formally began in 2016, replacing a targeted system with higher funding rates.

The low rate of success for funding grants brings into question the true cost of the grant. Hours of unpaid work are put into writing up a full grant proposal, which can be taxing on the time of an already overworked workforce. Relatively straightforward calculations suggest the value of unsubsidised proposal writing collapses at roughly 10% funding rates.[18] Rates in this range or below suggest that many more fundable proposals would be submitted if more funds were available. Further, although there is evidence that funding improves impacts and careers, there is no evidence that the ranking in highly selective proposal processes selects better proposals above the cutoff.[5,19] Agricultural research suggested that regular provision of agricultural research funding had a 60% social rate of return, and that a shift to competition did not improve on this.[20–22]

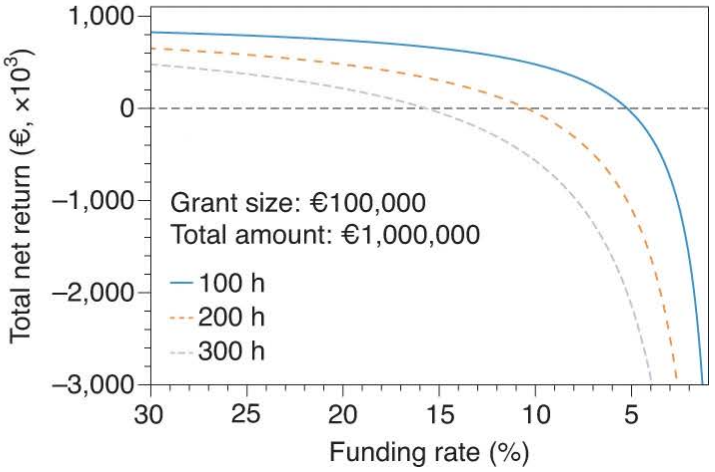

Figure 7: As depicted by Dressler et al. (2022) competitive funding schemes have success rates, typically near 10%, at which they are net cost to applicants after considering salary costs associated with proposal writing.

It had been argued that the Marsden fund should increase to the point where success rates were closer to 15% or 20%. Repeated and significant increases in the funding pool available have lifted the funding rate back to the 10-12% range but not above. Why?

Interestingly, the increase in funding available through the Marsden fund has only been picked up by universities, with the number of applications by CRIs remaining largely unchanged.[23] This shows that CRIs are not seeing the net gain in funding from such grants as fruitful, meaning that majority of the funding grants go to universities. From a university perspective, academics are expected and encouraged to apply for external funding and the Marsden grant is one of the few options available to NZ scientists.

US analysis finds that combining contestable and base (or 'earmarked') institutional funding sources can lead to the double-funding problem.[24] One aspect of this problem that anecdotally may dominate in New Zealand is the use of existing funding to compete for additional funding, whether it be competitive or commercial. Current allocations run the subsidising public institutions to outcompete independent research organisations. That would be unfortunate, as independent research organisations have been seen as important in particular areas and in filling gaps or making connections. This was an important consideration in the 1980s reforms of research[16,25] and may have only recently been undermined, creating difficult conditions for independents. An alternative is to put tight contracting conditions on public funding but this also limits flexibility and could exacerbate current concerns that contracting chains are over-complex. Base funding linked to individuals working within a system that incentivises cooperation and collaboration, with some competitive incentives, appears to be an innovative alternative.

Recommendations and potential solutions

A number of recommendations have been reviewed to improve funding systems to generate better outcomes for the research community[26]:

- Well designed base funding can address hypercompetitive forces by providing an anchor for the stability, capacity and well being of researchers, infrastructure, and systems. Issues with precarity can be addressed and steps taken to ensure base funding does not simply mean more support for more researchers competing in contestable funding rounds[9]. In the first instance, rebalancing of funding systems away from the over-incentivisation of PhD scholarships and toward functional careers is needed.
- Fellowships, primarily for ECRs provide a key core means to stabilise career development as well as new directions and connectivity. The loss of the main New Zealand Postdoctoral Scheme in 2010 was concerning at the time and has proven problematic, because it provided stable career pathways and had a funding rate of 30%. It has been replaced by the Rutherford fellowship schemes, which support rates in the hypercompetitive range. A range of options for fellowships can focus on connectivity to useful careers. For example, a proposal to create a government

Postdoctoral Fellowship scheme provides a pathway into the government sector for PhD students[27] and a similar proposal could be made to address the low number of PhD-qualified researchers in Business R&D.

- Competitive funding systems can be reformed to reduce hypercompetition. Pre-proposals for funding rounds reduce the workload of researchers as it gives an earlier indication of whether a proposal is likely to be successful. These are helpful for Marsden and Endeavour Smart Ideas, but can be further streamlined to improve equity and reduce effort. Rolling deadlines are a recent innovation that also appears more efficient. Both mechanisms can improve the demand on stakeholders asked to support research, and the likelihood that the system can provide useful feedback on assessed proposals that enable improved resubmission to be funded at a later date rather than abandoned.

- Very large funding packages with hypercompetitive funding rates deserve particular attention. The benefits of the Endeavour Research Programmes average funding size of $10 M over 5 years deserves assessment given the immense and increasing effort going into proposals with funding rates of 10–15%. Smaller funding packages may be more appropriate group investigator driven activity into mission groupings. The benefits of large programmes could be better achieved by creating mission-oriented targets for smaller proposals and additional support for exchange and collaboration across funded programmes addressing the same mission.

- Funding competitions may be particularly suited to enhancing flexibility and connectivity. For example, direct funding for international knowledge exchange also has considerable potential, but may be strongly limited by unnecessary current expectations of similar applications on each end of the exchange.

The recommendations above address a range of problems and are consistent with targeting hypercompetition. Future policies and their implementation deserve some monitoring to better detect hypercompetition or other deleterious outcomes. For example, a possible assessment mechanism with good sensitivity to the overall mix of funding policies may be the success of independent research organisations and the mobility of researchers to develop careers that respond to society's needs and drive innovation. The development of monitoring data for diversity, connectivity and the science policy capability to anticipate future problems across and within key fields appears to have been insufficiently provided for and should be prioritised.

Acknowledgements
We thank NZAS Council, Priscilla Wehi, the Kindness in Science team and others in Te Pūnaha Matatini who contributed ideas and support to this work. Te Pūnaha Matatini provided funding to support this work. Sneh Patel took primary responsibility for draft development; Troy Baisden provided original ideas and final shaping; Lucy Stewart provided additional ideas, familiarity with data, and editing; and Grace Yee provided graphics and editing.

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