

Innovation and firm performance

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An orbital-class rocket with a 3D-printed engine launches into space from the Mahia Peninsula. A self-driving car crosses the Auckland Harbour Bridge. A pizza company begins testing delivery using airborne drones. While these may sound like things of science fiction, they are in fact stories that have been in the New Zealand media over the last year. These stories provide a glimpse of how innovation and new knowledge are changing the nature of economic activity. Changes are not just happening around the edges but could be as disruptive as earlier industrial revolutions.

Given the importance of innovation, the Commission has produced two papers on the impact of R&D grants and the links between innovation and productivity. This Cut to the Chase outlines insights from these two papers: "Innovation and the performance of New Zealand firms" by Simon Wakeman & Paul Conway and "The impact of R&D grants on the performance of New Zealand firms" by Simon Wakeman.

Innovation is high risk and high return

Innovation is the process of creating new knowledge and translating it into growth. As well as inventing new products, innovation also covers improvements in production processes, marketing and business models. To innovate, firms need to invest in R&D, retrain employees, and promote new products to customers. Innovation is important not only for leading firms working to push out the knowledge frontier, but also for lagging firms wanting to adopt existing technology to improve their performance.

Innovation is costly and risky and has uncertain impacts on firm performance. By changing the way firms do things, innovation exposes businesses to a very real risk of failure; new products may not catch on or process changes could disrupt systems that were working efficiently. Even when innovation is successful, rivals may copy it and capture a large share of the returns.

Notwithstanding the costs and risks, knowledge is becoming increasingly important in driving economic growth and the benefits of investing in innovation can be greater than for more traditional assets. For example, the private returns to R&D are estimated to be around 20-30% on average, which is considerably higher than the estimated returns on investment in physical capital. In addition to the private returns, because new knowledge can spill over across firms, innovation can also carry high social benefits.

New Zealand firms could do innovation better

An OECD paper published by the Productivity Commission in 2014 estimated that up to 40% of New Zealand's productivity gap compared with the OECD average is the result of weak investment in knowledge-based assets such as innovation.¹ So while New Zealanders characterise ourselves as strong in ingenuity and innovation – for example, the number 8 fencing wire attitude – the economy-wide evidence for the claim is mixed and New Zealand firms do not perform well in some important aspects of innovation.

Most obviously, as a share of GDP, public and private investment in R&D are among the lowest in the OECD. New Zealand is also unusual in that less than 40% of total R&D is funded by the business sector, whereas the OECD average is close to 70%. More broadly, with innovation a key productivity driver, New Zealand's weak long-run productivity performance also hints at considerable room for improvement in innovation.

One reason for this underperformance is that the New Zealand economy has a low share of traditional R&D-intensive industries and the export mix – which is skewed towards raw food products – is also not typically associated with innovation. However, even within industries, R&D spending by New Zealand firms is low compared to firms in other OECD countries. In addition, with new knowledge and technologies becoming

¹ de Serres, Yashiro & Boulhol (2014), "An international perspective on New Zealand's productivity paradox", NZPC Working Paper 2014/01.

increasingly ubiquitous across the economy, economic structure is, at best, only a partial explanation for weak R&D spending by New Zealand businesses.

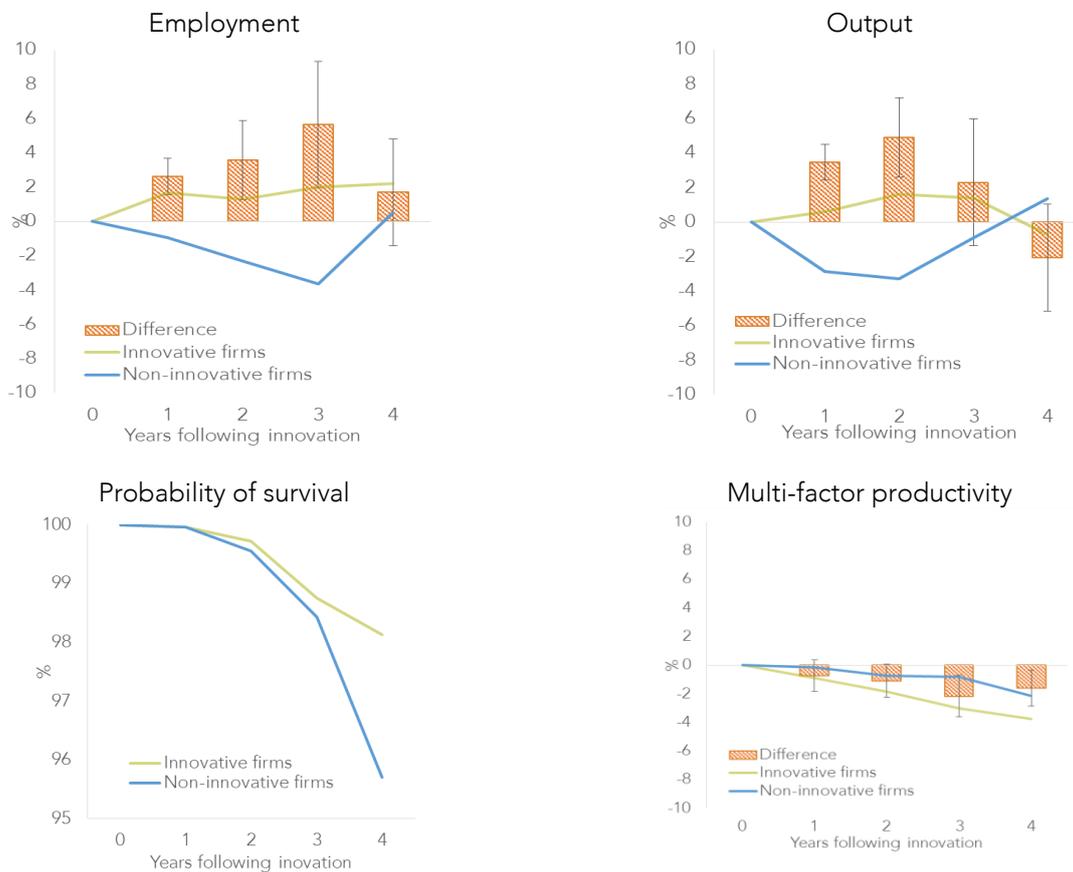
The impact of innovation on firm performance

Another possible explanation for a relatively poor innovation performance is that the expected returns to innovation are insufficient to outweigh the costs and risks for New Zealand firms. To explore this idea, an empirical model based on firm-level data is used to compare the performance of New Zealand firms that innovate with the performance of similar firms that do not innovate. This comparison is made across a range of firm-performance measures over the period of 2000 to 2012.

Results show that across all firms included in the study, firms that innovate had faster growth in employment and output and a better chance of survival compared to firms that did not innovate (Figure 1). However, on average, innovative firms did not improve their productivity compared to non-innovators. So while innovating firms grew more quickly than non-innovators, their productivity performance following innovation was, on average, no better.

Although firms are typically focused on profitability, productivity improvements will improve profits via higher revenues and/or lower costs, all else equal. So with little discernible difference in the productivity performance on innovating and non-innovating firms, it is little wonder that New Zealand firms underperform in some aspects of innovation.

Figure 1: Firm performance in innovating vs non-innovating New Zealand firms



Notes: These charts show the change in various performance measures for firms engaging in any form of innovation activity vs non-innovating firms. Performance differences across these two groups of firms are also plotted.

The impact of innovation on different types of firms

This lack of a productivity dividend across innovative New Zealand firms is concerning. After all, numerous international studies show that innovation is a key driver of productivity growth in many countries. So just what is it about the New Zealand environment that undermines the positive impact of innovation on firm productivity? Looking at the link between innovation and productivity across different types of firms can help shed light on this important question.

Firstly, translating knowledge into growth is not a straightforward mechanical process. Instead, to successfully innovate and make the most of new technology, firms need to reinvent many aspects of their operation – including process and service design, software development, organisation structure and marketing. This

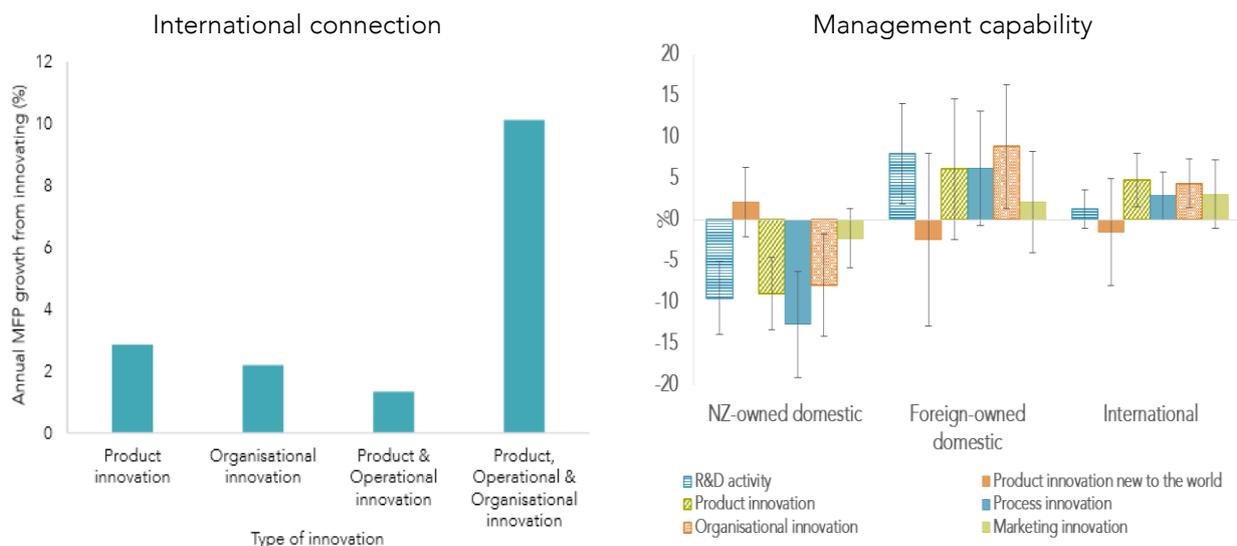
requires not only R&D capability, but also considerable management expertise and an “all-of-firm” innovation mind set. This can be a daunting challenge for firms, particularly those with a large existing asset base and a workforce with a particular set of skills configured to work in a particular way.

This idea that management capability influences the link between innovation and productivity finds support in the data. Specifically, New Zealand firms that improve operational processes and organisational structures at the same time as innovating their products achieve much better productivity gains than firms that innovate in only one of these areas (Figure 2). To lift productivity, it would seem that working on the business is just as important as developing new and improved products. Cross-country surveys tend to suggest that New Zealand may have issues with management capability. Some New Zealand firms may lack the full range of management skills necessary to successfully absorb and apply new knowledge.

Second, the “extent of the market” may also influence the productivity benefits that firms are able to capture from innovation. Firms operating in New Zealand’s small domestic markets may struggle to fully exploit the productivity benefits that can come from innovation. For example, small markets may limit the ability of innovative firms to achieve the scale necessary to realise the benefits of new knowledge. Alternatively, a lack of exposure to fierce competition and demanding customers in international markets may weaken management resolve to extract the maximum benefit from innovation.

Again, this idea that small markets and a lack of international exposure may limit the productivity dividend from innovation finds support in the data. Compared to firms focused solely on domestic markets, New Zealand firms that export or invest in offshore markets generally do experience productivity improvements following some types of innovation (Figure 2). This finding is also consistent with previous work showing that New Zealand firms focused solely on domestic markets are less likely to innovate.² With limited returns on offer, why would a typically small business facing weak competition undertake the costly and risky process of innovation?

Figure 2: The impact of innovation on productivity for specific firm types



The impact of R&D grants on firm performance

In much the same way that firm-level analysis can be used to explore the link between innovation and productivity, it can also be used to test the impact of R&D grants on firm performance. This is done by comparing the performance of firms that received an R&D grant with similar firms that did not receive a grant.

The comparison is based on grants of at least \$10,000 a year that correspond to Callaghan Innovation’s Project grant. Given data constraints, the analysis is conducted over the period 2000 to 2012. As such, this work does not directly evaluate the performance of the R&D grant scheme run by Callaghan Innovation, which began operating in 2013.

Results show that firms that received a grant are more likely to file patents and to introduce new products or undertake marketing innovation over subsequent years compared to similar firms that did not receive a grant. Grant recipients also have higher growth in employment and labour productivity and are more likely to survive in the three to four years following a grant. However, grant recipients do not increase their R&D expenditure

² Wakeman and Le (2015), “Measuring the innovative activity of New Zealand firms”, NZPC Working Paper 2015/02.

or improve their multi-factor productivity growth compared to non-recipients in the years after getting the grant.

It is important to stress that these results are not a direct evaluation of Callaghan Innovation's R&D grant programme. But even so, the lack of impact from grants on R&D expenditure and multi-factor productivity is concerning given that the objective of the current programme is to increase business investment in R&D to support long-term economic growth.

How this research can support innovation policy

Government interventions aimed at supporting innovation are based on the idea that new knowledge carries high social benefits because its productive capacity can easily spill over beyond the firm that created it. Given this potential for improved productivity and high social returns, innovation is a key area of economic strategy. While this focus is clearly welcome, policies aimed at creating more innovative New Zealand firms stand a greater chance of success if the links between innovation and firm performance are well understood. In short, the more we understand the impact of innovation on firms, the better we can target government interventions to maximise the chances of lifting productivity.

The research summarised in this Cut to the Chase looks only at the direct impacts of innovation and R&D grants on the performance of New Zealand firms. In addition, because the requisite databases are not up to date, the relationships uncovered in this work reflect the period 2000 to 2012 and may well have changed more recently. However, this work still holds some important policy insights. For example, if broader considerations – such as poorly-managed firms operating in small and fragmented markets with low returns to innovation – mean that R&D grants do not improve productivity in recipient firms, then there is little chance of positive spillover effects onto other firms.

The finding that grants do not lift the R&D expenditure or the multi-factor productivity of recipient firms does not necessarily mean that the government should reduce support for business R&D, which is already among the lowest in the OECD. Instead, the results suggest that the efficacy of the grants system could be improved by targeting support to firms that are best placed to extract maximum benefit.

For example, and following the social investment approach, updated versions of the models used in this research could be used to flag types of firms that are most likely to benefit from grants. In turn, this knowledge could be used to influence the allocation of grants. In much the same way, the empirical techniques developed for this research could also be used in an operational context to regularly monitor and evaluate the effectiveness of Government support aimed at lifting firm-level innovation.

Another key finding of this work is that the economic forces that make it difficult for New Zealand firms to connect into international markets may also be part of the reason for low innovation. This highlights the importance of policy coordination. For example, targeting public research funding on thematic areas where New Zealand firms stand a good chance of global visibility might lift the social return on this funding. As a case in point, reducing agricultural emissions – which is critical if New Zealand is to meet its climate change objectives – could generate valuable frontier technologies for New Zealand firms to roll out internationally. Similarly, there may also be scope for stronger coordination of the firm-level interventions of New Zealand Trade and Enterprise and Callaghan Innovation.

With the growing availability of firm-level microdata, there are increasing opportunities to use empirical economic research to improve policy. In principle, this data opens up the possibility of an "investment approach" in developing and implementing economic policies to lifting productivity. Greater use of firm-level evidence has the potential to move beyond the "average firm paradigm" and better tailor economic policy and monitoring and evaluation to the real world. This kind of innovation in policymaking can play a key role in helping New Zealand achieve its productivity potential.

Full paper and related research available from www.productivity.govt.nz/research

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