Innovation and Frontier Firms – a submission to the Productivity Commission from Anne French Consulting Ltd

Overview

The Commission is to be congratulated on its assessment of the current situation with respect to frontier firms. However, it is our view that the Frontier Firms report should take a much more robust line in proposing policy changes. New Zealand has a tendency to put schemes in place and never revisit them to determine whether they are fulfilling the original intention. The Performance Based Research Fund is a case in point. Having achieved its original intention, to incentivise universities to ensure that their teaching was research informed, and to put more effort into research, it is now having an unhelpful effect on innovation and specifically on research to support innovation by firms. Having outlived its original purpose, it should go. Likewise, the current experiment with a large amount of devolved funding (to National Science Challenges in particular) has dramatically ramped up the cost of fund management without delivering commensurate benefits. Researchers will strenuously defend their access to soft money, but this should not deter the government from undertaking a review of the effectiveness of the research in addressing the 'challenges' and closing down underperforming programmes. This will usefully reinflate the Endeavour Fund and allow for better priority setting, especially with respect to addressing the huge and urgent challenge of climate change and decarbonizing the NZ economy.

I have provided some detailed commentary below on areas of current policy weakness, with some suggestions for strengthening our approach. My overall message is for **boldness.** For more than 20 years, successive governments have made the same points about New Zealand's low productivity and the need to invest in innovation. We score top marks for problem definition, but we have done poorly in addressing NZ's systemic problems. This arises in part because we are too timid: reluctant to put too much money into novel approaches, and reluctant to evaluate what we have spent our money on to assess whether it is working, or working as well as it should. Entrepreneurs understand the value of 'fast failure'; it's a skill our policy-makers still need to learn.

Finally, we have some high-falutin' ideas about research, especially that undertaken by universities. Much of it is a long way from the kind of research that will most benefit Kiwi firms. Likewise, our firms underinvest in training and developing staff, as the Commission

has shown in its previous work on skills. A solid skills development programme to improve management expertise and the absorptive capacity of firms will do much to close the gap. The rest can be closed by targeted immigration policies to attract newcomers with the skills and expertise we need, especially in leading companies to export-led growth.

New Zealand's innovation policy with respect to firms

Innovation helps our firms to be more productive. It is critical to long-term economic growth.

Innovation is a fundamental driver of long-term economic growth. It is **the application of something new that confers value**.

Research in science and technology is a key input to innovation.

But it can take a long time to demonstrate results.

Importantly, scientific research is only one input into innovation. Improving productivity growth requires firms to successfully incorporate knowledge into their products and processes. The successful adaptation and adoption of existing knowledge by New Zealand firms is critical to improving New Zealand's productivity.

New Zealand performs fairly well on some aspects of innovation, but poorly in knowledge absorption, impact, and diffusion.

New Zealand ranked 25th out of 129 economies in the 2019 Global Innovation Index (GII), which aims to 'capture the multi-dimensional facets of innovation'.[2] This was a drop of 10 places in only four years – a significant fall. It indicates that our current innovation systems and policies are not delivering. We think it is because they are not tailored to New Zealand's unique economic circumstances.

In terms of the factors underlying innovation, according to the GII we rate third in terms of credit,[3] sixth in information and communication technologies; well in regulatory, political and business environments (1st, 7th, and 18th respectively); fifteenth in education and twelfth in tertiary education. But NZ ranked only 23rd for R&D (gross expenditure on R&D as a

[2] The GII placed us at 15th in 2015. Global Innovation Index, 2019, published by Cornell University, INSEAD, and the World Intellectual Property Organisation.

[3] Though less well on 'investment' – 36th

percentage of GDP), 20th for knowledge creation (i.e. patents, scientific and technical, etc.), and 28th for innovation linkages (e.g. university/industry collaboration).

Worse, the GII rates us even more poorly on measures of knowledge absorption (41st), knowledge impact (63rd), knowledge diffusion (82nd).

That means we spend a lot of money on the inputs to innovation but we fail to capture the benefits. So while we rank highly in generating ideas, New Zealand firms perform poorly in commercialisation. We are not very effective at generating applied knowledge and even less so at turning it into commercial products. Upstream inputs into innovation do not necessarily flow through to downstream improvements in firms' products and processes.

Should this be any surprise?

New Zealand has been tumbling down the OECD ranks in terms of its per capita GDP for 50 years, and now sits around 20th, with Australia at 10th. In the late 1990s, there was a lot of excited talk in New Zealand about the 'knowledge economy'. Some useful analysis was undertaken. David Skilling, a Treasury economist at the time, showed that New Zealand's economic geography – the small size of our domestic markets and long distance to large international markets – was an important cause of the relative deterioration in our economic performance.[4] Earlier, international commentators such as Michael Porter had identified a fatal dependence on primary commodities, and the consequent negotiating weakness of being a price taker rather than a price maker in global markets.[5] Others said that thin capital markets were a rate limiting step, preventing capital investment and throttling innovation. Skilling also cites thin labour markets. Later commentators have identified other barriers to firm growth, new market entry, and internationalisation.

David Skilling's point about the size of the NZ economy has been borne out by recent analysis, which shows that large population size is helpful when it comes to growth, with country data from the 1850s to the present supporting the argument.[6] The policy

[4] David Skilling, 'The importance of being enormous: towards an understanding of the New Zealand economy', 2011. Australia, whose economy is 7 times bigger ($1.4 trillion in 2018, compared with NZ's $203 Bn, IMF figures) and is much closer to Asia, has not fallen as far down the OECD ranking in terms of per capita GDP as NZ. See https://www.researchgate.net/publication/228701486_The_importance_of_being_enormous_towards_an_understanding_of_the_New_Zealand_economy

[5] Crocombe, Enright, Porter, *Upgrading New Zealand's Competitive Advantage* (OUP, 1991), passim. Fonterra's farmer shareholders would be inclined to agree.

[6] 'Where growth is concerned, is population destiny?' *The Economist*, 17 April 2019. 'Long-run growth, they suggest, is driven by improvements in technology. And more populous countries should accumulate more innovation than smaller

prescription for a small, distant economy such as ours has been less clear. Nonetheless, economist Paul Conway has suggested the following: help small and remote firms into global markets, improve the matching of skills to jobs, moderate population growth to encourage capital deepening, improve competition to lift the contribution of services, and strengthen the economic return from science and innovation.[7]

Government policy has focused more on the generation of knowledge and less on turning it into new products or services. Do we have the balance right?

In 2017, more than **$800m** per annum was granted for knowledge generation (i.e. research and science) through major science funds such as the Strategic Science Investment Fund and the National Science Challenges. A further **$191m** went to support business R&D through Callaghan Innovation's Growth Grants ($154m) and targeted R&D funding ($37.5m).

In comparison, only around **$87.3m** was invested by the government in 2017 to support businesses to turn this knowledge into new or improved products, processes and services. This included $14m in repayable grants for start-ups to support business incubator and accelerator activities, $4.3m in incubators and accelerators, and $9m (2019) through the Pre-Seed Accelerator Fund, which supports the commercialisation of public research. Callaghan Innovation also received around $60m in 2017 to support businesses to develop and improve products, processes, and services.

Funding is generally targeted towards knowledge creation because it is a public good.

In deciding where and how to spend public funds, the New Zealand government generally invests in 'public goods' (e.g. roads, health care, schooling, etc.) because these goods and services are accessible to everyone and because they generate wider spill-over benefits. Research and science are generally considered a public good because the knowledge it creates can (theoretically) be accessed by everyone, and there are wider spill-over benefits that come from technological advancement. Yet little government support has been put into the commercialisation of knowledge (and it is mostly spent through universities and CRIs via the Pre-Seed Fund). Universities and CRIs also spend on commercialisation, but because of thin local capital markets they tend to licence IP early, often to overseas investors.

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ones do…' See https://www.economist.com/finance-and-economics/2019/04/17/where-growth-is-concerned-is-population-destiny

[7] Conway, 'Can the Kiwi fly? Achieving productivity lift-off in New Zealand'. International Productivity Monitor, No 34, Spring 2018, pp. 52-60.

Less public money is spent on innovation that involves improving existing products or processes, perhaps because the benefit flows to the specific business receiving the support. It is expected that businesses will invest their own money in improving their products, services and processes, and if an entrepreneur sees an opportunity to build a business around a new scientific breakthrough, they should be able to find venture capitalists or use debt to support their ideas (if their idea is seen as profitable). This is high-minded but demonstrably unhelpful. A good deal of firm innovation in New Zealand is smothered in its cradle by a lack of capital. Banks do not like lending for R&D, unless they can use the owner's house as collateral. This reluctance could be addressed by policy.

What works in larger countries may not work in New Zealand

Being enormous, as David Skilling put it, has advantages. As detailed in MBIE's 2016 paper, 'The New Zealand economy's small size and distance from world markets create barriers to economic growth by limiting the scale economies available to businesses domestically and by making it more difficult to trade, invest and gain access to new technology.' New Zealand has a small domestic market. The returns that a business or an entrepreneur could expect from investment in innovation are less than if they were operating in a larger, better internationally connected, more densely populated country.

Furthermore, while New Zealand is an open economy, with limited regulatory barriers constraining the flow of trade, capital, and labour, our trade intensity is low compared with OECD countries with economies of similar size. But our economic geography is the biggest barrier. We ranked lowest out of 38 countries in terms of participation in global value chains (MBIE, 2016). Some commentators, such as Michael Reddell, think this is an inevitable consequence of being small and distant.[8] International connections, including strong trade links, are more important for small economies like ours than for large ones.

Our unique economic geography means that our businesses are likely to benefit less from investment in innovation, and are less exposed (through international connection) to new ideas. The effect should not be under-estimated.

A more direct approach by the government is needed to encourage our firms to invest in innovation, to commercialise it, and to take it to the rest of the world.

[8] Michael Reddell, 'Why New Zealand languishes,' 2013. Available at croakingcassandra.files.wordprss.com

What can we learn from other small advanced nations?

Several small advanced economies such as Norway, Finland, and Singapore perform much better than New Zealand in terms of measures of economic growth and research, science and innovation. All are located much closer to their export markets than we are, and all have more directive governments than we do.

The Israeli innovation system benefits from significant military investment in technology, which supports a large and dynamic innovation ecosystem. Norway has benefited significantly from oil exploration (46% of export revenues), and has developed some large industries with significant government ownership.

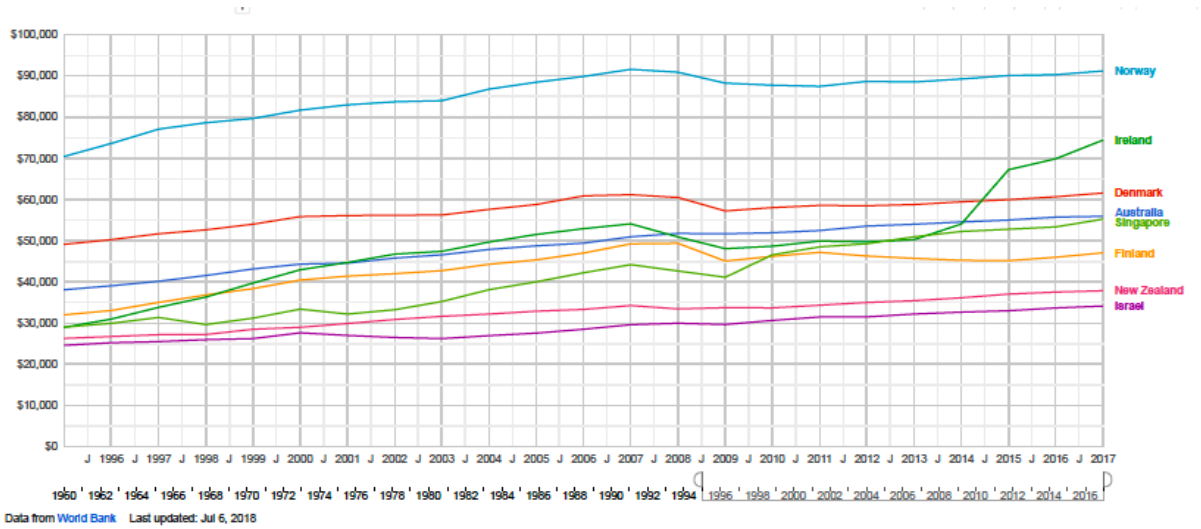

Figure 1: Per capita GDP, selected OECD countries

Ireland, about the same size as New Zealand, was much poorer than us (and the UK) until it joined the EU. Since then it has become much wealthier. It dropped its corporate tax rates to attract investment into high technology, life sciences, and financial services; survived the Global Financial Crisis by the skin of its teeth; and emerged close to the top of the OCED's ranking by per capita GDP. Some of the policy steps taken by Ireland could be usefully applied to New Zealand. Ireland's government science funder takes an enlightened view. Funding recipients must report back to them whenever an end user makes use of their research, no matter how long after the original grant. Researchers report back to the funder 20 years afterwards, or even later.

In New Zealand, in contrast, we are poor at measuring the economic impacts of our science and innovation grants. We therefore have a poor understanding of the impact of innovation support on firm performance and the contribution of the science system to New Zealand's

economic performance. We need to take a leaf out of Ireland's book and do a much better job of monitoring and evaluation, so we can discover what works, and use the information to improve policy design.

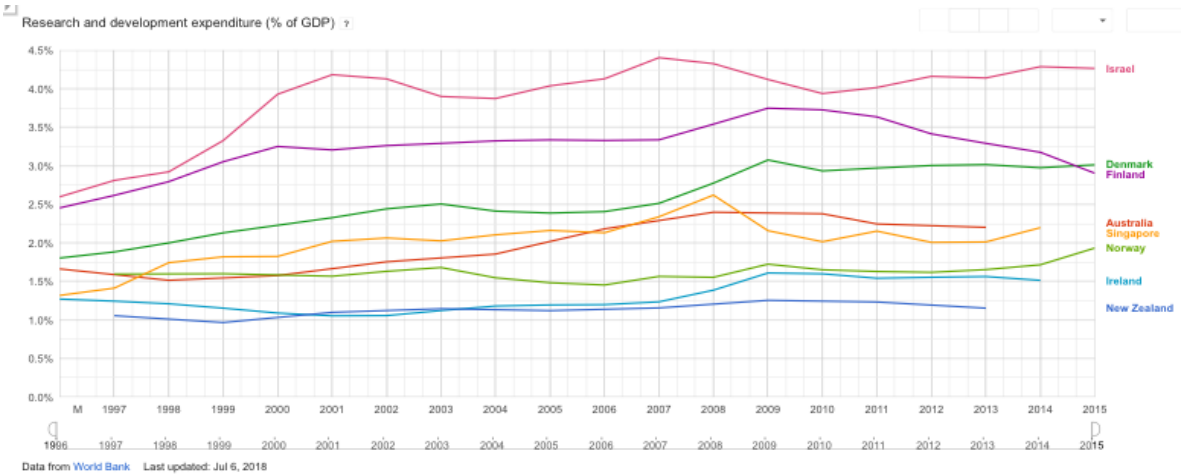

Figure 2: R&D expenditure as percentage of GDP, selected OECD countries

Singapore has been particularly successful in attracting foreign investment, partly through a low tax rate, but also by implementing (and regularly updating) its *Research, Innovation, and Enterprise Plan,* which aims to transform Singapore into a 'Smart Nation'. The government is investing S$19 bn over 2016 to 2020 to establish Singapore as a 'global R&D hub'. The scale of the spend is an order of magnitude greater than New Zealand's. To maximise the impact of this funding, the Singaporean government has prioritised four strategic technology domains where Singapore has competitive advantages or important national needs: Advanced Manufacturing and Engineering; Health and Biomedical Sciences; Urban Solutions and Sustainability; Services and Digital Economy. Their strategy includes key priorities of 'providing targeted support to help firms scale up'.[9] Singapore's policy is more focused than ours, and its priority areas have been stable for at least 15 years. Policy stability is helpful.

Given our economic geography, the ongoing policy challenge is to develop a science and innovation system that is open and responsive to new opportunities and focused on creating rich, dense innovation ecosystems in areas appropriate for New Zealand's economic geography.

[9] *Research Innovation Enterprise 2020 Plan: Winning the future through science and technology*, National Research Foundation, Prime Minister's Office, Singapore, passim.

This may entail a greater focus on thematic research platforms in areas conducive to small, remote firms engaging internationally. We need to follow Singapore's lead and tailor our innovation programme to our specific economic circumstances.

But there is a limit to what we can learn from other small countries. The OECD considers that the best thing we can do is to improve New Zealand's productivity. To that end, we should remove the tax advantage from property to encourage productive investment (rather than rewarding people with capital for over-investing in housing, as at present).[10] One effect of our over-investment in housing has been to starve investment into New Zealand companies. Property speculation will not address our innovation and productivity problem. The Productivity Commission understands the impact of our current tax settings better than most. The advice may be unpalatable, but that doesn't mean you should not give it. Be bold.

A holistic research, science and innovation system

New Zealand needs a research, science and innovation system that not only creates new knowledge, but focuses on knowledge that is of particular importance to our society, our economy, and the environment. We also need a system that aims to encourage firms to turn that knowledge into useful new products and business processes, thereby creating new businesses, jobs, and economic opportunities. But first we need to understand the impact of government support for innovation – what works, and what doesn't - so we can focus on supporting innovation at the level of the firm that results in productivity improvements.

To achieve this, NZ should focus on four key areas of priority:

1. Increasing businesses' investment in R&D (e.g. to the goal of 2% of GDP);
2. Aligning R&D and science funding towards the needs of our businesses, people, and the environment (e.g. by reviewing the National Science Challenges, and other funds);
3. Ensuring New Zealand has the skills it needs for innovation by improving the matching of skills to jobs, beefing up polytechnics, reining in universities, and fine-tuning immigration to get the specific skills we need for innovation;
4. Supporting the diffusion and commercialisation of knowledge.

[10] Michael Reddell, 'Possibilities and (lack of) passion: lifting productivity, for our kids' sake', 2018, available from https://croakingcassandra.files.wordpress.com/2018/05/psn-lecture-series-lifting-productivity-for-our-kids-sake-may-20181.pdf

The following sections propose an approach in each of the above priority areas.

1 Increasing firm R&D

There are many reasons why companies don't invest in R&D. It's expensive and risky (and it's hard to know in advance whether you'll get your investment of time and money back). It may require knowledge or skills that the company doesn't possess or doesn't know where to find. Many Kiwi businesses are undercapitalized and are run very lean, so there's no spare money for R&D even if they'd like to do some. And it's hard to estimate the market size for a new product or service. It's also hard to find out what your competitors have in train already until they announce it. If you think something is a good idea, chances are that a larger and better capitalized competitor has already had the same idea.

New Zealand's very small domestic market doesn't offer much incentive for innovation. The New Zealand data show a strong link between innovating and international connection. But otherwise we don't know much about what innovation policies work. We need to get a much better understanding of the impact of innovation support on firm performance and the contribution of the science system to New Zealand's economic performance.

Applying for government R&D grants is time-consuming and painful. Often, perhaps mostly, small companies decide the paperwork and delay is not worth the effort – so the innovation grants tend to go to big companies, which don't need them. For a small or new firm that doesn't fit into NZTE's top 700 company profile, it's pretty much impossible to get useful market information if they are considering taking their products to a new export market. No surprise that lots of companies just give up and do their best on their own. China is particularly risky – yet public officials are still wildly enthusiastic about it.[11] This is unhelpful.

All this is not to say that NZ companies don't innovate. They do. In some competitive, fast-moving sectors it's the only way to stay in business. Companies tend to think of this as solving problems rather than innovating – but at a certain point 'solving problems' turns into R&D. And that is the point at which the company may need a bit of expert advice and

[11] Fonterra's dismal experience in China with Beingmate and other investments indicates the risks. At the very least, companies should be reminded to do thorough due diligence when finding a partner (whether in manufacturing or as a channel partner). For most Kiwi companies, it's not worth the risk.

technical support. But it's hard to know how much NZ firms put into R&D, because until very recently our tax settings encouraged them to spend (or declare) as little as possible.

Most New Zealand companies are small and under-capitalised, so expecting them to commit resources and potentially risk the business to do some R&D is a big ask. Too big. That is why a lot of our product and process innovation is driven by customer requirements, not company strategy; and why the improvements often come in small increments.

Much industry R&D is undertaken by CRIs, and is delivered on time, on spec, and on budget. This part of the system seems to be working well. But universities also undertake R&D projects for firms. There is a huge disparity in size and incentives between the university and the company, as there is with CRIs. But universities come with extra features that make it hard for them to deliver company research on time, on spec, and on budget.

For the past decade, the science funder, MBIE, has been hung up on 'science excellence'. But NZ companies mostly don't need world-leading research. The quality should be *good enough*, but the real test of value is **whether they can use it**. Thanks to the perverse incentives of our funding system, university researchers tend to look down on applied research – the stuff that's actually useful to the company because it can be quickly taken to market – because in all likelihood they can't publish an academic paper on it.

Our public sector is very poor at measuring the economic benefits derived from spending on science and innovation. Assessing the value of academics' research based on whether it is put to good use by NZ companies would put an end to low-value research. PBRF is a funding scheme that does the opposite: it values publications and citations a lot and productive research very little. It is time to get rid of it.

Rather than do the work themselves, academics will often opt to supervise a student to do it. This is a double win for them (they get the financial benefit of doing contract research plus a post-graduate supervision). As a result, the cost is often way too high (overheads of 115% on staff time are ridiculous), the students are learning on the job (great for them; not so great for the company), and the delivery time fits the academic year, not the company's needs. The final score is: academic 2; student 1; company (potentially) nil.

Charging overheads on university research is a classic example of rent-seeking behaviour. Originally designed to cover the cost of capital investment in medical and scientific research, charging overheads has become a shibboleth. Universities apply their overhead rate to all research they undertake, irrespective of the costs – so the overhead rate is the same whether it applies to a humanities researcher who does all their research in a library or a medical researcher who needs to run expensive clinical trials or use costly equipment.

Successive Ministers of Science have been disappointed by the length of time it takes to turn research into value. Some of them lost interest in the portfolio as soon as they discovered that it's not possible to get results within an electoral timeframe. Distinguished Professor Emeritus John Boys, the world-famous father of Inductive Power Transfer, describes his work as 'a 25-year overnight success'. But our public funds expect impressive returns much faster than that. John Boys' research team didn't get a cent from the public purse for the first 20 years. Scientists are encouraged to overstate the scale and speed of the returns to NZ from their research. That is why many research proposals contain an element of fiction.

What is needed is a way to improve our productivity and reduce the hurdles of money, time, risk, and market insight that stop Kiwi businesses from undertaking R&D.

Lots of models have been tried. These have the greatest potential to make a difference to lots of companies:

- Increase private investment into NZ businesses, remove the tax breaks for housing, and reduce NZ's company tax in line with the rest of the OECD.
- Incentivise banks to lend to firms to fund R&D (without using the owner's house as collateral).
- Provide access to technical expertise to answer questions quickly at no cost to the company and with no forms to fill out.
- Provide access to research that is timely and delivered complete and ready to go, so it is immediately useful.
- Share the cost of useful research that takes longer to do but delivers more value. The cost can be shared with other companies but when the research is a long way from market application, most of the cost (say 80%) should be paid by the government. This could be done via a partnership between the government and peak industry bodies. When the research gets closer to market, firms can pick up a higher

proportion of the cost. This approach needs expert project management to ensure the researchers deliver the results on time and at technology transfer stage (that is, not under-cooked). It may also need extra market validation work to ensure the commercial success.

- Provide access to technology foresight and market analysis work to understand where things are heading.

What doesn't work is expecting companies to co-fund 60% or more of the cost of speculative R&D, and expecting them to take on the whole risk.

Some specific policy recommendations:

- Fund polytechs (and perhaps some CRIs and universities, if they show they can respond promptly and usefully) to provide advice and support to companies up to an agreed cap of $5000 per enquiry. This will be done by a call-off contract, so that polytechs are reimbursed monthly for work they have done, and firms never have to fill out any paperwork.
- Set up a new government-backed Innovation Fund for businesses that the public can invest in, with a range of options to suit their risk appetite.
- Put more money into funding for commercialisation, based on track record of commercial success – and disinvest from poor performers.
- Hold back the final payment on research undertaken for industry until the usable solution has been delivered to the firm – as certified by the firm.
- Dismantle the Performance Based Research Fund, because it rewards the wrong behaviour (publications and citations that benefit universities and individual researchers, not research that is actually useful to NZ firms). Instead, provide an alternative incentive to do research that firms can use.
- Measure the success of research funding on the basis of technology transfer and uptake, with no end date – all research providers must report uptake of their work to the funder whenever it occurs.
- End the payment of a flat rate of overhead on university research. Instead, universities can charge direct costs and set up their own capital funds – diverting money that they currently put into property investment.

2 Setting priorities

Public R&D and science funding is about the creation of new knowledge for the benefit of society as a whole.[12] Governments often shy away from strategic prioritisation for fear of picking the wrong races (let alone winners), and focus instead on trying to increase the pace of innovation across the board. While the unpredictable nature of science means that some government funding should always be available for unfettered blue-sky thinking, New Zealand's small size and large distance from international markets means that we also have to make some tough choices about where we spend our limited funds.

A better way to think about priority-setting is to think about how we put money into Olympic sport. We give some support to spectacular and promising individual athletes, such as Valerie Adams; and we also put money into sports such as cycling or yachting where there is already great infrastructure and a proven system of developing athletes. And we strike some kind of balance between both.

Some areas of research, such as climate change mitigation and adaptation, are mission critical for New Zealand. Others are areas that only New Zealand can be expected to put money into, such as research into superior animal genetics to support our primary sectors or developing gene editing tools to control or eliminate introduced pests such as wasps or kauri dieback.

The government's recent response to the Productivity Commission's Low Emissions Economy report called for improving the performance of sectors that relate to emissions-intensive activities, without specifically targeting emissions; and investing in knowledge-intensive industries that contribute to the diversification of the economy, as these will reduce per capita emissions.

This is right in the sense that a narrow focus on emissions alone is unlikely to lead to the kind of transformation New Zealand needs to become more productive, environmentally sustainable, and socially inclusive. But what is missing from the government's analysis is a thorough examination of the sectors and knowledge-intensive industries New Zealand should therefore be investing in. The broad overarching criteria for choosing the races we would like to run in are areas in which New Zealand firms have strengths and the

[12] https://www.mbie.govt.nz/have-your-say/draft-research-science-and-innovation-strategy/

possibility of global visibility, and where we have the greatest potential to mitigate climate change.

Some emerging fields that appear pertinent to New Zealand are the development of plant-based proteins as an alternative to meat and dairy, the use of hydrogen to replace fossil fuels in energy production, and the replacement of the oil barrel with biomass in the production of chemicals, plastics, textiles, and other non-food essentials. The Climate Commission's recent advice to do some destocking does not go far enough in addressing the emissions from dairy. Shifting from dairy production based on cows to farming plant-based protein (such as oats for oat milk) or non-cow dairy (such as sheep dairying) at scale would also improve emissions and water quality and improve returns to the farm long-term. Modelling shows that beef and sheep farms in Canterbury and Southland would pass breakeven within three years of a switch to sheep-milking, and be in profit after five years. (Southland would be perfect for oat growing, if its water were not too polluted with nitrates from intensive dairying. Canterbury's high nitrate levels in ground water pose a health hazard to humans, and its polluted waterways kill native fish. A return to low-impact farming is needed.) For dairy conversions, where a significant investment has already been made in irrigation and other farm infrastructure, reaching breakeven would take longer unless the carbon price were higher and emissions regulations were tightened – but plant-based proteins and non-cow dairy offer a high-value, sustainable alternative to intensive dairy farming of cows.

All these ideas deserve to be further investigated and tested against Treasury's new Living Standards Framework.[13]

In the event that new domains or technologies are shown to be worthy of greater R&D spend, the funding should be backed up by aligning related policies such as skills (see below, next section), education, procurement, employment, and standards.

Some specific policy suggestions:

- Establish a robust process to set priorities for research funding from a broad economic, environmental and social perspective, and determine the right balance between discovery and applied research in various domains.

[13] https://treasury.govt.nz/information-and-services/nz-economy/living-standards/our-living-standards-framework/measuring-wellbeing-lsf-dashboard

- Investigate alternatives to cow dairy, such as sheep dairy or plant-based proteins, and undertake export market development.
- Establish robust technology foresighting, so we can make better strategic decisions regarding the future direction of our limited public R&D spend.
- Update New Zealand's outdated GM policy to permit gene editing.
- Evaluate existing research investments in terms of their original aims and intended outcomes, and disinvest from research that doesn't score well.
- Review the total cost of fund management of devolved funds. If it is more than 5% of the total fund, bring the costly devolved funds back into the Science and Technology Research Fund to be centrally managed, so that more money can go into research.
- Support strategic investment in R&D priorities through alignment of related polices such as skills, education, procurement, employment, and standards.

3 Skills policy for innovation

This section considers skills policy from the narrow perspective of New Zealand's innovation policy. Skills policy must build the absorptive capacity of New Zealand firms, by improving their technical expertise and developing their management expertise. Specifically, we need to improve the matching of skills to jobs. We should also target migration settings to focus on migrants who have the skills that are relevant to our innovation aspirations.

It is well known that management expertise is a rate-limiting step for firm growth. Technology start-ups often outgrow their founder-owners; savvy investors review the capability of the management team and replace founders with more experienced CEOs. But how do most NZ firms access the expertise they need to innovate?

Most Kiwis learn on the job, as the Productivity Commission has already said. Between 2005 and 2015, the proportion of employed people undertaking formal study declined from 0.08% to 0.07%. Two thirds of employers don't provide any paid training at all, and most of the remainder of employees received 2-5 days or less.[14] This unwillingness to invest in our people is holding us back. It's one of the contributing causes of our low productivity, and it's not improving.

[14] NZ Productivity Commission, *New Models of Tertiary Education*, March 2017, p. 110, citing Statistics NZ 2012 data. https://www.productivity.govt.nz/sites/default/files/New%20models%20of%20tertiary%20education%20FINAL.pdf

Industry bodies provide a range of cheap, generic short courses (typically ranging from 2 hours to 2 days in length) to their members, but tertiary providers are wedded to delivery models that don't suit the needs of people already in employment. They are incentivised to package learning into expensive three-year degrees, and to push as many people as possible into post-graduate study. Their ideal consumer is a full-time student fresh out of secondary school.

Rather than being able to choose short courses that are well integrated with employers' needs, mid-career learners are typically offered expensive, full-year or two-year Masters courses. There is an unmet need for courses that better serve employers and employees. It's time for our universities to become customer focused.

The Productivity Commission has noted that there are 'long-held concerns about the level of engagement between the tertiary education sector and employers'. It cites evidence that the current tertiary education system 'does not always prepare students well for employment', and comments that the underlying incentives in the system encourage tertiary providers to be more responsive to their primary funder, the government, than to employers.[15] Law graduates, for instance, complain that their years of study do not in fact prepare them for working in a law firm.[16]

As well as being expensive, tertiary study is inflexible and not very portable. But mid and late-career learners are less interested in completing a full qualification, and more interested in gaining skills they can apply now. Younger learners would benefit from time spent in their future industry, via internships or summer projects that would benefit them and bring in new ideas and fresh thinking to a potential employer.

Polytechnics are better able than universities to provide short, focused, building-block courses that people can take whilst working. These could be customised to provide the technical skills that support specific company projects. Incentives could be provided by funding providers on the number of firm-endorsed completions. Likewise, firms need fast access to technical expertise to give advice on technical issues as they arise. Polytechnics should be bulk-funded to provide this service, rather than the cost being passed on to firms.

[15] Productivity Commission, op. cit., p. 124.

[16] Ibid, p. 104.

Proposed policy

Education and training must be more responsive to business.

- To help small and medium-sized firms innovate, we need to improve skills development and encourage lifelong learning. We must also refocus our immigration policy on migrants with skills that support our innovation skill gaps.
- We need to rebalance tertiary funding to encourage providers to develop innovative courses and provide technical services that respond to market needs; including short courses co-designed with employers, aimed at developing mid-career employees and building the technical competence of the firm.
- We need to incentivise universities to innovate in course delivery, responding to the needs of NZ businesses and working closely with industry to produce industry-ready graduates (and disinvest if graduates are not industry-ready).
- We need to remove universities' incentives to undertake low-value research, inflate grades, and enrol too many graduate students simply to boost the university's ranking by changing how universities are funded.
- We should remove the incentive for universities to push students towards postgraduate study and to publish academic papers rather than create economic impact. Instead, we need to incentivise firms to invest in training and developing their staff.
- Putting student loans on to universities' balance sheets would encourage them to create value for their student clients in the shortest time.

4 Supporting the transfer, diffusion, and commercialisation of knowledge

Investment in research and science generates new knowledge that can allow us to understand the world around us and help us to solve complex social, cultural, environmental and economic challenges. To realise the full benefit of this investment, however, this knowledge needs to be turned into something people can use to solve these challenges – this often involves turning an idea into a new product or service that solves a particular problem that people or society face.

It is therefore not enough for the government to invest only in the creation of knowledge. We must also ensure that this knowledge is successfully used turned into new or improved

products and services, enabling our firms to become more productivity, to grow and compete offshore, and to create new, better-paying jobs for Kiwis.

As outlined earlier, government investment and support has tended to prioritise knowledge creation over commercialisation. The Labour-led government appears to making some tentative steps in the right direction, investing through Budget 2019 $25.5 million [over four years] 'in a package of initiatives intended to promote the commercialisation of innovation, including increased support for the Commercialisation Partner Network Fund and the PreSeed Accelerator Fund and scaling up the Technology Incubator programme'[17]. This is a good first step. Budget 2019 also allocated $10 million into the Innovative Partnerships Programme which is run by MBIE, and 'designed to attract globally leading firms and innovators to New Zealand'.

However, when compared with the 2019/20 yearly spend through the Strategic Science Investment Fund ($300m), R&D Growth Grants ($223m), Endeavour Fund ($223m) Health Research ($117m), Marsden ($79m), Partnered Research ($40m), and National Science Challenges ($100m),[18] it is clear that investment in the diffusion and commercialisation of knowledge is still a very long way behind investment in the creation of knowledge.

Some initiatives, such as the Venture Investment Fund, have been only modestly successful, so a thorough evaluation is needed and the settings changed to get better results – or the money put to a more productive use.[19]

Suggested policy prescriptions

1. Boost funding for initiatives that have proven successful in:

[17] https://www.mbie.govt.nz/science-and-technology/science-and-innovation/agencies-policies-and-budget-initiatives/budget-initiatives/

[18] Treasury, Vote Business, Science, and Innovation Estimates of Appropriations 2019/20, p.2. See https://treasury.govt.nz/sites/default/files/2019-05/est19-v1-buscin.pdf

[19] The Government's own review of VIF concluded: 'We noted that the overall returns were modest. We were told that the NZVIF was not established with the intention that it should provide an investment return to the shareholder. Rather, it was established to catalyse the venture capital market.' See https://www.parliament.nz/resource/en-NZ/SCR_86556/15fc2efadbfa984a7529ea9921c8ac37a991d28b

   a. *Supporting the diffusion and commercialisation of knowledge* so that new ideas are turned into successful businesses, such as the successful Pre-Seed Accelerator Fund.
   b. *Building the management capability of New Zealand businesses,* so that these firms know how to implement innovation within their businesses and grow and compete both domestically and internationally; for example, via New Zealand Trade and Enterprise's various business development programmes, but also through industry organisations and regional EDAs.
   c. *Developing strong and productive connections between* researchers, start-ups, investors, large firms, and also between New Zealand's innovation ecosystem and international ecosystems, for example via the Commercialisation Partner Network.
2. Ensure firms have the support they need through the full innovation cycle. This will involve a full review of the support currently available to businesses, from R&D incentives, to business development services, to support breaking into international markets. The intention is to fill any gaps that become apparent through this review to ensure our innovative firms have all the support they need to be successful beyond the first phase of creating something new (i.e. through R&D).
3. Ensure firms have the capital they need to innovate and grow. Along with ensuring firms have the support they need through the full innovation cycle (as above), we will also work to ensure they have access to the capital they need to innovate and grow. Firms have often noted that it can be very challenging to raise 'mid-range' capital, investments of between $2m and $10m. We will review the current investment landscape, and if a lack of mid-range capital is a serious problem for our innovation system, we will work with financial institutions, angel investor networks (both domestic and international), and the start-up community to develop and implement a viable solution.

New Zealand needs to significantly increase the diffusion and commercialisation of knowledge. If successful, it will result in more start-ups growing and expanding, exporting high value products and services, and will create more jobs and better opportunities for New Zealanders. It will also result in greater innovation across all industry sectors.

Thank you for this opportunity to provide feedback on your excellent report.