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Editorial – Assessing and Enhancing New Zealand's Productivity

Lifting productivity is the answer to many of New Zealand's hardest problems. It can mean families have decent incomes without having to work long hours. It can help the country earn a living from the rest of the world while protecting our natural environment. It underpins the provision of state services to an ageing population in a tighter fiscal environment.

The importance of productivity has been understood for many years. It has been almost 60 years since Conrad Blyth began measuring productivity at the New Zealand Institute of Economic Research (NZIER). Yet – except for a short period in the late 1990s – New Zealand's productivity performance has been stubbornly poor and lagged many OECD countries.

For many years the drivers of this productivity performance were not well understood. There were suspects of course: distance from international partners, small domestic markets, industry structure, and even culture. But generally New Zealand's low productivity was viewed as a paradox, particularly given the quality of some of our policy settings.

But, as the article by Nolan, Fraser and Conway notes, we have well and truly moved on from this idea of a productivity paradox. The articles in this edition help show why. They represent a sample of recent research. Much more could have been included and, indeed, will be included in future editions of *Policy Quarterly*.

In their article Pilat and Crisculo of the OECD discuss the potential impact of digital transformation on productivity. Current and emerging technologies could be as disruptive to models of production as earlier industrial revolutions. But, as the authors note, while the digital transformation of the economy holds much promise, these opportunities will not materialise automatically.

One critical example of the potential of technological change is in transitioning to a low-emissions economy. As Bailey and Lewis argue, the effects of this transition will be "profound and widespread" and innovation will be key to avoiding damaging climate change while also protecting (improving) national wellbeing. But they also suggest that it would be wrong to simply expect new opportunities to materialise. Well-designed laws and institutions are needed.

Further, as they note, innovation needs a stable and enduring policy framework. Yet, as Yui and Gregory show, the past 30 years have seen "successive and seemingly endless cases of organisational restructuring." This is based on new data collected by Yui as part of his PhD research and which could in future be used to test a number of important hypotheses. One question the authors raise is whether we too often use institutional reform as a "surrogate for genuine innovation designed to effectively achieve better policy outcomes."

Continuing with this theme of a need to lift the performance of the government sector, Lattimore outlines key lessons from the Australian Productivity

Commission's (APC) recent five-year productivity review. He points to a focus on the non-market sector (mainly education and healthcare), the quality of cities, and the effectiveness of government itself as central to achieving better outcomes.

This work by the APC is mirrored by its Kiwi counterpart, as shown in the articles on healthcare (Nolan) and education (Gemmell, Nolan and Scobie). Nolan's article on health productivity argues that a greater focus on lifting productivity in this sector is desirable given the fiscal outlook and changing demand facing health services. Gemmell, Nolan and Scobie's article on education highlights the challenge in measuring productivity, particularly in accounting for changes in quality over time.

Some of the challenges facing productivity measurement in the state sector (e.g. services being provided to users free of charge) are now being seen in the private sector. Pells notes that as a result we could be seeing a re-run of the "Solow computer paradox," where he famously wrote "you can see the computer age everywhere but in the productivity statistics." However, she argues, despite measurement issues, the productivity slowdown in New Zealand and elsewhere since the mid-2000s simply cannot be written off as measurement error.

Interestingly, Pells also shows that the global slowdown in labour productivity growth (i.e. GDP per hour worked) is largely due to lower growth in the effectiveness with which different inputs are combined in production (a component of labour productivity called multi-factor productivity). Yet, as Nolan, Fraser and Conway show, New Zealand's recent productivity performance differs from this in key ways. Not only has the slowdown in labour productivity been relatively mild, but our multifactor productivity performance has been stable.

They thus show that the major factor holding back New Zealand's productivity growth since the Global Financial Crisis has been the failure of capital to grow in line with labour, even with the historically low interest rates over this period. Flatlining business investment (when measured relative to population growth) could mean that New Zealand misses the boat on future technology-led productivity growth and suggests we still have a way to go in making the transition from an economic model that emphasises growth from working more.

This discussion leads to the question of how reform could support closing the productivity gap with the rest of the world. Charles Dickens' character Mr Micawber was always hoping for something to turn up to help solve his problems. But, as the articles in this edition show, we can and should do better than this. Lifting New Zealand's productivity requires a broad reform agenda, ranging from topics such as matching skills to jobs, to lifting business investment and trade in services, and to improving government productivity. The opportunity is there – we need to take it.

Patrick Nolan – Guest Editor

MOVING ON FROM New Zealand's Productivity Paradox

Abstract

For many years New Zealand's productivity performance has been disappointing. This article outlines recent progress in understanding what could be driving this performance. It starts by drawing on Statistics New Zealand industry-level data, before summarising insights from firm-level research using linked data sets (the Longitudinal Business Database (LBD)). It then concludes with a high-level summary of directions of reform that could help improve New Zealand's productivity performance.

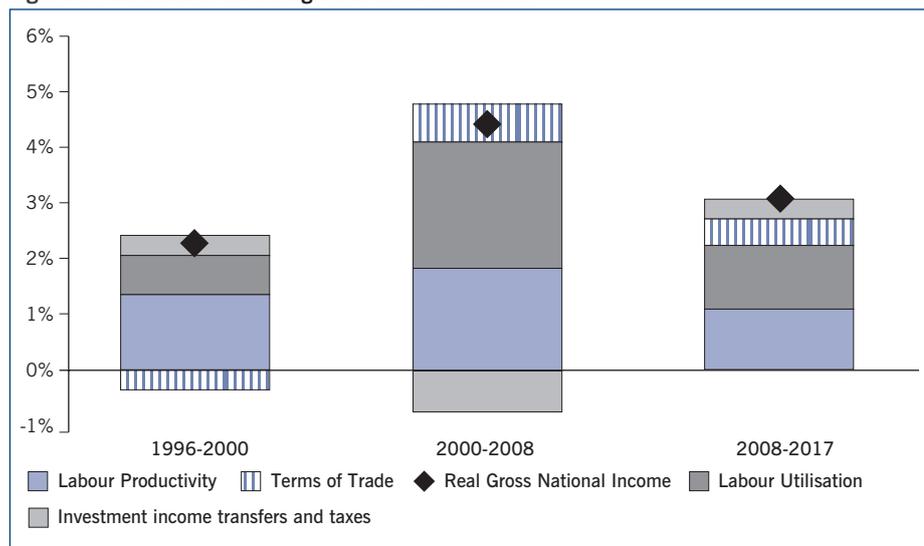
Keywords productivity, technological diffusion, reallocation, firm-level research

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For many OECD countries the decade following the global financial crisis was tough going. Yet New Zealand avoided the worst of the downturn. GDP growth was healthy, the public finances remained in generally good shape,¹ and the central bank was able to rely on conventional macro-policy tools. Participation in the labour market continued to be high and there was little or no real decline in the share of national income going to labour (the 'labour income share') (Fraser, 2018). Yet, as a previous article in this journal argued (Nolan, 2014), one area where New Zealand has needed to lift its performance for a long time is productivity, with the country being below the OECD average for output per capita and labour productivity.

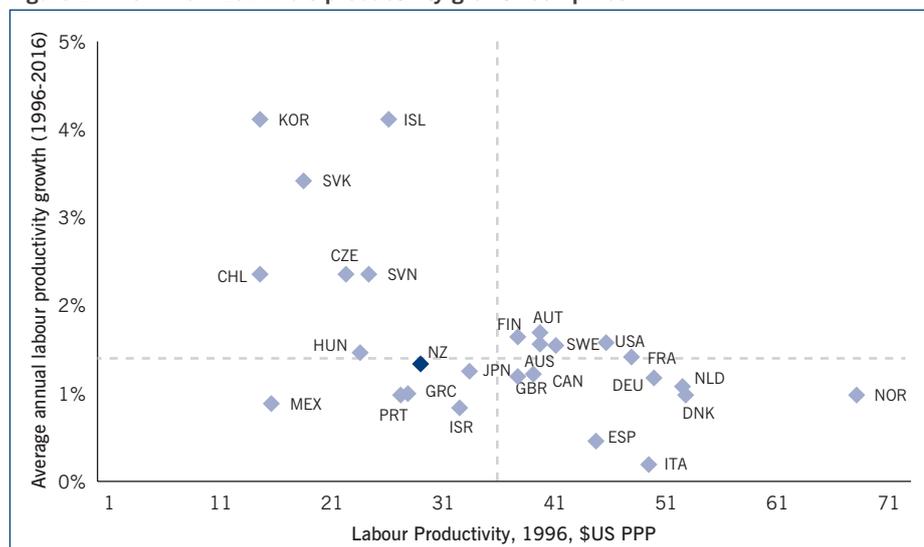
This productivity performance has been described as a paradox, as this occurred despite policy settings in many important areas appearing at or close to

Figure 1: Sources of income growth in New Zealand



Source: Authors' calculations based on Statistics New Zealand

Figure 2: How New Zealand's productivity growth compares



Source: Authors' calculations based on OECD and Statistics New Zealand

best practice; at least when 'viewed through the long-range telescopes of the OECD and World Bank' (Conway, 2018, p.52). Indeed, OECD research estimated that while New Zealand's broad policy settings should have generated GDP per capita 20% above the average for advanced OECD countries, the country was in fact 20% below (de Serres, Yashrio and Boulhol, 2014). This article revisits these concerns and considers recent progress made in understanding New Zealand's productivity performance.

Why care about productivity?

Higher productivity expands choices. It is a major driver of income growth. Indeed, as shown in Figure 1, increases in labour productivity have made a major contribution to lifting gross national income. New Zealand evidence also shows

that wages increase more rapidly when labour productivity growth is strongest (Conway, Meehan and Parham, 2015; Fraser, 2018). Further, productivity is not good just for incomes. A more productive use of natural resources can allow the same level of output to be achieved at lower environmental cost (Bailey and Lewis, 2018). By delivering more for less, higher productivity can also increase the time available for leisure and support the delivery of valuable state services in an increasingly tight fiscal environment (Nolan, 2018).

New Zealand's aggregate productivity performance

For many years New Zealand's productivity performance has, however, been disappointing. Statistics New Zealand

industry-level data shows that since 1996 the average growth in labour productivity across the whole economy has been 1.3%. Productivity in private sector industries (the so-called measured sector) has averaged 1.5% while in public sector industries, like education and health, it has averaged 0.2%. (For a fuller discussion of the performance of the public sector see articles by Gemmell, Nolan and Scobie and Nolan in this issue of *Policy Quarterly*.) Since the global financial crisis there has been a slow-down in productivity growth, with average annual productivity in the measured sector being 1.1% between 2008 and 2017.

To give a sense of how these results compare, Figure 2 shows labour productivity growth among OECD countries along with their labour productivity levels in US dollars in 1996. Making cross-country comparisons can be difficult given changes in relative prices in countries (measured in purchasing power parities (PPPs)) and the composition of the OECD (particularly the addition of lower-income countries). Nonetheless, New Zealand's growth in labour productivity since 1996 has been close to the OECD average, and has been stronger than that of countries like Australia, Canada and the United Kingdom. New Zealand's relative performance is, however, flattered by the decline in performance in these countries following the global financial crisis. For example, compared to the fall in New Zealand, the labour productivity growth rate in the UK (output per hour worked) had a larger fall from 2.1% (for 1996–2007) to 0.3% (for 2008–17). Further, New Zealand's performance since 1996 has been from a base of a relatively low productivity level and so, even with average growth, New Zealand has been trading water not catching up.

The significance of this aggregate productivity performance can be seen in Figure 3. This shows GDP per capita as a share of the OECD average. The gap between the average income in the OECD and in New Zealand has been closing since the global financial crisis. This improvement is largely due to relatively strong labour utilisation. In contrast, labour productivity (or GDP per hour worked) has remained at about 80% of the OECD average. The

result is that New Zealanders work, on average, about 10% more hours than the OECD average to produce about 20% less.

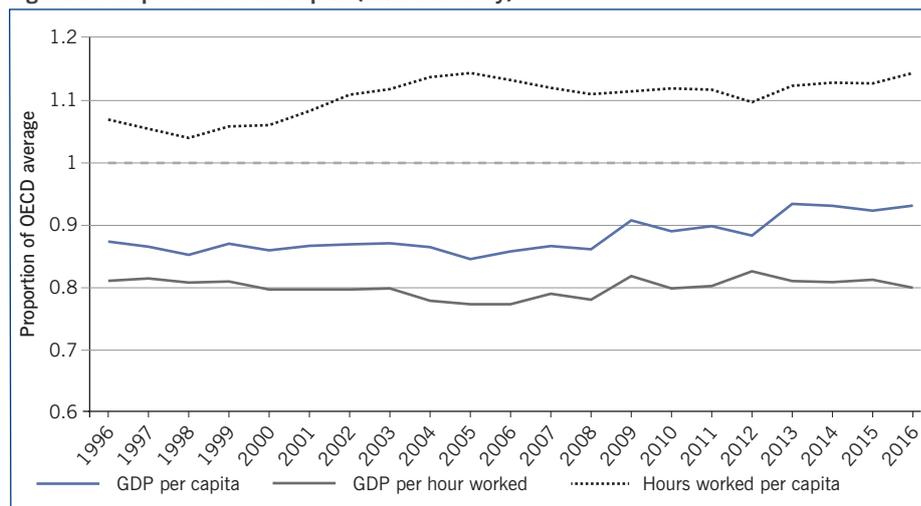
This labour productivity performance can be broken into two parts: multifactor productivity (the effectiveness with which inputs (such as labour and capital) are combined in the production process) and capital deepening (the capital available per unit of work). Since 2008 New Zealand's multifactor productivity performance has been relatively strong. Thus, as Figure 4 shows, the main reason for low labour productivity has been flat capital deepening. The figure shows an index of capital for the measured sector (excluding investment in owner-occupied housing and the government's spending on capital). While this capital index has been growing, the fast growth in labour inputs has meant that there has been little growth in capital per unit of labour. This failure of capital to grow in line with labour (in an environment of historically low interest rates) appears to have played a major role in holding back New Zealand's labour productivity since the global financial crisis.

Capital shallowness

This problem of capital shallowness in the New Zealand economy has been well canvassed before. For example, in 2009 it was estimated that capital per hour worked in the measured sector in New Zealand was about 40% below that in Australia and that this accounted over a third of the trans-Tasman gap in labour productivity (Mason, 2013). Similar work showed that capital per worker in New Zealand was also below that of the United Kingdom (Mason and Osborne, 2007). Capital shallowness has, in turn, been attributed to factors such as:

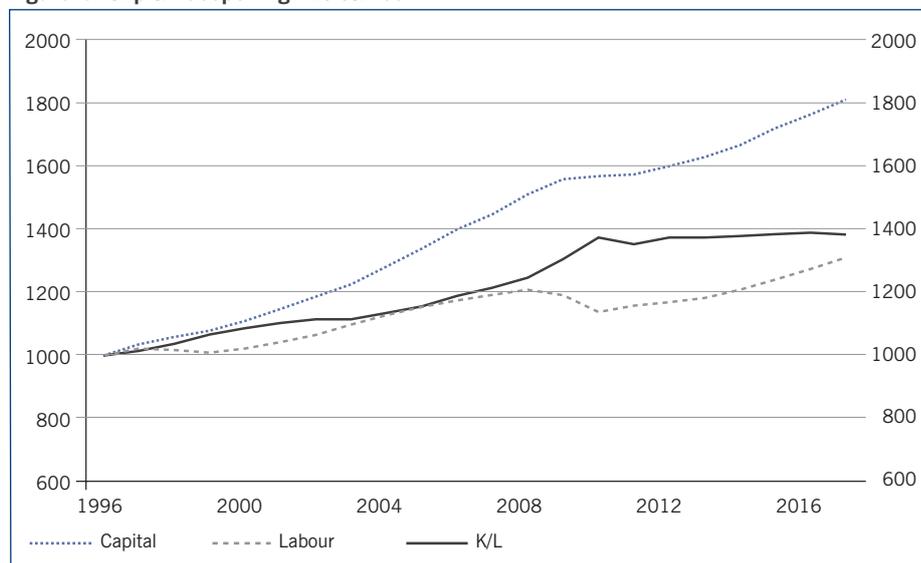
- relatively high long-term real interest rates, which contribute upward pressure on the cost of capital faced by firms and the real exchange rate. This suppresses investment and exacerbates the difficulties New Zealand firms face in accessing international markets, encouraging resources into the low-productivity non-tradable part of the economy (Conway, 2016, 2018);
- a high 'off-the-shelf' cost of investment goods. As Gemmell (2014) noted, the price of investment goods – such as infrastructure and construction – was

Figure 3: Gap in GDP Per Capita (total economy)



Source: Authors' calculations based on OECD and Statistics New Zealand data
Note: Calculations are based on the full set of OECD countries and constant PPPs.

Figure 4: Capital deepening has stalled



Source: Authors' calculations based on Statistics New Zealand

around 19% higher in New Zealand than the OECD average and 15% higher than in Australia; and

- fast population growth. As Culling and Skilling (2018) noted, since 2000 growth in the New Zealand labour force has been more than twice the OECD average. Growth in the working-age population has been largely driven by strong migration inflows, while participation rates have increased for older workers and also women (Reddell, 2013, 2017; Conway, 2018).

Yet, while these explanations are important, they are only part of understanding New Zealand's productivity performance. A fuller explanation requires understanding, for example, the degree to which small insular markets suppress investment, how capital deepening is

related to firms' business strategies (such as exporters' entry into new markets), and the relationship between investment in capital and the diffusion of new technology (as new technologies are often embedded in capital equipment).

Getting under the hood

Access to linked administrative and survey data for individual firms (microdata) is improving our understanding of New Zealand's productivity performance. Aggregate data (industry-level) and microdata (firm-level) illustrate productivity performance in different ways and often employ different methodological approaches (Mai and Warmke, 2012). Aggregate data shows the performance of the average firm, which can mask how different firms

have different levels of performance (the distribution of performance). Conversely, while microdata can provide a deeper picture of performance, aggregate data can be especially useful for illustrating wider trends (providing a broader picture).

New Zealand is fortunate to have a relatively rich source of microdata on New Zealand firms: the Longitudinal Business Database (LBD). The LBD provides a detailed view of firms' behaviour and performance across a broad range of topics (Fabling and Sanderson, 2016). Over recent years there has been a focus on how microdata can transform thinking on social policy in New Zealand. The data on the firm side is proving to be just as

of the firms that survive do not grow as they age (Meehan and Zheng, 2015). The result is that, rather than flowing to higher-productivity firms, resources are getting stuck in low-productivity ones (Meehan, 2018).

Small firms and markets

This raises the question of why surviving firms do not grow. One candidate is small markets. Not only is New Zealand a relatively small economy, but, when looking at employment shares, many firms only operate in (trade their output in) markets that are domestically close by (Conway and Zheng, 2014). The problem is that small markets are associated with

trade to GDP), firms' connections into global value chains (de Serres, Yashiro and Boulhol, 2014), and inward and outward foreign direct investment (Wilkinson and Acharya, 2013). This is significant, as foreign-owned firms operating in New Zealand outperform domestic firms on almost all measures of performance, with higher capital intensity, higher average wages and higher labour productivity (see, for example, Maré, Sanderson and Fabling, 2014). However, these results appear to reflect in large part foreign owners acquiring already high-performing firms (Fabling and Sanderson, 2014). Likewise, while New Zealand's internationally connected firms have relatively high productivity levels and are larger than domestically focused firms (Fabling et al., 2008), larger, more capital-intensive and more productive firms tend to opt into exporting, and this explains most of the productivity difference between exporters and non-exporters (Fabling and Sanderson, 2013).

The LBD has also been used to investigate barriers to earning international income and how these relate to the probability of future export success. Sanderson (2016) found that regulations and tariffs play a limited role in determining which firms generate international income (pp.18, 24), and noted that, while 'it is impossible to draw any strong conclusions regarding the barriers and strategies that may be holding firms back, these results point towards firms which are already succeeding in innovative or niche markets and which have definite plans for expansion having a higher chance of expanding further' (p.10). Country-specific knowledge can also be an important determinant of export success, with firms that have a higher share of workers from a specific country being more likely to export to that country (Sin et al., 2014). And there is some evidence that exchange rates make a difference (Fabling and Sanderson, 2015).

Investing in knowledge

As well as market size, recent LBD research has highlighted the importance of New Zealand firms' ability to learn (absorptive capacity) as a factor in shaping their ability to innovate and improve their productivity. Harris and Le (2018) found that the ability

A healthy rate of firm births and deaths can ensure resources do not get trapped in underperforming firms and can, in turn, support aggregate productivity growth ...

powerful. Indeed, there have been several important studies completed using the LBD over the last few years. The Ministry of Business, Innovation and Employment has prepared a valuable stocktake of these studies (Allan, 2018) and key findings are summarised below.

Insights from recent firm-level research

A healthy rate of firm births and deaths can ensure resources do not get trapped in underperforming firms and can, in turn, support aggregate productivity growth (Maré, Hyslop and Fabling, 2016). From the perspective of the economy as a whole the impact of a change in an individual firm's productivity will be magnified when productive firms gain market share and resources at the expense of less productive ones. Early research using the LBD found that firm entry and exit in New Zealand is not unusual when compared with other economies (Mills and Timmins, 2004; Law and McLellan, 2005; Meehan and Zheng, 2015). However, as more recent research has shown, a relatively high proportion

weak competitive intensity (Ministry of Business, Innovation and Employment, 2016), which can, in turn, hold back resource reallocation and slow technology diffusion. For example, in relation to technology diffusion, Wakeman and Conway (2017) found that small markets could be one explanation for low business enterprise expenditure on research and development and innovation in New Zealand. Their argument was that firms will be less likely to engage in risky and costly innovation when the final prize is a small domestic market. Consistent with this, they found that New Zealand firms that operate in international markets innovated more than firms focused solely on domestic markets.

One way to increase market size is to look to international markets – through trade, investment, people and the flow of ideas (Conway, 2016). Yet despite being relatively open on paper, the New Zealand economy is not well connected internationally, with there being concerns over trade intensity (ratio of international

of New Zealand firms to make use of external knowledge was positively related to their propensity to undertake research and development, innovate and export, even after controlling for other firm characteristics (e.g., foreign ownership and employee skill levels). This reinforces the importance of management practices (Bloom, Sadun and Van Reenen, 2016). Indeed, Fabling and Grimes (2014) found that firms that adopted a suite of human resource management practices boosted their productivity and raised the average wages they paid. Yet New Zealand has a relatively large number of firms with poor management practices (Bloom, Sadun and Van Reenen, 2016). Understanding the reasons behind this is an important area of ongoing research (Sanderson, 2018).

Likewise, LBD research has helped explain firms' investments in knowledge-based capital. Knowledge-based capital includes a range of intangible assets, such as software, research and development, product design, inter-firm networks and organisational know-how (Wakeman and Le, 2015). Intangible assets are difficult to measure, but international data suggests that investment in them is rising and may exceed investment in machinery and equipment in some countries. However, in New Zealand, Chappell and Jaffe (2016) found little link between investment in intangible assets and average firm productivity, although firms that invested in intangibles did expand employment and output.

This is an area where the LBD has been used to evaluate policy interventions. Wakeman (2017) found that the overall impact on firm performance of receiving a research and development grant was mixed. Likewise, while research and development subsidies were found to have a positive impact on patenting and introducing new goods and services to the world, their impact on process innovation and introducing products new to New Zealand or the firm was smaller (Jaffe and Le, 2015). Further, Fabling and Grimes (2016) found that, when considered in isolation, the adoption of ultra-fast broadband (UFB) had no effect on overall employment, labour productivity and multifactor productivity. However, firms that adopted UFB also tended to introduce

other organisational changes and there was a positive relationship between introducing complementary organisational changes and productivity among firms that adopted UFB.

Further, while New Zealand experienced strong employment growth in the lead-up to the global financial crisis, LBD research has shown that this has lowered the average quality of labour (Maré et al., 2017). Maré et al. (2017) also looked at the career and earnings trajectories of recent graduates, comparing outcomes for those who studied STEM and non-STEM subjects at both degree and sub-degree levels, and found that those who studied at degree level had

Commission, 2016) discussed how recent research has allowed us to improve on three traditional explanations for New Zealand's productivity performance – industry structure, geography and business culture. Take business culture. Low firm productivity is sometimes attributed to a supposed preference for the 'three Bs' (business owners and operators stop expanding their firms once they get a bach, boat and BMW). But more powerful insights come from research that allows researchers to understand what leads to business owners and operators deciding to limit their ambition in this way. With firm-level research on topics like barriers

A key theme of the firm-level research cited in this article is that the processes of diffusion and reallocation generally do not work as well as they could in New Zealand.

a significantly higher contribution to productivity. However, the contribution of female workers tended to be systematically undervalued by employers (Sin, Stillman and Fabling, 2017). Chappell and Sin (2016) also showed that the 90-day trial period had no effect on firm hiring behaviour on average, but firms in the construction and wholesale trade industries (heavy users of trial periods) increased their hiring by around 10%.

Death of a paradox

It used to be said that New Zealand's productivity performance was a paradox, but, as the studies cited in this article show, researchers have well and truly moved on from this view. Of course, a large number of unanswered questions remain. Our understanding of the economy will always be incomplete, particularly given some of the internationally unusual features of the New Zealand economy, but progress has been made in better understanding our productivity performance over recent years. As an example, the New Zealand Productivity Commission (Productivity

to export success, it is increasingly possible to understand these underlying drivers.

A key theme of the firm-level research cited in this article is that the processes of diffusion and reallocation generally do not work as well as they could in New Zealand. Many domestic frontier firms are disconnected from the international frontier, laggard firms tend not to catch up to the domestic frontier, and resources are stuck in a tail of small and unproductive firms (Conway, 2016, 2018). While there are some successful New Zealand firms, there is evidence that too few New Zealand firms are benefiting from new productivity-enhancing technologies and ideas developed at the global frontier. A large share of employment and capital is concentrated in firms with low productivity. There are too many small, old and relatively unproductive firms that neither grow rapidly nor exit the market.

Conclusion

The explanations for New Zealand's productivity performance contained in this article (summarised in Table 1) lead

Table 1 Explanations for New Zealand's productivity problems

Explanations based on aggregate data	Explanations based on microdata
Capital shallowness reflecting: <ul style="list-style-type: none"> · High long-term real interest rates · High off-the-shelf cost of capital goods · Fast population growth 	Impaired reallocation and diffusion (firms that are disconnected and stuck) reflecting: <ul style="list-style-type: none"> · Weak international connections · Small size of domestic markets · Low investment in knowledge-based capital · Firms' limited ability to learn · Weaknesses in the allocation of labour

to the question of how policy reform could support a successful New Zealand economy steadily closing the income and productivity gaps with the rest of the world. In many respects the future policy challenge is different to what has been faced previously. With dramatic falls in the price of transmitting data over distance an opportunity is now opening for firms to engage in new ways internationally (Conway, 2017). This trend is likely to continue given the 'servitisation of manufacturing' and strong growth in digital products that can be marketed and delivered worldwide through fibre-optic cables. This is consistent with some promising signs in the New Zealand economy, such as increasing export

diversity and a growing high-tech sector.

Making the most of these new opportunities implies a reform agenda focused on skills, flexibility, openness and receptiveness to new technology. These issues are canvassed in Conway (2016, 2018) and in work by the OECD and the Australian Productivity Commission (see articles by Pilat and Criscuolo and Lattimore in this issue of *Policy Quarterly*). Key directions of reform that have been proposed (Conway, 2018) include: prioritising trade in services and digital products in New Zealand's trade strategy; improving the matching of skills to jobs, including through encouraging the education system to be more adaptive and responsive to labour market demands;

focusing immigration policy on lifting the skill composition of the workforce; making investment easier and more effective, including addressing differences in the taxation of different forms of savings (e.g., business assets and housing); and enhancing New Zealand's competition policy framework. This also presents a major challenge for the New Zealand public sector and will require improvements in policymaking capability (including the use of monitoring and evaluation) and the delivery of services (Gemmell, Nolan and Scobie, 2018; Nolan, 2018).

¹ As the 2017 OECD economic survey of New Zealand noted, 'considerable progress [was] made in lowering the general government budget deficit from a post-recession high of 7.1% of GDP in 2010 to near balance since 2014' (OECD, 2017, p.31). A factor in this was the rise and then fall of spending related to the Canterbury earthquakes (net of reinsurance receipts), which went from 4.4% of GDP in 2010–11 to 0.3% in 2015–16.

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THE FUTURE OF PRODUCTIVITY

what contribution can digital transformation make?

Abstract

This article summarises emerging evidence on the relationship between productivity and the digital transformation, based on work underway in the OECD's Going Digital project. The article starts by discussing the relationship between the global productivity slowdown and the diffusion of digital technologies and related processes across firms and industries. It then outlines the role of structural factors in digital adoption, before concluding with a brief discussion on policies to strengthen future productivity growth.

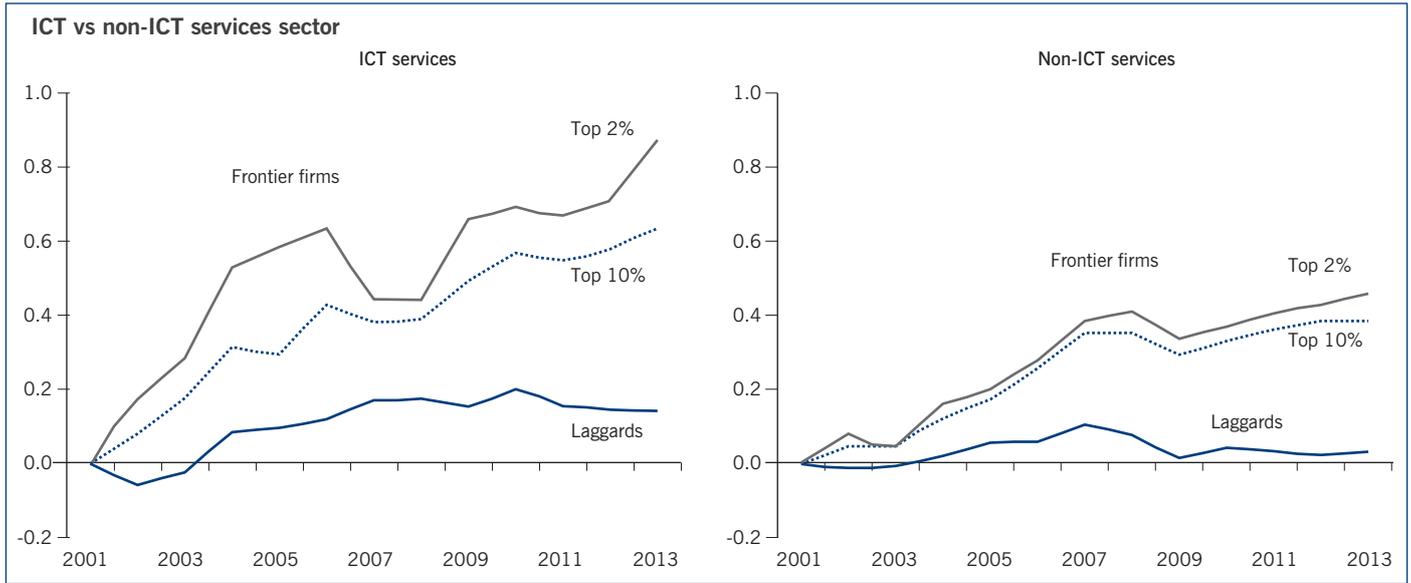
Keywords productivity, technological change, digital transformation

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The ongoing digital transformation of the economy and society holds many promises to spur innovation, generate efficiencies and improve services, and in doing so boost more inclusive and sustainable growth as well as enhance well-being. But these opportunities will not materialise automatically and require policy action to make digital transformation work for growth and well-being.

One example of such an opportunity concerns productivity. Digital transformation of our economies holds the promise of improving productivity performance by enabling innovation and reducing the costs of a range of business processes (Goldfarb and Tucker, 2017). But, despite the rapid rise of digital technologies starting in the mid-1990s, aggregate productivity growth has slowed over the past decade or so, sparking a lively debate about the potential for digital technologies

Figure 1: The divergence in multi-factor productivity growth



Source: Andrews, Criscuolo and Gal, 2016

to boost productivity. Today, as in the 1980s, when Nobel Prize winner Robert Solow famously quipped, ‘You can see the computer age everywhere but in the productivity statistics’ (Solow, 1987), there is again a paradox of rapid technological change and slow productivity growth.

This article summarises emerging evidence on the relationship between productivity and the digital transformation, based on work underway in the OECD’s Going Digital project, and explores some policies that may help realise its benefits.

The productivity slowdown: laggard firms and stalling diffusion

The current literature points to several possible factors that may contribute to

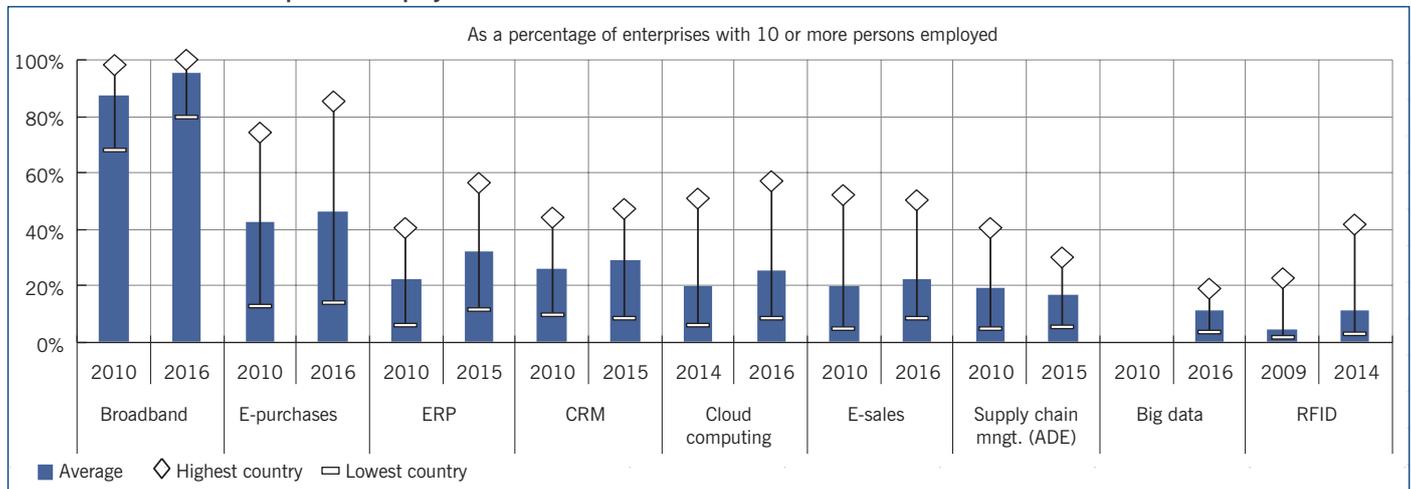
the new productivity paradox (including inadequate measurement: see, for example, Ahmad, Ribarsky and Reinsdorf, 2017). Together, these provide clues to possible avenues for policy action that could strengthen future productivity growth based on digital transformation.

First, there are still important differences in digital transformation across industries that affect the overall state of digital transformation, and thus its impacts on productivity (see McKinsey Global Institute, 2018). Recent OECD analysis shows that some sectors are less advanced than others in terms of the pace of digital transformation (Calvino et al., 2018; OECD, 2017). For example, even if new technologies are being integrated here too,

agriculture, mining and real estate still rank in the bottom part of the distribution on digital intensity across the available indicators. Conversely, telecommunication and IT services rank consistently at the top of the distribution. Other sectors display a large heterogeneity in the adoption of different digital technologies, suggesting that they are engaged in only some aspects of digital transformation.

Looking behind the aggregate and sectoral statistics, micro-level studies reveal that the aggregate productivity slowdown masks a widening performance gap between more productive and less productive firms, especially in ICT services sectors (Andrews, Criscuolo and Gal, 2016; Figure 1). Throughout the economy, this

Figure 2: Diffusion of selected ICT tools and activities in firms, 2010 and 2016, as a percentage of enterprises with ten or more persons employed



Note: The upper and lower bar denote the minimum and maximum average value across countries. ERP refers to enterprise resource planning, CRM to customer relationship management, RFID to radio frequency identification.
Source: OECD, 2017

divergence is driven not just by frontier firms pushing the productivity frontier out, but also by the stagnating productivity of laggard firms, related to the limited capabilities of, or lack of incentives for, such firms to adopt best practices. Together, these signs illustrate that the main source of the productivity slowdown is not so much a slowing of innovation by the most globally advanced firms, but the uneven uptake and diffusion of these innovations throughout the economy (OECD, 2015b).

OECD data also show that the diffusion of digital technologies across OECD countries is far from complete. While most firms now have access to high-

view (and what may be implemented by frontier firms) and what is currently being implemented by firms on average.

The history of technological change also demonstrates that the successful implementation of new technologies involves much trial and error, and that it takes time to reorganise production processes, introduce new business models, and provide workers and management with new skills. Digital transformation is not just about the diffusion of technology, but increasingly about the complementary investments that firms need to make in skills, organisational changes, process innovation, new systems and new business

spur investment and strengthen technology diffusion (McKinsey Global Institute, 2018).

Opportunities and challenges for SMEs

Digital technologies offer new opportunities for SMEs to participate in the global economy, innovate, scale up and enhance productivity. Digital transformation facilitates the emergence of 'born global' small firms, and SMEs' access to customers in local and international markets, with internet platforms increasing the supply of products and services and allowing trades that otherwise would not happen. Big data and data analytics enable SMEs to better understand the processes within the firm, the needs of their clients and partners, and the overall business environment. The use of digital technologies can also ease SMEs' access to skills and talent, such as through better job recruitment sites, and the outsourcing of key business functions, all of which can help improve performance. It can also facilitate access to a range of financing instruments and the development of innovative solutions to address information asymmetries and collateral shortages.

However, SMEs also face particular challenges in the adoption and effective use of ICT, particularly in the case of productivity-enhancing applications. The adoption lag of SMEs is mainly due to a lack of key capabilities, such as human resources and management expertise, and a lack of investment in complementary assets. Furthermore, SMEs face specific challenges in managing digital security and privacy risks, mainly due to lack of awareness, resources and expertise to assess and manage risk effectively. Finally, the slow adoption of digital technology might also be a reflection of the lower incentives for some SMEs which might not be able to reap the same pay-off from the digitalisation of their production processes as larger businesses.

The role of structural factors for digital adoption

A second factor limiting the impacts of digital technologies on productivity is the slow pace of structural change and resource reallocation in OECD economies. Digital

Digital transformation of firms involves a process of search and experimentation with new technologies and business models, where some firms succeed and grow and others fail and exit ...

speed broadband networks, more advanced, productivity-enhancing digital tools and applications, such as enterprise resource planning systems or big data analytics, have diffused to far fewer firms in OECD countries (Figure 2). Moreover, significant cross-country differences emerge – even among the most advanced economies – raising important questions about why some countries are more successful at adopting digital technologies than others.

The diffusion of so-called 'general-purpose technologies' (GPT) like digital technologies typically follows an S-shaped curve, where technologies are initially adopted only by some leading firms and later diffuse to all firms, as they become more established, prices fall and markets grow. Moreover, technology development and adoption depend on a host of economic, legal, ethical and social factors, as well as on the availability of the requisite skills and organisational changes. Consequently, there is a significant gap between what can currently be implemented from a technical point of

models (Haskel and Westlake, 2017). Some recent research suggests that the scale and complexity of these complementary investments is growing, which may make digital transformation particularly difficult for non-frontier firms, such as traditional small-to-medium enterprises (SMEs) (Brynjolfsson, Rock and Syverson, 2017). During this process of adjustment and experimentation, productivity growth may be low and can even turn negative (ibid.).

On a positive note, the slow diffusion of digital technologies and the related processes across firms and industries in OECD countries suggests that its impacts on productivity are likely to emerge in the years to come, as digital intensity in firms and sectors increases further and the economy adjusts (Van Ark, 2016). This might also be affected by the current business cycle: as firms in several OECD countries are starting to incur labour and skills shortages, they will increasingly look for digital tools to help enhance their productivity performance. Moreover, the recent pickup in global demand may help

transformation of firms involves a process of search and experimentation with new technologies and business models, where some firms succeed and grow and others fail and exit (OECD, 2004). Countries with a business environment that enables this process may be better able to seize the benefits from digital transformation than countries where such changes are more difficult and slow to occur.

New OECD research shows that the diffusion of selected digital technologies is typically more advanced in sectors where firm turnover (i.e. entry and exit) is higher (Calvino and Criscuolo, 2018). This is consistent with the idea that new entrants: (a) possess a comparative advantage in commercialising new technologies (Henderson, 1993); (b) place indirect pressure on incumbent firms to adopt new technologies; and (c) can more fully reach their potential when they have sufficient space to grow, which is accommodated by the exit of inefficient firms.

Moreover, digital adoption will be facilitated by efficient resource allocation, since a firm's incentives to experiment with uncertain/risky digital technologies will be shaped by its perceived ability to rapidly scale up operations in the event of success, and rapidly scale down operations and potentially exit the market at low cost in the event of failure (Andrews and Criscuolo, 2013). From this perspective, harnessing digital transformation for firms places an added premium on policies that foster business dynamism and efficient resource reallocation. This is a challenge in many OECD countries against the backdrop of declining business dynamism (Criscuolo, Gal and Menon, 2014) and rising resource misallocation (Adalet McGowan, Andrews and Millot, 2017b; Berlingieri, Blanchenay and Criscuolo, 2017) in many OECD countries over the past decade.

A range of policies can incentivise greater digital adoption through experimentation either by increasing competitive pressures or by lowering the costs of reallocation. This includes insolvency regimes that do not inhibit corporate restructuring and do not excessively punish entrepreneurial failure. At the same time, access by entrepreneurs to appropriate forms of finance, such as venture capital financing, together with

corporate tax regimes that do not excessively favour debt over equity financing are also associated with higher digital adoption rates.

Importantly, the transition of an economy based on tangibles to one based on intangibles (or ideas) can only succeed if firms have access to the right set of capabilities. For example, qualified firm management that takes the decisions to invest and guides the adoption process has been identified as a key capability (see Bloom, Sadun and Van Reenen, 2012; Pellegrino and Zingales, 2014). Firm-level practices related to workers, including their

increasing in many OECD countries, particularly since the global financial crisis, while the productivity of this group of firms has been falling rapidly relative to 'viable' old firms, as well as younger firms in general (Adalet McGowan, Andrews and Millot, 2017b). The growing amount of resources trapped in unproductive 'zombie' firms and the slowdown in reform efforts to tackle regulations that impede product market competition (Adalet McGowan, Andrews and Millot, 2017a) have also contributed to the slowdown in structural change.

To explore the role of business

Recent OECD work has pointed to a slowdown in business dynamism in OECD economies, which has slowed down the necessary reallocation of resources across the economy.

participation in training, or their flexibility in working hours, are also important in this context.

Second, workers' skills matter, including providing them with the opportunity to continuously develop their skills in order to keep pace with the fast-changing technological landscape, and ensuring that people's skills are allocated to their most productive uses. In addition, evidence gathered within the Going Digital project shows that workers' wages, which can be used as a proxy for their productivity, are positively correlated not only with workers' advanced numeracy skills but also with their management and communication capabilities.

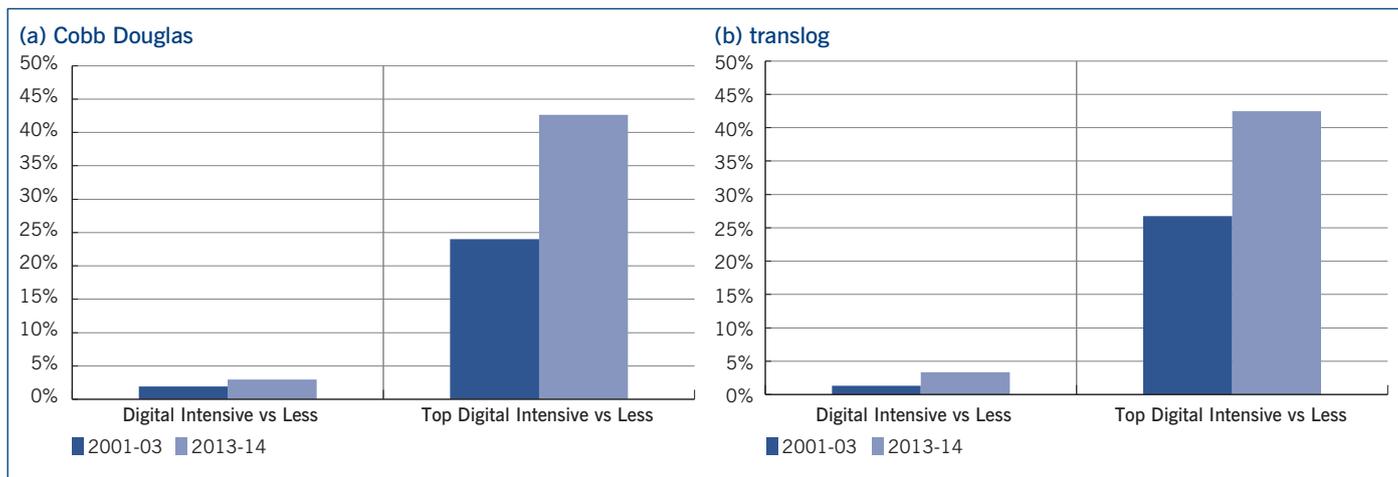
Digital transformation and business dynamism

A third, and closely related, factor concerns the link between digital transformation and business dynamism. Recent OECD work has pointed to a slowdown in business dynamism in OECD economies, which has slowed down the necessary reallocation of resources across the economy. For example, the share of non-viable old firms has been

dynamism for digital transformation in more detail, new evidence from the OECD's Going Digital project investigates two aspects of these issues and how these have been affected by the ongoing digital transformation: business dynamics and mark-ups. First, research examining the association between business dynamism (measured by the churning rate) and selected measures of digital intensity (Calvino and Criscuolo, 2018) points to the existence of a positive role of digital transformation for business dynamics. This is in line with the idea that digital transformation lowers barriers to entry and facilitates reallocation. It also suggests that the more digitally intensive sectors are those that are more dynamic (i.e. with higher rates of entry, higher churning and higher post-entry growth).

On the other hand, sectors where the automation of tasks and the share of turnover from e-commerce are higher are also those where business dynamism is lower. These findings likely reflect the role of high fixed costs, data and networks with customers and suppliers as a barrier for new firms. They might also reflect that

Figure 3: Average percentage differences in mark-ups between firms in less digital-intensive and in digital-intensive sectors at the beginning and at the end of the sample period



Note: The graphs report the estimates of a pooled OLS regression explaining firm log mark-ups in the period, on the basis of the company's size, age, and country and year of operation, as well as a dummy variable with value 1 if the sector of operation is digital intensive versus less digital intensive (specifications on the left in the graph), or if the sector of operation is among the top 25% of digital-intensive sectors versus not (specifications on the right in the graph). Panel (a) estimates mark-ups based on a Cobb Douglas production function; panel (b) on a Translog production function. Standard errors are clustered at the company level. All coefficients are significant at the 1% confidence level.

Source: Calligaris, Criscuolo and Marcolin (2018) based on Orbis® data.

growth of firms in highly automated sectors might not always involve the direct creation of new jobs.

Digital technologies are also transforming the way firms produce, scale up and compete. They allow firms to leverage ever larger networks of consumers, access multiple geographical and product markets almost instantaneously, and exploit increasing returns to scale from intangible assets.

In this context, new OECD work (Calligaris, Criscuolo and Marcolin, 2018) explores mark-ups: the difference between the price a firm charges for its output on the market and the cost the firm incurs to produce one extra unit of output. The study estimates mark-ups at the firm level for a large sample of companies across 26 OECD and non-OECD countries, for the period 2001–14. It finds that mark-ups have been increasing over the period, on average across firms and countries, but especially in firms at the top of the mark-up distribution. Furthermore, the results suggest that mark-ups are higher in digital-intensive sectors than in less digitally intensive sectors, other firm characteristics being equal, with the difference increasing over time (see Figure 3).

The results might be reflecting both changes in production as a consequence of the digital transformation – such as stronger reliance on intangibles – and higher fixed costs. They could also be indicative of a shift in the market structure,

reflecting lower costs of production, easier penetration of multiple markets and higher intensity in knowledge assets, which allow digital companies to scale up more quickly and more easily, and generate increasing returns to scale, thus potentially making the entry of new players into the market more difficult. Ongoing OECD work investigates the relative importance of these changes in explaining aggregate trends. This analysis helps shed light on the mechanisms underlying increasing trends in market concentration, declining business dynamism, and declining trends in labour share and capital. In addition, providing evidence on the link between these trends and firms' digital intensity expands on existing studies that have uncovered a positive correlation between industry concentration and firms' use of proprietary IT systems (Bessen, 2018).

While the changes in business dynamism and the growth of mark-ups (in particular in digitally intensive sectors) are not necessarily a cause of concern, as they may be inherent to the nature of digital transformation, they do point to important changes in the competitive environment linked to digital transformation that need to be further examined and considered by policymakers.

Policies to strengthen future productivity growth

For policymakers, a number of points emerge from the discussion above. First,

digital transformation is already having impacts on productivity in individual firms, and also in specific industries. Second, further and larger impacts are likely to emerge as digital transformation evolves and new technologies, business models and practices diffuse to more firms and industries. Third, ensuring that the largest possible impacts emerge can benefit from proactive policy action. All of this will also support productivity growth more generally. Key actions include:

- *Strengthening national and international technology and knowledge diffusion.* As discussed in detail in OECD (2015a), advanced technology and knowledge often comes from abroad, as it is developed in scientific institutions and global frontier firms. Openness to foreign technology and knowledge is therefore essential to benefit from digital transformation, and requires openness to trade, investment, and international mobility of the highly skilled. Moreover, strengthening knowledge diffusion within the economy is important and can benefit from policy action – for example, as regards the wider use of technology extension services, improvements in science–industry linkages and stronger mobility of human resources within the economy.
- *Fostering investment in tangible and intangible capital, notably skills.* With investment levels remaining low across

most OECD countries, policies that can strengthen investment in tangible and intangible capital are crucial to increase the adoption of digital technologies, strengthen the necessary complementary knowledge and enhance the absorptive capabilities of firms, managers and workers. Training and investment in skills of both workers and managers is particularly important in this context.

- *Enabling SMEs to harness digital transformation.* Enabling SMEs and entrepreneurs to fully harness digital transformation can help ensure that growth is inclusive, as well as boost productivity and competitiveness, as these firms find new niches in global value chains. Comprehensive national digital strategies that take into account SMEs, policies that facilitate access to finance, knowledge networks and skills, including the development of management skills for the digital economy, and SME engagement with competency centres and/or technology extension services can be helpful. National digital security strategies can also help address the specific needs of SMEs by providing them with practical guidance and the appropriate incentives to adopt good practices.
- *Facilitating the necessary structural change in the economy.* Policies in

OECD countries often implicitly or explicitly favour incumbents, and do not always enable the experimentation with new ideas, technologies and business models that underpins the success of innovative firms, be they large or small. Policies which (unwittingly) constrain the entry and growth of new firms can also slow down structural change. Moreover, policy should also avoid trapping resources in inefficient firms – e.g., through bankruptcy laws that do not excessively penalise failure.

- *Strengthening structural reform to support digital transformation.* In many sectors of the economy, successful digital transformation will require changes to existing institutions, regulations and markets, as new technologies enable the emergence of new business models, as well as new ways of delivering public and private services. To unlock the potential of digital transformation, further structural reforms will eventually be required in many areas, including financial services, health services and education services, as well as the public sector itself.

- *Ensuring effective competition.* Policymakers will also need to ensure that market competition is effective by providing competition authorities with

rules and tools that can address the new challenges posed by the digital economy, where these prove to be necessary; and that co-operation across national competition agencies is enhanced to address competition issues that are increasingly transnational in scope or involve global firms.

- *Investing in innovation to drive the productivity frontier.* Firms and governments will also need to continue investing in innovation to further develop digital and other technologies that can move the global productivity frontier. This includes ensuring sufficient investment in basic research that is key to developing the seeds for future innovation and that has underpinned most of the technologies that drive the current digital transformation (OECD, 2015a, 2015b).

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Steven Bailey and Geoff Lewis

Meeting the Challenge of a Low-Emissions Economy

Abstract

The impacts of climate change threaten the productivity, incomes and well-being of all humanity. Climate change has been described as the ‘greatest market failure the world has ever seen’. In 2017 the government asked the Productivity Commission to ‘identify options for how New Zealand could reduce its domestic greenhouse gas emissions through a transition to a lower emissions future, while at the same time continuing to grow incomes and wellbeing’. New Zealand can achieve a successful low-emissions economy, but there will be challenges. The commission’s recently released draft report provides insights into how and where the country can best achieve emission reductions and the types of policies and institutional architecture required to drive the transition.

Keywords low-emissions economy, climate change policy, transition, emissions pricing, innovation, institutions, pathways

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The impacts of climate change threaten the productivity, incomes and well-being of all humanity. Nick Stern describes climate change as ‘the greatest external effect in human history’ in his eponymous *The Economics of Climate Change: the Stern Review* (2007). Increases in global temperature are already causing, and will continue to cause to an increasing extent, widespread impacts on human, economic and natural systems. Impacts include heatwaves and extreme rainfalls, more frequent droughts and cyclones, water scarcity, threats to food security, dangerous flooding caused by sea level rise, ocean acidification, and major extinction of species of flora and fauna. The damages expected from only a small rise in the global temperature are severe.

The economic costs of escalating climate risks are daunting. For example, the Economist Intelligence Unit warns that the ‘tail risks’ of climate change could cause an eye-watering US\$43 trillion worth of global assets in present value terms to be wiped out by 2100. Others estimate that failure to act to lower emissions will reduce global GDP by as much as US\$72 trillion by 2060 (Citigroup, 2015). The effects of climate change are inextricably entwined

with human health. The work of the 2015 Lancet Commission on Health and Climate Change concluded that anthropogenic climate change threatens to undermine the past 50 years of gains in public health, and, conversely, that a comprehensive response to climate change could be ‘the greatest global health opportunity of the 21st century’ (Lancet, 2015).

New Zealand is committed to being an active participant in the international response to the challenge of climate change (through the 2015 Paris Agreement), principally by making substantial reductions in its greenhouse gas emissions. In 2017 the government asked the Productivity Commission to ‘identify options for how New Zealand could reduce its domestic greenhouse gas emissions through a transition to a lower emissions future, while at the same time continuing

and some (e.g., the OECD, the World Economic Forum, PwC) refer to decarbonisation as a ‘mega-trend’ that will reshape the global economy over the next several decades.

In the coming years, New Zealand’s governments (central and local), businesses and society will make a series of key choices that will influence the structure of the economy and the cost of reducing greenhouse gas emissions. The broad purpose of the commission’s inquiry is to recommend actions that the government might take to reduce New Zealand’s emissions given the levers within its control, and recognising that some influential factors are outside its control. The commission’s draft report, released in April 2018, provides insights into how and where the country can best achieve emission reductions and the types of

party agreement, is the most urgent and important law that our next Parliament could legislate’ (Generation Zero, 2017, p.3).

New Zealand’s role in tackling global climate change

New Zealand produces among the highest greenhouse gas emissions per person in the world. This is despite having an electricity system that is overwhelmingly powered by renewables. The explanation for such high perperson emissions lies substantially in New Zealand’s large agricultural sector, which accounts for nearly half of New Zealand’s total emissions and which exports a very high proportion of its output. Yet the fastest *growth* in emissions in recent years has come from rapid population growth and the associated growth in the light vehicle fleet.

While per person emissions are high, New Zealand’s total emissions make up less than 0.2% of global emissions. Actions in New Zealand will not make an appreciable difference to the global climate change trend. This exemplifies the public policy challenge of climate change. It is a classic example of the ‘tragedy of the commons’, in which individuals tend to overly focus on value to themselves without taking into account the detriments of their actions to the whole community. The ‘commons’ in this case is a truly global resource – the shared atmosphere upon which life depends – and its limited ability to absorb greenhouse gas emissions without giving rise to climate disruptions that are enormously damaging to life on the planet. So, while it is small, New Zealand’s size does not justify inaction. Indeed, quite the opposite. Around 30% of global emissions come from small emitters. Collectively, small economies do matter and a global, concerted effort by all is needed to solve this issue.

Further, by achieving a successful transition to a low-emissions economy, New Zealand has a major opportunity to influence others. It can reduce the risk of other countries failing to pursue mitigation pathways because they either do not know how to, or do not think it can be done while continuing to grow incomes and well-being. This is likely to be particularly relevant in areas where New Zealand has

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to grow incomes and wellbeing’ (Productivity Commission, 2018, p.1). In 2018, James Shaw, as the new government’s minister for climate change, signalled a more ambitious agenda and asked the commission to include the target of achieving net zero emissions by 2050 in its analysis.

The transition to a low-emissions economy will mean that New Zealand will look very different in 2050, and even more transformed by 2100. During the transition, action to mitigate greenhouse gas emissions will require real and significant changes, affecting households, businesses, industries, cities and regions. It is no exaggeration to say that a shift from the old economy to a new, low-emissions economy will be profound and widespread, transforming land use, the energy system, production methods and technology, regulatory frameworks and institutions, and business and political culture. Of course, this transformation is a global phenomenon,

policies required to drive the transition. It explores the challenges, opportunities, benefits and costs of alternative transition pathways and makes specific policy recommendations.

Climate change is a problem unlike any other, both because of its scale and because it is about the near and far future. An important theme in our inquiry is that a long-term perspective must be introduced into politics and policymaking, domestically and internationally. The long-term nature of climate change and the deep uncertainty about many aspects of the future require political commitments and a durability that spans many generations. It is future generations who will live with the consequences of actions taken, or not taken, today to reduce emissions and curb the impacts of climate change. It is therefore not surprising that, in their submission to this inquiry, Generation Zero – a youth-led organisation in New Zealand – say, ‘We believe a Zero Carbon Act, backed by cross-

expertise and experience (e.g., pastoral greenhouse gas mitigation). New Zealand's capacity to influence will be the greater if it can point to its own credible and substantial mitigation progress.

Overcoming myopia and managing uncertainty

New Zealand has had climate change policies in place for some time, but it has not taken effective action to lower its emissions. This reflects the problems that lie at the heart of climate change policy: time inconsistency in policy settings (the tendency to continue to put off hard decisions) and uncertainty about the future.

While the costs of change are immediate and real, the benefits may not be clear for many years. The nature of democratic political systems (where the political executive governs based on short-term electoral cycle mandates) tends to favour short-term interests over long-term interests (Averchenkova and Bassi, 2016; Boston, 2016; Hovi, Sprinz and Underdal, 2009). This presents a problem for any government wanting to credibly commit to a long-term policy response and makes the formulation of enduring policy solutions hard. The governor of the Bank of England, Mark Carney, puts it this way: 'climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix' (Carney, 2015). The temptation is to push the responsibility onto others, most likely future generations. Yet without durable and ambitious policies now, the signals for firms and households to move their production and consumption towards less emissions-intensive options will be weak at best.

So stable and credible climate policy settings, starting now, must lie at the heart of a transition to a low-emissions economy. The private sector and civil society must be able to plan and take long-term decisions with confidence. As the parliamentary commissioner for the environment puts it, '[u]nderwriting a long-term reorientation of the economy away from fossil fuel dependency requires policy stability decoupled from the short-term ebb and flow of politics ... It requires a broadly

shared commitment to steady progress' (Parliamentary Commissioner for the Environment, 2018, p.17).

The Productivity Commission's draft report makes concrete proposals for a stable and credible policy environment and a set of actions to enable New Zealand to transition to a low-emissions economy. These proposals are that the government should:

- send a strong signal that it is committed in the long term to the transition to a low-emissions economy and provide transparency about future policies to achieve this;
- use emissions pricing to send the right

- support investment in low-emissions technology, infrastructure and other activities, through leadership and by mobilising new sources of finance.

Together, these steps will provide an enabling platform that will shape incentives for producers and consumers to reduce their emissions, make the right investments and come up with new ideas.

Getting emissions pricing right

An emissions price is the price an emitter pays for each unit of greenhouse gas they release into the atmosphere. Properly designed and implemented, emissions pricing is a powerful policy instrument

The commission considers that the New Zealand emissions trading scheme (ETS) should remain the centrepiece of New Zealand's emissions reduction efforts as it has the potential to provide pervasive and visible emissions pricing.

signals for investment, innovation and mitigation;

- enact laws and build institutions that underpin policy settings, with clear targets and accountability for action, and that act as a commitment device for future governments to continue the development and implementation of long-term policies to combat climate change;
- harness the full potential of innovation through making it a priority and devoting significantly more public resources to low-emissions research, and to the deployment and adoption of low-emissions innovations;
- ensure that other supportive regulations and policies are in place, to address non-price barriers, encourage the transition, and manage serious adverse impacts on lower-income households and affected businesses. This acknowledges that emissions pricing is not sufficient on its own to change behaviour and reduce emissions;

to reduce emissions. A single emissions price provides a strong incentive to reduce emissions at least cost. It decentralises decisions to invest, innovate and consume across the economy to people who have the best information about opportunities to lower emissions given their circumstances. An emissions price is also pervasive through the whole economy, shaping resource and investment decisions across all emitting sectors and sources. Ensuring that emissions are appropriately priced is an essential step in New Zealand's approach to climate change mitigation.

Several tools exist to apply emissions pricing – including taxes, market-based schemes such as 'cap and trade', and hybrid combinations – and each tool can be designed in a variety of ways. For the purposes of credibly moving towards a low-emissions economy, gaining certainty over the quantity of emissions that will be permitted is vital. The commission considers that the New Zealand emissions

trading scheme (ETS) should remain the centrepiece of New Zealand's emissions reduction efforts as it has the potential to provide pervasive and visible emissions pricing. However, the ETS needs to be made credible and effective.

The emissions price created through the ETS needs to rise considerably. Previous prices have been so low as to make the scheme ineffectual in changing firm and household behaviour. Just what level of pricing will be required cannot be known precisely. However, specialised modelling and other available evidence suggests that New Zealand's emissions price will need to rise to levels of the order of \$75 a tonne of CO₂ equivalent (CO₂e) and possibly over \$200 a tonne over the next few decades to achieve the domestic emissions reductions needed to meet New Zealand's international commitments. Robust and transparent

decades may need to increase by between 1.3 million and 2.8 million hectares, mostly converted from marginally profitable beef and sheep farms. Growth in horticulture (from a relatively small base) will likely also play a significant role in reducing agricultural emissions. The needed rate of land use change is comparable to the rate at which, over the last 30 years, beef and sheep farms have been converted to forestry, dairying and other uses.

Reducing agricultural emissions, particularly from dairying, will also be important. Scope exists for further modest reductions in emissions intensity, through higher productivity and wider adoption of current low-emissions practices. Research into new technologies has the (uncertain) potential to further reduce agricultural emissions in the medium to long term. Yet the potential pay-off from successful

Stable and enduring laws and institutions

There are strong political incentives to avoid making long-term policy decisions that will have short-term cost and impacts, but benefits that manifest well into the future. Well-designed laws and institutions can play a critical role in providing a strong signal about future policy intentions and act as a 'commitment device' to help drive the development and implementation of a long-term policy response to climate change.

New Zealand has an existing climate change regulatory framework, but it is not underpinned by a credible commitment to a low-emissions transition. New Zealand needs a reformed statutory framework, one that will lock in long-term thinking, encourage policy stability and provide the right signals, yet allow flexibility about the precise path to the long-term goal: essentially ensuring that an eye is kept on the long-term compass while letting the tiller be adjusted along the way. A new architecture for New Zealand's climate change legislation should be built on principles of transparency and accountability, with a backbone based on mandatory processes. It should include the following mutually reinforcing elements:

- Legislated and quantified long-term greenhouse gas emissions reduction targets to clearly signal the policy destination. Targets should be informed by science. This is central to the credibility of the climate change statutory and institutional framework. Mitigation targets should distinguish between short-lived and long-lived greenhouse gases. Emissions of some gases (such as CO₂) can stay in the atmosphere for centuries. Emissions of long-lived greenhouse gases must be reduced to net zero at a minimum. Other greenhouse gases (such as methane (CH₄)) dissipate comparatively quickly. They will need to reduce, but not to net zero, to stabilise temperature.
- A system of successive (say, five-year) 'emissions budgets' that translate long-term targets into clear short- to medium-term emissions reduction goals. The budgets provide visible stepping stones to achieving the long-term targets and help reinforce steady action on, and accountability for,

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domestic caps on the supply of New Zealand units (NZUs) (one NZU is a permit to emit one tonne of CO₂e) are needed to drive a higher emissions price to materially influence production and consumption decisions.

Expectations about future emissions prices are important for driving investment in new technologies. To ensure clear and credible investment signals, the government should provide guidance about the path of future emissions prices. A key step is setting rolling five-year quantity caps on emissions within the ETS, to provide certainty about the future supply of NZUs.

Land use change, agriculture and emissions pricing

Land use will need to change substantially if New Zealand is to transition to a low-emissions economy. Modelling undertaken for the commission suggests that land planted in forests over the next three

research justifies scaling up current efforts.

An emissions price that covers all land use, including agriculture, should be the main driver of land use change. A well-designed and stable ETS will incentivise land use change, including more afforestation, as well as a search for, and adoption of, low-emissions practices and technologies in agriculture. To reflect the trade-exposed nature of the sector, current technological limits and the short-lived nature of methane (an important, but not the only, agricultural greenhouse gas), the entry of agriculture into the ETS needs to be carefully designed.

The government can best support the rural transition through stable policy, pricing emissions and supporting innovation. Transparency and advanced notice will provide clear signals while helping to avoid significant economic and social dislocation in the transition to a low-emissions rural economy over the next three decades.

achieving them. The emissions budgets would also guide the determination of caps in the ETS.

- An independent expert advisory body (a climate commission) to provide objective analysis and advice to the government on the scale of emissions reductions required over the short to medium term (i.e., by recommending emissions budgets) to meet long-term targets, reflecting scientific evidence as well as considerations of economic and social impacts. A climate commission, set up as an independent Crown entity, would help to insulate policymaking from short-term political pressures, promote stability and predictability, expand climate policy debate, and improve transparency and accountability. Decision rights should not be delegated to the climate commission, but it would have a role in identifying regulatory and other barriers, or opportunities and priorities, to reduce emissions. It would also regularly assess New Zealand's progress towards meeting agreed budgets and targets. Effectively, a climate commission would be the custodian of New Zealand's climate policy and long-term climate change objectives.

As noted, long-term political commitment and durability are essential to the success of climate change laws and institutions. Substantial cross-party support for the core elements of statutory and institutional arrangements will help provide policy permanence regardless of the make-up of the government.

Developing the government response to the climate commission's recommendations to meet emissions budgets and targets will be a substantial and challenging policy process. It will require ongoing leadership from the centre of government, and policy alignment across government to navigate the long and uncertain journey to a profoundly different low-emissions future.

Harnessing the full potential of innovation

Innovation comes in many forms and is unpredictable. Yet it is the closest thing to a 'silver bullet' to enable humanity to meet the challenge of avoiding damaging climate change. It also holds out the opportunity

to combine the transition to low emissions with dynamic and creative improvements in national well-being. While the form, timing and impact of innovation are highly uncertain, a country's policies and institutions significantly affect its innovation performance. They need to enable and encourage researchers and business organisations to both create new low-emissions technologies and deploy existing low-emissions technologies.

The processes of innovation and economic change are strongly path dependent. This can make it difficult to shift an economy from polluting to clean technologies. Delay in making the transition can increase the productivity gap between the polluting and clean technologies and make the transition

Given the imperative to reduce emissions, the government should devote significantly more resources to low-emissions innovation than the modest and inadequate current allocation. Well-designed and implemented support for low-emissions innovation is likely to have pay-offs for New Zealand's wider economic performance and its international reputation. Through innovation, New Zealand can make a material contribution to combating dangerous climate change at a global level.

The right climate policies are likely to trigger new waves of global investment, innovation and discovery. If a country designs its policies to foster learning and flexibility, then new opportunities will arise. The transition to low emissions may

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longer and costlier in terms of slower growth during the transition (Acemoglu et al., 2012).

New Zealand's record as an innovative economy is mixed. Lacklustre productivity growth in the economy partly reflects low investment in research and development for business and other issues in its innovation ecosystem, including a patchy record at commercialising research and skill shortages. Yet within this broad picture, pockets of successful innovation exist.

Transitioning to a low-emissions economy calls for directed technical change in New Zealand's energy and transport systems, land use, buildings and industrial processes. In many areas New Zealand will be a technology taker. This requires capacities and resourcing to identify, absorb, adapt and deploy technologies from offshore. Yet in certain areas New Zealand should invest in the full menu of basic and applied research, commercialisation, infrastructure and skills.

represent a very attractive path that could, if economic history is a guide, stimulate dynamic, innovative and creative growth.

Complementary regulation and policies

While stable policy and emissions pricing are needed to change behaviour and promote investment, they will not be sufficient to promote a fair and efficient transition, or to maximise New Zealand's opportunities from the transition. Put more strongly, 'it is theoretically both unsound and impractical to rely on carbon pricing only' (Stiglitz and Stern, 2017). This is because of market or government failures, or because a market-only solution could involve unacceptable costs or distributional consequences. Complementary regulation and policies can help to create and deploy mitigation technologies, support behaviour change by firms and households, and manage risk. Such complementary measures can also lower the emissions price that would otherwise be needed.

In traversing sources of emissions in New Zealand, our inquiry found areas for complementary regulation and policies. For example, transport is one of the largest and fastest-growing sources of emissions in New Zealand. Transport is also a sector where lower-emission alternatives to fossil-fuel vehicles are both available (e.g., public and active transport modes) and emerging (e.g., electric and other low-emission vehicles), and where there is scope to improve the efficiency of vehicle use (e.g., through congestion charging).

Electric vehicles (EVs) offer some of the most promising mitigation opportunities for New Zealand, but their uptake faces several barriers, such as high prices relative to fossil-fuel vehicles, anxiety about their

Electricity is another area for complementary policies. An efficient and well-functioning electricity system will play a central part in the transition to a low-emissions economy. New Zealand's largely decarbonised electricity sector is a major advantage. Yet considerable scope exists to further increase the supply of electricity from renewable sources, such as wind (the cost of which has been falling rapidly) and geothermal (which still produces some emissions). Distributed electricity generation and the ability of some consumers to reduce their demand when electricity supply is short will also play an increasingly important part in a low-emissions economy. But additional steps will be needed to manage growing complexity and risks to system stability, and

could affect the rate and scale of change. Whether and when these factors will emerge cannot be predicted with much accuracy. Despite this uncertainty, it is possible to imagine different pathways towards a low-emissions economy. These scenarios can be useful for informing policy decisions around priorities and trade-offs and for gauging the implications of different rates of economic change.

Modelling can throw light on whether an emissions target is feasible, the measures needed to achieve a target at least economic cost, and the character of alternative pathways, and give a quantitative picture of what needs to happen by when to reach a target. Yet modelling has well-known limitations and is not prediction. The transition to a low-emissions economy for any country will be a long journey to a known and desired destination, but through very uncertain terrain.

Modelling commissioned for the inquiry suggests that New Zealand can move to a low-emissions economy (i.e., 25 megatonnes of net CO₂e emissions by 2050) at an emissions price rising to between \$75 a tonne of CO₂e and \$152 a tonne of CO₂e by 2050. Also, New Zealand could reach the more ambitious target of net zero greenhouse gas emissions by 2050 with emissions prices rising to between \$157 and \$250 a tonne of CO₂e by 2050 (with the higher figure arising when technological change is slow). While far above the current level of around \$21, these prices are comparable with the emissions prices that it is estimated will be needed in other developed countries to deliver the objectives of the Paris Agreement to limit global temperature rise to under 2°C.

The modelled pathways reveal three key drivers of lower emissions: the expansion of forestry; the electrification of New Zealand's light transport fleet; and changes to the structure and methods of agricultural production. Emissions reductions in agriculture can come from both technological and structural change. For example, synthetic protein could disrupt traditional farming, and, even in its absence, further shifts in land use could occur – mostly away from marginal beef and sheep farming towards forestry, and possibly from pastoral farming to horticulture.

A lesson from history is that productive and successful economies position themselves to handle the disruptive nature of major transitional change and seize opportunities.

limited travel range, and poor public understanding of their benefits. The government can offset some of these barriers by:

- introducing a 'feebate' scheme, in which importers would either pay a fee or receive a rebate, depending on the emissions intensity or fuel efficiency of the imported vehicle;
- providing funding for some EV infrastructure projects to fill gaps in the charging network, which would be commercially unviable for the private sector;
- raise awareness and promote uptake of low-emission vehicles through leadership in procurement; and
- require imported new and used fossil-fuel vehicles to meet rigorous emissions standards. New Zealand is one of a handful of developed countries without vehicle emissions standards, and risks becoming a dumping ground for high-emitting vehicles from other countries that are decarbonising their fleets.

to ensure a level playing field for different types of technology and service providers. The regulatory framework governing the electricity market should be updated to allow consumers to become more informed and have the potential to become active buyers and sellers of electricity.

There are also opportunities to use regulation to reduce emissions from waste. Only around one-third of waste emissions are covered by existing waste management or climate change policies. The waste disposal levy should be extended to all known, consented waste disposal sites, and increased over time to encourage better waste management. Local authorities should also be given greater support to regulate farm dumps and other unknown waste disposal sites, such as through the Resource Management Act and the Waste Minimisation Act.

Pathways to a low-emissions economy

Several pathways to a low-emissions economy are possible, and many factors

Expanding forestry can achieve large reductions in net emissions up to 2050. Yet heavy reliance on forestry will create challenges in the longer term because it is not possible to expand without limit the land area under forest. With continued emissions reductions required after 2050 to maintain net zero, New Zealand will need to find other ways to reduce emissions. But it has time to consider options and seek new technological solutions.

A lesson from history is that productive and successful economies position themselves to handle the disruptive nature of major transitional change and seize opportunities. The New Zealand economy is not as nimble as it needs to be, especially in core aspects like innovation and shifting resources from less productive to more productive activities. These overarching economic competencies will play key roles in determining the success of New Zealand's transition to low emissions.

Many benefits from the transition

Many estimates of the scale of expenditure necessary to drive a transition to a low-emissions economy are in the range of 1–3% of GDP per year (Stern, 2015).¹ An important framing point is to think about the potential cost of transitioning to a low-carbon economy as an investment, rather than as a net cost on the economy, the government or taxpayers (Romani, Stern and Zenghelis, 2011). With all nations playing their part, there is the huge return in the form of avoiding catastrophic climate damage. Much of the investment will come from the private sector. For example, the International Energy Agency estimates that, globally, additional energy investment needed to decarbonise will cumulatively be in the order of US\$36 trillion by 2050 (International Energy Agency, 2012). If New Zealand businesses are to the fore in tackling their emissions, investment opportunities will surely arise for them globally. Areas could include low-emissions technologies in electricity, transport, heating and cooling, industrial processes and agriculture.

Importantly, investing in cutting greenhouse gas emissions will produce significant co-benefits, beyond reducing climate risk. These co-benefits include:

- Cleaner air, and reduced rates of illness and mortality caused by air pollution.

Pollutants from fossil-fuel vehicles (particularly those that run on diesel) are associated with respiratory illnesses such as asthma, impaired lung development and function, and heart, brain and general health issues. A shift to a low-emissions vehicle fleet would remove these pollutants.

- Cleaner water, and less harm to biodiversity. As an emissions price is progressively extended to agriculture, and farmers take greater steps to use nitrates effectively, water pollution will reduce. Greater afforestation could also help reduce soil erosion and the resulting siltation of waterways.

action will compound the transition challenge, making it much more costly and disruptive, and limiting viable and cost-effective mitigation options in the future. And if we don't act now, New Zealand risks being left behind in technology and economic opportunities.

New Zealand has experienced economic and social transformations before, and the scale of change involved in the transition to a low-emissions economy looks comparable to some of those earlier transitions. This is a 30-year transition. Looking back in history, other examples of profound change occurred over similar timeframes. Moreover, these changes

The transition to a low-emissions economy is potentially a powerful, attractive and sustainable growth story – one marked by greater resilience, more innovation, more liveable cities, robust agriculture and stronger ecosystems ...

- The dynamics of discovery and learning will see the emergence of new technologies and firms. These will provide opportunities for employment, exports and productivity gains. A higher emissions price will foster greater demand for emissions-reducing technologies. A reinvigorated and refocused innovation system will put more effort into developing and applying new ideas that offset, reduce or remove greenhouse gases. New Zealand has already proved a fertile ground for developing such technologies, and scope exists to considerably expand New Zealand's contribution to global knowledge.

Meeting the challenge

New Zealand can achieve a successful low-emissions economy, but there will be challenges. Action is urgently needed, for we stand at a crossroads of fundamental decisions that will shape New Zealand's future economy and climate. Delaying

eventually enhanced community well-being despite, at first, appearing highly disruptive and threatening.

The transition to a low-emissions economy is potentially a powerful, attractive and sustainable growth story – one marked by greater resilience, more innovation, more liveable cities, robust agriculture and stronger ecosystems (Stiglitz and Stern, 2017). Iwi will play an important role in the process of change as significant partners in transforming the New Zealand economy over the coming decades.

To succeed and realise the potential benefits of the transition, careful policy design will be critical. The commission's draft report sets out the policy architecture for New Zealand to transition to a low-emissions economy, while continuing to grow income and well-being. Clearly there is much uncertainty about what lies ahead, how a low-emissions economy will evolve, and what this will mean for New Zealand. An important task of government is to be

clear on New Zealand's ambition to achieve a low- or zero-emissions economy. It needs to establish credible and stable policies and institutions so that businesses, households and consumers can plan, invest, and embrace the opportunities of a low-

emissions future. There does not need to be a trade-off between economic prosperity and the preservation of the planet. With the right policies, and plenty of Kiwi ingenuity and commitment, the two can go together.

¹ Interestingly, if we assume that New Zealand's GDP grows at 1–3% per year, this means that by 2050 the country will need to wait only one more year to 2051 to reach the GDP it would otherwise have reached in 2050 without this expenditure on reducing emissions.

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Quakes and Aftershocks

organisational restructuring in the New Zealand state sector, 1960–2017

Abstract

This article draws upon co-author Masashi Yui's unique database on state sector organisational restructuring in New Zealand from 1960 to 2017. It shows that if the peak years of structural change, 1986–92 – the 'revolution' which saw New Zealand as a world leader in what became known as New Public Management – were seismic shocks, then they have been followed by an apparently endless number of aftershocks, which distinguish the post-peak period from the 25 years preceding it. The article speculates as to whether there could be links between the amount of organisational restructuring, unsatisfactory productivity rates in the New Zealand state sector, and the embedding of the 'managerialist' culture that was introduced by the 'revolution'.

Keywords machinery of government, organisational restructuring, managerialism, productivity, state sector, New Zealand

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Thirty years ago New Zealand's State Sector Act 1988 transformed the country's central governmental system into what was widely seen at the time as an exemplar of public management reform, a poster child for what soon became known as New Public Management (Boston et al., 1996).¹ These changes involved, *inter alia*, a massive restructuring of the country's machinery of government, and were accompanied by the adoption of 'managerialist' practices in an effort to make the state sector more like corporate business in how this machinery was run. We do not discuss the pros and cons of these radical changes, but instead draw upon a unique body of empirical research conducted by co-author Masashi Yui for his as yet uncompleted PhD in public policy at the School of Government, Victoria University of Wellington, documenting all cases of organisational restructuring in the country's state sector between 1960 and 2017. This research enables comparisons to be made for the first time between the amount of restructuring that occurred in the New Zealand state sector in the nearly three decades before the 'revolution' of the

late 1980s and early 90s, and in the 30 years since then.²

Governmental restructuring

The radical structural changes that were implemented mainly in the period 1986–1992 were dramatic events in the history of New Zealand governmental administration. To use a seismic analogy, these massive quakes have been followed over the past 30 years by a whole host of aftershocks, successive and seemingly endless cases of organisational restructuring, which have left the governmental ecosystem fluid and relatively unstable. Such restructuring has been much more likely to occur in the

restructuring, such as the creation of new government organisations, the abolition of existing organisations, the transfer of functions between organisations, and the change of organisations' names. These changes were made through replacement, merger, splitting, absorption, take-over of responsibilities, rebranding, and so forth.

This study uses an empirical method to further understand the transformation of the state sector that occurred between 1986 and 1992, by comparing the amount of central government organisational restructuring that occurred in the decades both before and after this time; that is, in the 57 years from 1960 to 2017. The data

enterprises, such as New Zealand Post Ltd and the Transpower New Zealand Ltd, are essentially government-owned companies created by the State-Owned Enterprises Act 1986. Non-departmental bodies are not a legally constituted group of state service organisations, but for this study this categorisation was applied to non-departmental government organisations existing until the mid-1980s and early 1990s, which were predecessors of Crown entities/agencies or state-owned enterprises that are now legally constituted forms and collectively governed by respective laws. This study classified them into this category if they were either body corporates that were established under specific statutory acts, and for which the government had power to nominate a majority of governing board members, or corporations/companies whose shares were totally held by the government. These corporations/companies were listed in the annual reports of the controller and auditor-general, as required by section 79 of the Public Revenues Act 1953.

In New Zealand there is no single source of ready data that can be used to provide a comprehensive picture of machinery of government changes over a long period of time and in chronological order. Therefore, this study collected data on structural reorganisations from a variety of sources. The primary source was the Archway agency list organised by Archives New Zealand, and based on public records transferred from organisational entities which have engaged in record-keeping activities from 1840 to the present day. In Archway the entities are called 'agencies', and there are currently 5,337 agencies documented in the system. Archway contains descriptive information on government organisations, including the functions they performed. For this study's purposes, Archway is useful because information on structural organisational changes carried out to date can be obtained by tracing changes of locations of records. This enables the researcher to identify administrative changes (creation, disestablishment, merger, name change, transfer of functions between departments, etc.) and also predecessor/successor and superior/subordinate relationships. The information provided through Archway

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decades after the 'revolution' than it did in the decades preceding it. Ironically, while the advent of MMP – mixed-member proportional representation – in the mid-1990s has not brought with it increased political instability, as many of its opponents had predicted would happen; instead instability has become a central feature of the governmental bureaucracy. This article provides data to substantiate this claim.

Research methods

Structural reorganisations are machinery of government changes carried out to achieve policy goals and solve perceived problems with the way government bureaucracy functions. For this study, structural reorganisations are organisational changes that affected the number and configuration of distinct state sector organisations (ministries/departments, Crown entities and state-owned enterprises).³ Internal restructurings that occurred solely within each organisation are beyond the scope of this study.⁴ Therefore, the unit of analysis in this study is individual cases of

generated covers structural reorganisations that have taken place in departments/ministries, Crown entities/agencies and state-owned enterprises. The data is presented here in graphs, which help to identify trajectories over time and any patterns of structural reorganisation.

All New Zealand governmental organisations that have existed over the past nearly 60 years have been included in this study, a total of 327.⁵ The study first identified 457 structural reorganisations⁶ at the levels of departments/ministries, non-departmental bodies, Crown entities/agencies and state-owned enterprises (or SOEs), all of which were carried out between 1960 and 2017. Departments/ministries include public service departments as well as non-public service departments, such as the New Zealand Defence Force and the Police, which are not bound by the State Sector Act 1988. Crown entities/agencies are government-controlled entities specified as such first by the Public Finance Act 1989 and later by the Crown Entities Act 2004. State-owned

was cross-checked with relevant statutes, including the State Services Acts of 1962 and 1988, the Crown Entities Act 2004, the State-Owned Enterprises Act 1986, the Public Finance Act 1989, the Parliamentary Commissioner (Ombudsman) Act 1962, the Ombudsmen Act 1975 and the Official Information Act 1982, where equivalent information is available as statutory amendments. Additional sources used for this study were Statistics New Zealand's *New Zealand Official Yearbook* (1957–2012), the State Services Commission's and the Ministry of Justice's *Directory of Official Information* (1983–87; 1988–2017) and the State Services Commission's annual reports to Parliament (1955–2017). Also, the annual reports to Parliament of government departments and agencies published in the *Appendices to the Journals of the House of Representatives*, and the *New Zealand Parliamentary Debates* were consulted when sufficient and reliable information was not readily obtained from the other materials. In addition, this study has made extensive use of government press releases available at the official website of the New Zealand government (www.beehive.govt.nz).

Research findings

How much restructuring?

Figure 1 shows that from 1960 through to 2017 the number of government departments and ministries declined gradually, except for a spike in the late 1980s. In 1960 there were a total of 44 such departments; by 2017 the number had come down to 33. During the term of the fourth Labour government, 1984–90, the deputy prime minister (later prime minister), Geoffrey Palmer, engaged on what he termed a 'quango hunt' to reduce the number of arm's-length bodies. As Figure 1 shows, this hunt was not particularly fruitful, as 'traditional' quangos (here termed non-departmental bodies, or NDBs) continued to increase in number (apart from a short-lived reduction under Prime Minister Robert Muldoon's government), and from the late 1980s there was a huge and rapid increase in the number of Crown entities (as they became called), resulting from the hiving-off of functions from large conglomerate departments.⁷ State-owned enterprises,

Figure 1: Trends in New Zealand state services, 1960–2017

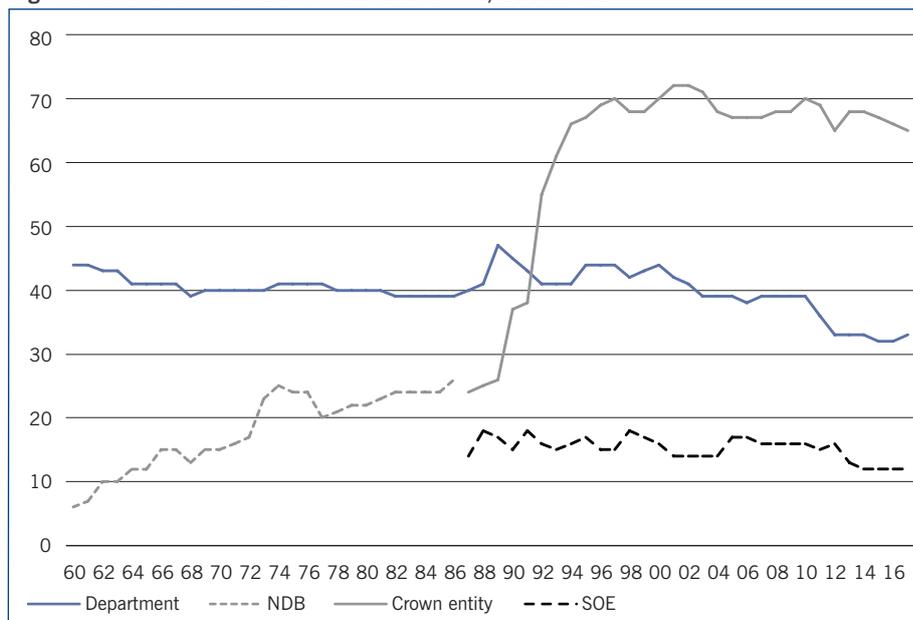


Figure 2: State services restructuring cases, 1960-2017

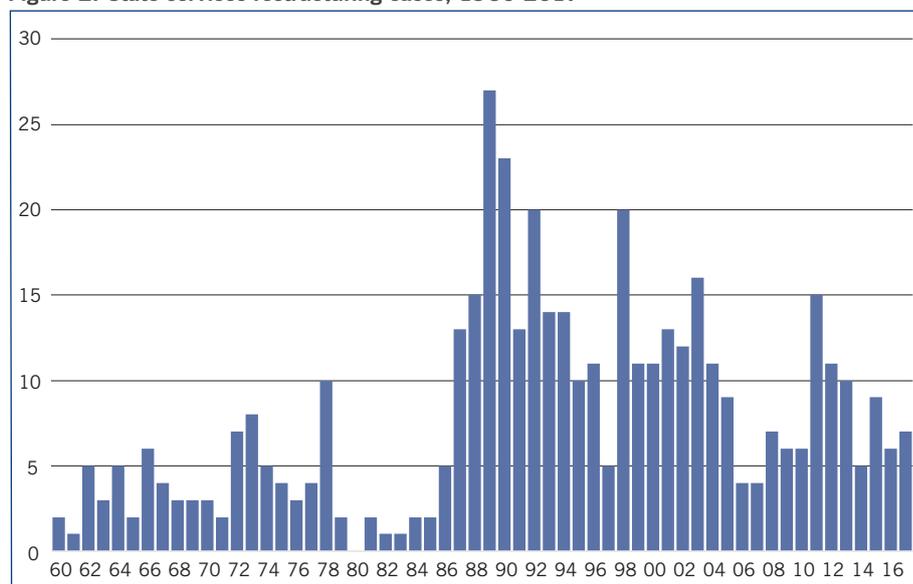


Figure 3: Targets of restructuring, 1960-2017

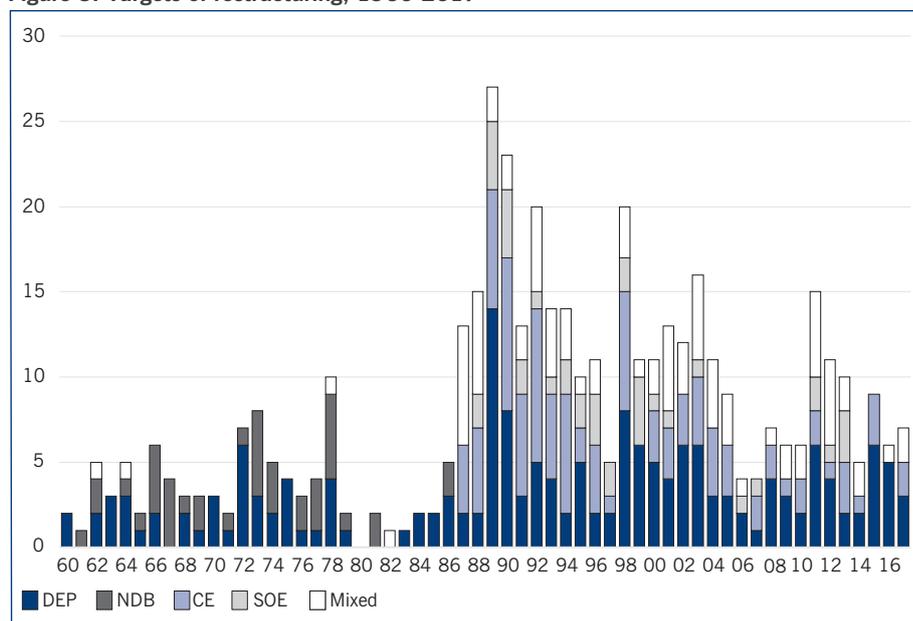


Figure 4: Form of restructuring, single groups (department, NDB, CE, or SOE) vs. mixed

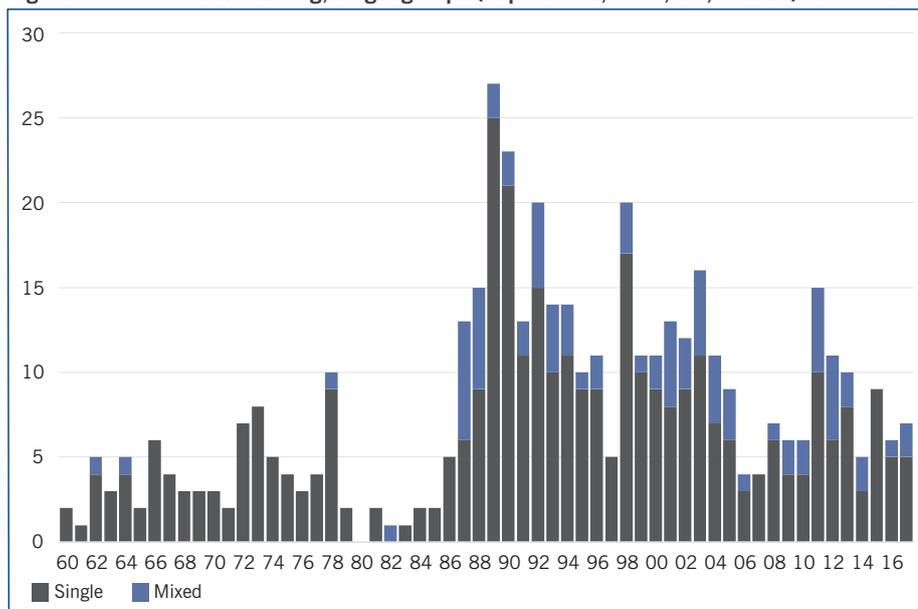


Figure 5: Departments affected by restructuring, 1960-2017

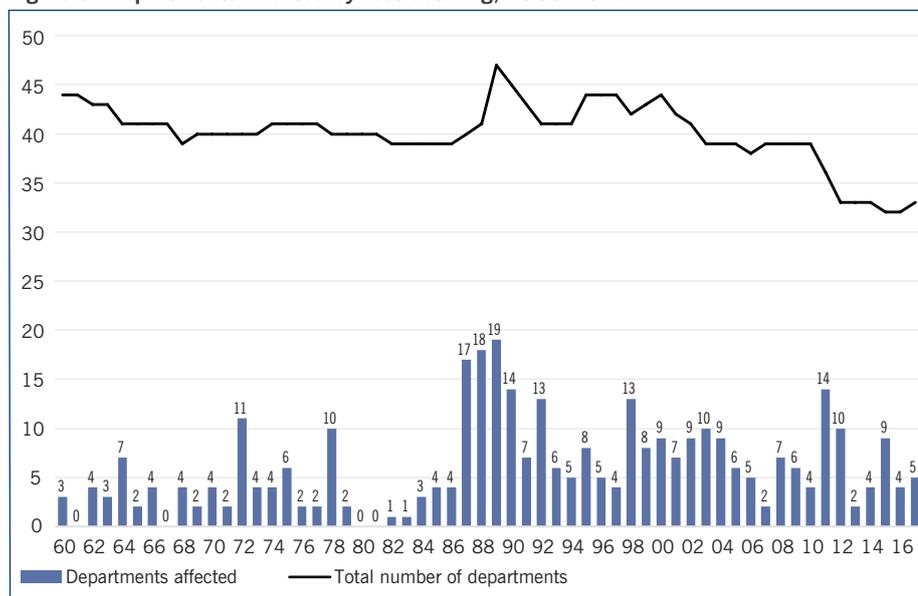
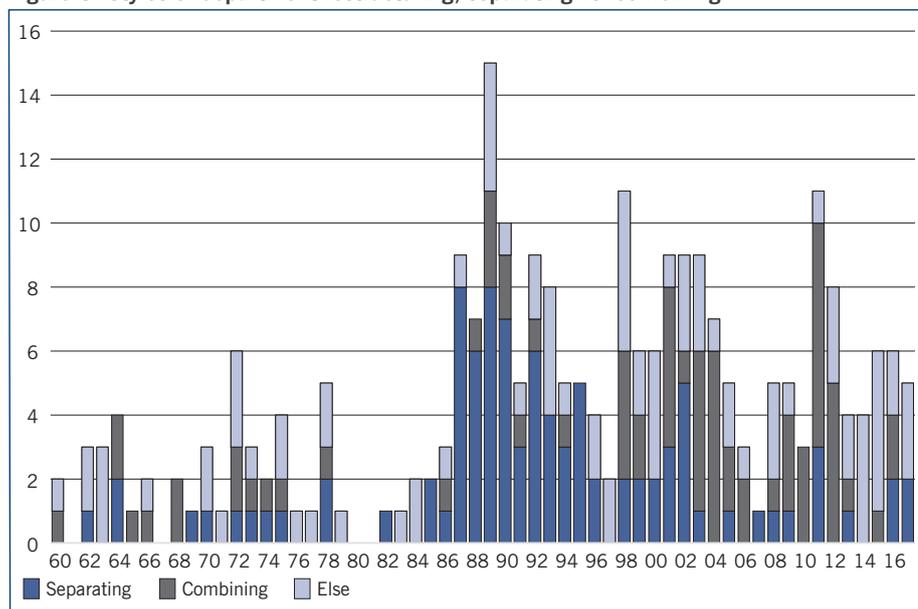


Figure 6: Styles of department restructuring, separating vs. combining



first established in the mid-1980s, have declined only marginally in number.

In Figure 2 one gains a graphic picture of the number of individual cases of restructuring carried out between 1960 and 2017. It is clear that in the 30 years since the radical changes of the late 1980s and early 90s there have been far more cases of restructuring than in the preceding two decades. Removing these years from the count shows that between 1993 and 2017 there were a total of 198 reorganisations, compared to a total of 90 between 1960 and 1985; that is, an increase of more than double. The big quake continues to be followed by frequent, though usually smaller, aftershocks.

Which types of organisations were restructured?

As shown in Figures 3 and 4, departments/ministries have been the main target of restructuring, while reorganisations among Crown entities were regular occurrences from the time of their inception in the late 1980s through to the late 1990s. Reorganisations among SOEs have been much less frequent, though there have been a considerable number of reorganisations involving a mixture of one or more of the three categories since the late 1980s. Much of this reflects changes in the legal form of various organisations, from being departments or ministries to becoming Crown entities or SOEs.

During the peak years (of radical restructuring), 1987–89, as indicated in Figure 5 a high proportion of departments/ministries were subjected to restructuring – about 42% of them on average. This was matched only in 2011, when 41% of departments and ministries were involved. As Figure 5 shows, in the years before the fourth Labour government pursued radical change, the proportion of departments and ministries subject to change had been much lower, with peaks of 28% in 1972 and 25% in 1978, compared with an average of just over three reorganisations per year from 1960 to 1985. From 1993 to 2017 there was an average of nearly seven per year.

What types of restructuring?

Figure 6 shows the fragmentation of larger departments and ministries that occurred during the peak years, 1987–92, reflecting

the separation of many ministries from their operational arms, the hiving-off of a plethora of departmental functions to single-purpose Crown agencies, and the privatisation of state-owned assets. The figure also shows that since 1998, and especially in the earlier years of the Labour-led governments from 1999 to 2004, and then under the National-led government of 2010–12, there were prominent moves towards more ‘joined-up’ government, especially as many departments and ministries were reconnected to their operational arms.

There were 24 cases of name change for departments/ministries⁸ during the whole period. Seven such changes were made during the 28 years before the introduction of the State Sector Act 1988, and 17 have been made since then (i.e. up to 2017). Name changes were most common under both the Clark and Key governments, each with five cases.

Which organisations were more and which less likely to be restructured?

There are variations in changeability of government organisations over time. When classified by policy area, far fewer reorganisations were found in the areas of defence, finance and foreign affairs, and in the legislative and Cabinet offices. On the other hand, policy areas that are strongly connected with people’s interests were most likely to see restructuring – examples are business and economy, welfare, and communities and social groups. Communities and social groups are the policy area of those departments/agencies that deal with interests of particular clients: women, Māori, Pasifika, seniors, youth, people with disabilities, and so on. More restructuring in sectors targeted at these particular groups of population is mostly explained by differences in the way of delivering public services to them – i.e. through a stand-alone organisation or a larger department responsible for a wider range of functions. Figure 7 shows the number of reorganisations in sectors that were most susceptible to restructuring, and how the focus of restructuring has changed among sectors over the past 60 years. The business and economy sector was commonly found across time, whereas welfare and communities and social groups

Figure 7: Focus of reorganisations among most changeable sectors, 1960-2017

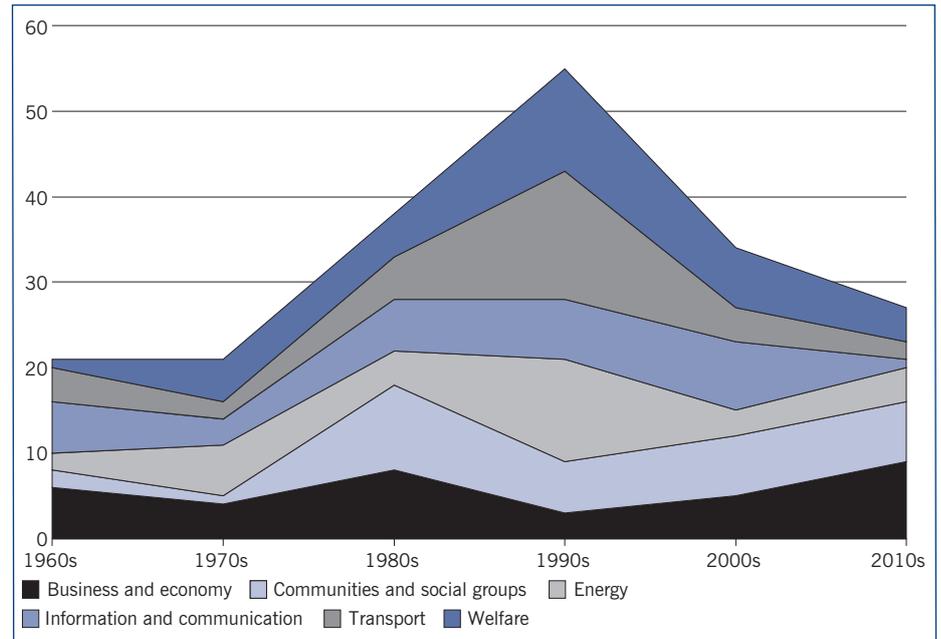
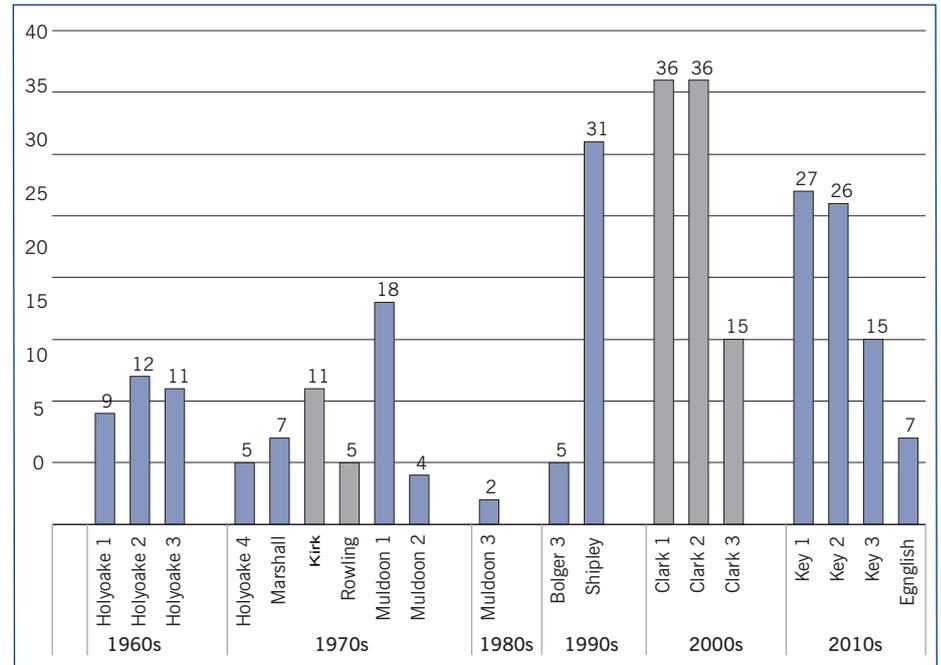


Figure 8: Restructuring carried out by government, 1960-2017 excluding peak years



have become the main focus since the late 1980s and early 1990s. Restructuring in the energy, information and communication, and transport sectors was largely a result of corporatisation (and subsequently privatisation) and departmental functions being transferred to agencies.

Which governments did the most restructuring?

During the years 1960–2017, National or National-led governments held office for 68% of the time and initiated 58% of all the restructurings, while Labour or Labour-led governments, in office for 32% of the duration, instigated 42% of

the changes. So, proportionate to the time in office, significantly more restructuring was carried out by Labour or Labour-led governments than was conducted by National or National-led ones. This may not be surprising in view of the fact that it was a Labour government that was responsible for the peak years of restructuring. When those years, 1986–92, are set aside, the data shows that National or National-led governments, which held office for 37 of the remaining 51 years – that is, 73% of the time – conducted 62% of the reorganisations. Labour or Labour-led governments were responsible for 38% of the changes, over only 12 years, or 24%

of the period. Proportionately, therefore, Labour or Labour-led governments were, overall, markedly more inclined to restructure than were their main political opponents.

As Figure 8 shows, the Labour-led governments of Helen Clark (1999–2008) engaged in the most restructuring in their earlier years, after Jennifer Shipley's National-led government in the late 1990s, and before another reorganisational boom occurred during the first years of the National-led governments of John Key. This figure also illustrates the 'seismic aftershock' effect of the upheaval of 1986–92: only 30% of the restructurings occurred in the years beforehand – that is, 1960–85 – with 70% occurring afterwards, between

MMP electoral system from the mid-1990s?

While some organisational changes, including the establishment of new agencies, resulted from the politics of government formation, the data is inconclusive. There is some evidence, though weak, that government restructuring is more likely to occur in the first two or three years of a new government's time in office: the third Labour government led by Norman Kirk generated markedly more cases after coming into office in 1972 than there had been during the preceding 12 years, and Muldoon's government seems to have got most of its reorganisational energy out of its system in 1978 before leaving things

be better organised. On the other hand, it is possible that bureaucrats can most effectively promote their own reformist agendas during such times.

Figure 8 shows that the National government led by Prime Minister Robert Muldoon was, of all administrations during the whole period covered by the study, markedly the least likely to engage in state sector organisational restructuring. By and large, Muldoon kept intact the machinery of government that he had inherited from his predecessors – having famously said that he wished to leave New Zealand no worse than it was when he took office. The commission for the Future, established during Muldoon's time as prime minister, did not survive his growing political impatience with it. The commission was abolished, but not before it had predicted the advent of ultra-fast broadband, the internet, high-definition flatscreen TV sets and 'pocket telephones' (Morton, 2016).

Strong criticisms of the New Zealand public service have recently been levelled at it by Sir Geoffrey Palmer, who, as deputy prime minister and then briefly prime minister in the fourth Labour government, was – ironically – one of the principal promoters of the radical changes of that time ...

Organisational mortality

What in New Zealand has been the answer to Herbert Kaufman's (1976) question: are government organisations immortal? Apparently not, although some have much longer life-spans than others. During the period studied, 55 organisations were abolished, of which five were ministries or departments, the rest being non-departmental bodies, Crown entities or SOEs (including those that were privatised). Only five ministries or departments were done away with entirely – the Legislative Department, the Government Printing Office, the State Insurance Office, the Audit Department and the Canterbury Earthquake Recovery Authority.

1993 and 2017. As shown in Figure 8, outside the period 1986–92, Labour or Labour-led governments were significantly less likely to reduce the numbers of governmental agencies than were National or National-led governments, while both centre-left and centre-right governments were more or less equally inclined to create new agencies.

When was restructuring most likely to occur and who – politicians and/or bureaucrats – impelled it?

Can the fact that there were markedly higher levels of organisational restructuring in the New Zealand state sector from 1993 through to 2017 than in the 25 years prior to the changes introduced by the fourth Labour government be explained in part by the country's adoption of the

largely intact. The National government of Jim Bolger was caught up in the reformist frenzy in its initial years, 1990–93, and after Bolger was deposed as prime minister by Jenny Shipley in 1997 there was, in the following year, another burst of intense reorganisation. A similar pattern is evident, on the face of it, in the first two or three years of the Clark-led governments, before another spurt occurred in the second term of office of John Key's National-led government, 2011–14.

Such a pattern, while not strongly pronounced, seems unexceptionable, as new governments might be expected to come into office with policies that they believe require organisational change for their implementation, and they may also have fresh notions about how the machinery of government as a whole can

Discussion: why did restructuring become more frequent?

These preliminary findings from Masashi Yui's database raise a number of questions. Foremost among them is: why, after such an upheaval, has restructuring continued to occur so frequently, at a rate much higher than what had occurred before? Organisational restructuring in some shape or form will always be required, and cannot be regarded as a negative thing in and of itself, and 'turf battles' and the like have historically been as characteristic of New

Zealand government administration as elsewhere. Clearly, successive governments since the early 1990s have been addressing ‘fragmentation’ and ‘siloes’, in their efforts to re-establish ‘joined-up government’, a more strategically coherent state sector; all this in a much more complicated politico-administrative ecosystem than ever before, and when social and technological change demands that the machinery of government be constantly kept fit for purpose.

Major reorganisations, like the creation in 2013 of the large (by New Zealand standards) bureaucracy the Ministry of Business, Innovation and Employment, reflect this, and, as with this ministry, governments of different political stripes have continued to reshape the bureaucracy according to their own preferences and priorities: for example, the National-led government’s establishment of Work and Income New Zealand in the late 1990s, melding the former Employment Service and the income maintenance function of the then Department of Social Welfare; and the current Labour-led government’s creation of a Ministry of Housing and Urban Development, bringing together a number of functions previously carried out by several agencies.

However, it may also be that managerialism tends to foster more managerialism, as more people are recruited to bureaucratic executive positions who tend to see ‘good management’ as a function, in the first instance at least, of ‘good’ organisational design, depending on their definition of ‘good design’. It is also plausible that the end of the unified state sector career service in 1988, and its replacement with a position-based system, without the establishment of a unifying senior executive service, has seen the inculcation of a managerialist culture, in which structural reorganisation both within and among agencies is an instrument that can be used by executives and managers to expand or consolidate their own control and to advance their personal careers, in ‘bureau-shaping’ behaviour (Dunleavy, 1991; Norman and Gill, 2011). Also, organisational restructuring can be used to move people out of jobs, when employment laws may make this otherwise

too difficult or costly. Or it may simply be a surrogate for genuine innovation designed to effectively achieve better policy outcomes.

Strong criticisms of the New Zealand public service have recently been levelled at it by Sir Geoffrey Palmer, who, as deputy prime minister and then briefly prime minister in the fourth Labour government, was – ironically – one of the principal promoters of the radical changes of that time (Palmer and Butler, 2016). Palmer and Butler have called for a full royal commission of inquiry into the state services, which would be the first such inquiry since 1962 (although one was held in 1968 on wage-fixing procedures in the state services).⁹ In April 2018, in a speech

‘measured’) sector (Productivity Commission, 2017). And New Zealand’s overall productivity rates were well below those achieved in other countries, notably Australia. No data is available on state sector productivity in the decades before the radical changes of the 1980s and 90s, so it is not possible to demonstrate that productivity growth was in fact greater during that period than it has been since then. Nevertheless, the Productivity Commission report provides no evidence that state sector productivity overall was enhanced by the upheaval of the 1980s and 90s, and we are left to speculate on how a different package of reforms might have improved productivity levels. The report does not explicitly identify excessive

Whatever the case, it can be said with certainty that the ‘restructuring culture’ remains alive and well in the New Zealand state sector.

at a function to mark the 30th anniversary of the State Sector Act 1988, Palmer summarised what he considered to be the main problems that need to be addressed. These include far too much ‘managerialism’, and ongoing problems of creating a public service with a sense of collective purpose, rather than it being a collection of separate fiefdoms. Only then, in Palmer’s view, will the quest for effective collaborative inter-agency action be effectively fulfilled.

Both in his book with Andrew Butler and in his speech at the anniversary, Palmer strongly criticised the ‘endless restructuring’ that continues to characterise the New Zealand state sector. In doing so, he was echoing the sentiments expressed back in 1998 by the then state services commissioner, who warned of the risks to productivity and staff morale generated by what he called a ‘restructuring culture’ (State Services Commission, 2013). Nearly 20 years later, a New Zealand Productivity Commission draft report argued that state sector productivity was significantly lower than productivity in the corporate (or

restructuring as one of the major problems with state sector productivity, and it says little or nothing about the impact of the radical changes on these productivity levels.

However, if there is a negative correlation between the amount of organisational restructuring, on the one hand, and systemic productivity, on the other, then the data presented in this article would suggest that New Zealand’s state sector was probably more productive in the 20 years before the radical changes of the 1980s and 90s than it has been since then. Of course, it is not possible to draw this conclusion with any certainty, as there are many more factors that need to be taken into account.

Conclusion

Whatever the case, it can be said with certainty that the ‘restructuring culture’ remains alive and well in the New Zealand state sector. How much of this has been driven internally by organisation chief executives and top management, and how much has resulted primarily from ‘external’ factors is not clear. Further

research is needed to try to trace the connections between the degree of organisational restructuring and such dimensions as public service motivation and morale, and to test hypotheses about its occurrence, and beyond that to determine the conditions under which it is an effective instrument in enhancing productivity and effectiveness, and when it is simply a manifestation of other, less laudable, motivations. Perhaps it is simply appropriate that in a seismically challenged country, where many aftershocks follow major earthquakes, the New Zealand state sector ‘landscape’ should find itself built on ever-shifting political and bureaucratic sands.

1 This is an edited version of a paper prepared for the RC27 Structure and Organization of Government panel, ‘Public Management Reform Models: flawed or the future?’, International Political Science Association, World Congress,

- Brisbane, 21–26 July 2018.
- 2 In New Zealand, the ‘core’ public service exists within the wider state sector. The latter comprises all central government agencies, together with several non-public service departments (e.g., the Defence Force and the Police). The ‘public sector’ refers to all agencies in both central and local government.
 - 3 The following types of organisation were omitted from analysis in this study: offices of Parliament; legislative branch departments; Crown entity subsidiaries, school boards of trustees, tertiary education institutions, organisations and companies on Public Finance Act schedules 4 and 4A, and mixed-ownership model companies.
 - 4 An exception is inclusion of semi-autonomous bodies that operated more or less independently within their hosting ministries/departments. The semi-autonomous bodies were often converted into stand-alone departments/ministries or agencies, and vice versa.
 - 5 The number is the total of distinct state sector organisations existing during the period of investigation. The following groups of Crown entities/agencies and non-departmental bodies were treated as single organisations: area health boards; business development boards; Crown health enterprises; Crown research institutes; district health boards; hospital and health services; regional health authorities.
 - 6 The rules for counting structural reorganisations were as follows: (1) interconnected events of restructuring in the same policy areas constitute one change (e.g., the creation of the Department of Conservation, Ministry of Forestry, Department of Lands, Department of Survey and Land Information and two state-owned enterprises from the Ministry of Agriculture and Fisheries, Ministry of Transport, Commission for the Environment, New Zealand Forest

- Service and Department of Internal Affairs); (2) despite rule (1), a series of restructuring events are counted as separate events when there was significant time lapse between previous and subsequent changes (e.g., preceding the transfer of functions of the Canterbury Earthquake Recovery Authority to the Ministry of Business, Innovation and Employment, Land Information and the Ministry of Health, and its later disestablishment).
- 7 Crown entities do not include Crown entity subsidiaries, school boards of trustees, tertiary education institutions, and organisations and companies on Public Finance Act schedules 4 and 4A.
 - 8 In this study name change is purely about changing organisations’ names, which was not associated with any other type of restructuring implemented at the same time. For example, the name change of the Ministry of Works in 1973 was not categorised as such because the ministry was replaced by the Ministry of Works and Development, taking over some functions from the Department of Labour.
 - 9 Palmer and Butler have since published a revised, and retitled, version of the book, but retaining the original’s main arguments (Palmer and Butler, 2018).

Acknowledgement

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Social Investment

A New Zealand Policy Experiment

edited by Jonathan Boston and Derek Gill

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Shifting the Dial improving Australia's productivity performance¹

Abstract

Non-market sector reform is much overlooked. The sector is the fastest growing part of the economy, the most controlled by governments, and critical to everybody's quality of life. Reforms to healthcare – principally a shift to an integrated care model – would promote patient well-being and could offer benefits of around \$145 billion in constant dollars over the next 20 years. Universities play an increasing role in skills acquisition, but need incentives and new structures to give primacy to teaching quality. Australian cities need Hilmer-like competition reform in planning and zoning, and entirely new approaches to funding roads.

Keywords productivity, healthcare reform, road reform, cities, zoning, teaching

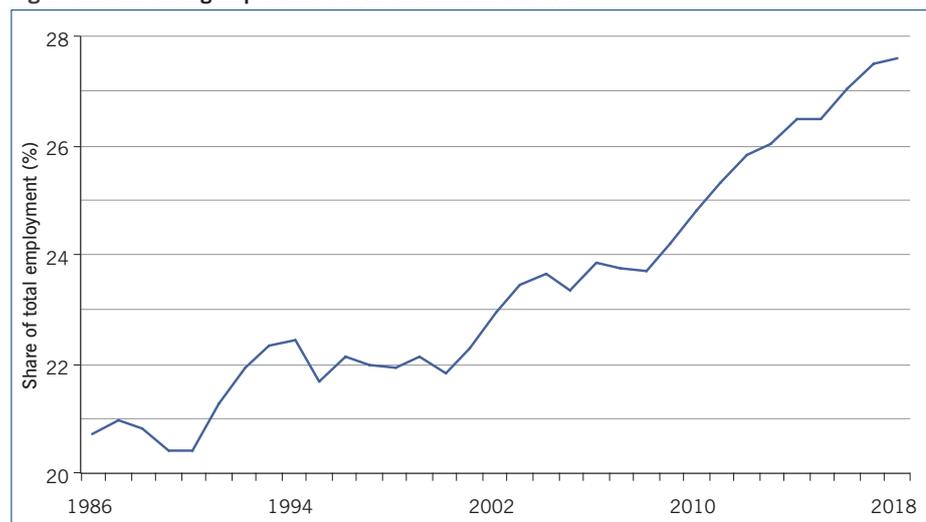
Ralph Lattimore is an executive manager at the Australian Productivity Commission, with experience covering many social and economic issues, including competition policy, the design of the National Disability Insurance Scheme, gambling and workplace relations. His most recent inquiry was the five-year productivity review.

The various concepts of productivity are perplexing abstractions for the public. Yet ultimately a country's prosperity relies on sustained productivity growth, as is best visible in those countries where the productivity 'machine' has failed, and poverty and disadvantage remain people's typical lot.

Growth in productivity and prosperity is not automatic. For the 50 years from 1890, Australian labour productivity growth moved glacially by around half a per cent per year. In the 'golden productivity era' from 1940 to the later 1990s, growth rates were on average around 2%. For the past two decades, labour productivity growth has again stagnated at around 1% per year. Multifactor productivity – a measure that combines labour and capital productivity into a single metric – has also languished in the last decade. Sustained weak productivity growth will continue to place downward pressure on wage growth and the living standards of Australians.

This story is not an Antipodean idiosyncrasy. Policymakers around the world have shared a collective anxiety

Figure 1: The rising importance of the non market sector*



* The non market sector is defined as the combination of public administration, defence, healthcare and education. Source: Australian Bureau of Statistics, 2018

about the enduring slowdown in productivity. The labour productivity growth rate in OECD countries fell from about 3.7% annually in the decade 1950–60 to only 0.9% per annum in 2008–18. The ‘paradoxical’ coincidence of slow growth alongside the major information technology advances in this period has given rise to a vigorous debate about the real impacts of these technologies compared to past innovations, and led to prognostications – pessimistic and optimistic – about the impacts of digital disruption.

Regardless of the effects of new technologies, from a policy perspective the key question is always ‘can we do better?’

It was against the backdrop of sustained lacklustre productivity performance that the Australian government asked the Australian Productivity Commission to undertake five-yearly reviews assessing Australia’s productivity performance and recommending reform priorities. The first of these reviews, titled *Shifting the Dial: 5 year productivity review*, was released in October 2017.

Improving non-market productivity is key

The review took an explicitly different approach to productivity and prosperity than the usual examinations of this topic. While undoubtedly there remain benefits from further traditional forms of microeconomic reform, many of the most desperately required policy changes (floating the exchange rate, liberalising capital markets, and competition policy)

have already been made. There remains an important repertoire of policy actions, and the required changes have been comprehensively mapped out (not least the commission’s recommended changes to Australia’s workplace relations system). The review identifies again the usual suspects, but the imperative for orthodox reforms is ‘to do’ rather than to understand ‘what to do’.

Achieving better outcomes for Australians now requires a focus on the non-market sector (mainly education and healthcare), on the quality of cities, and on the effectiveness of government itself. The non-market sector is the most rapidly growing part of the economy (accounting for some 30% of total employment in 2018). Moreover, Australian governments provide the sector’s main funding, coordination and service suppliers. Above all, these areas of the economy matter to all people. Everyone wants an effective healthcare system, good schools and universities, and cities that function well. In all of these systems, their putative goal is to serve the needs of people. Yet, unlike most of the market sector, they are not structured to do so.

One driver for reform of market sector industries is the visibility of underperformance. There are well-understood (albeit imperfect) measures of their productivity through standard national accounts data. However, no such broad indicators are available for non-market industries. This is because the prices and quantities revealed by market

transactions are absent for non-market services. For instance, measuring activities per se – such as an unplanned avoidable re-admission to a hospital – is not an output that should be given much weight in productivity given that it is a low-quality outcome.

Most statistical agencies have struggled with the estimation of productivity in these areas. The Australian Bureau of Statistics is currently developing measures of healthcare productivity, primarily through constructing disease-based output measures, and further work will be undertaken for education and social services (Luo, 2018; Australian Productivity Commission, 2017b). Improved aggregate measures of productivity for non-market services will be useful for many reasons. They will provide a better understanding of the drivers of economic growth; reveal any systemic underperformance in non-market industries (especially if benchmarked against other countries that have also refined their measures); create a framework for assessing the quality of outputs; and require the construction of micro-performance metrics, as these are the necessary building blocks for any aggregate measures.

As useful as aggregate productivity measures will ultimately be, often more granular information is needed to discover reform options and to evaluate outcomes (such as data on the use of low-value treatments). Fortunately, there is enough evidence to identify high-priority areas for reforms to non-market services. Nevertheless, *how* to achieve better outcomes – especially in a federation where multiple governments are collectively at work – is not well established. This was the focus of the Productivity Commission’s analysis.

The commission identified three major areas where governments can act:

- more integrated healthcare that places the patient at the centre of the system, and that manages, and prevents the onset of, chronic ill health;
- an education system that supports better teaching in both schools and universities; and
- cities that ease the costs of moving around and locate infrastructure and services where people most value them.

Better healthcare to reduce chronic illness and lift participation rates

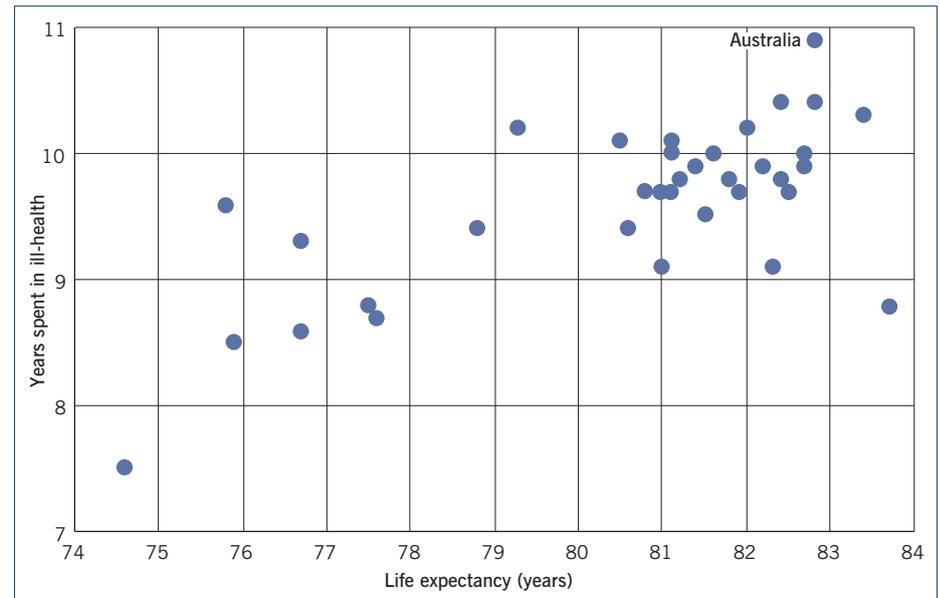
By global standards, Australians have high life expectancy, healthcare is accessible, and the costs of the system are reasonable. However, among OECD countries Australians also have a high share of their lifespan spent in ill health, at around 13% and amounting to an average 10.9 years (the latter the highest in the OECD). In contrast, New Zealanders have the ninth highest share of their lifespan spent in ill health.

Australia has high rates of chronic disease, placing major pressure on healthcare costs, and, even more problematically, creating misery among millions. As medical and public health advances have lowered the rate of death from causes such as infectious disease and trauma, the focus of Australia's healthcare system has shifted to managing chronic and complex conditions (such as diabetes, lung cancer, cardiovascular disease and mental illness). 1.2 million Australians have diabetes, 600,000 chronic obstructive pulmonary disease, and an extraordinary 4 million people have a mental or behavioural problem. Such diseases are over-represented among low-income and indigenous Australians.

Many of these conditions can be prevented: tobacco use and high body mass are the top two contributors to the burden of disease. Images of lean athletic Australians are at odds with the actual morphology of the average person, with Australia being towards the top of the global obesity ladder. Where chronic illness exists, there is considerable scope to manage it better. Care pathways, especially between general practitioners and hospitals, are often poorly coordinated. Clinicians, patients and researchers are constrained by inadequate information flows and haphazard data collection: for example, only around one in five GPs are notified when a patient is treated in a hospital emergency department. (The figure in New Zealand is more than 50%.) Regulatory and jurisdictional obstacles prevent effective linkages between hospitals and GPs that would enable better management of chronic conditions and reduce hospitalisations.

Many medical interventions funded by taxpayers are undertaken despite little

Figure 2: Many years are spent in ill health*



* Years spent in ill health is defined as life expectancy less health-adjusted life years.
Source: World Health Organization, 2017

evidence that the intervention is beneficial (arthroscopic knee surgery is a case in point). There are striking inexplicable variations in clinicians' use of medical procedures across different health districts – hardly science at work.

The system is medically rather than patient-centred, with the patient as a person often an inconvenient guest within the system. Patient health literacy is low.

The solution: integrated, patient-centred care

The key to better outcomes are reforms aimed at achieving what is now commonly referred to as 'integrated, patient-centred healthcare', delivering customised services to people across the entire health system.

There are already examples in Australia and other countries where the gains of integrated care have been demonstrated. For example, the Western Sydney Diabetes Initiative reduced patient costs by \$4,000 and hospitalisations by 45%. Scaling these up is not easy, not least because of fractured funding systems and clinical cultures. Changing the latter requires a new mindset from all parties in the system, but already the leading colleges of clinicians are onside. It requires better patient health literacy so that people can be partners in their healthcare (for example, through improved medication compliance and through a greater capacity to change the lifestyle factors that heighten the risks of chronic illness). The information and data systems need to enter the digital age, and data

records should be used systematically for better healthcare and be available to patients.

New measures of performance that centre on the patient – patient-reported outcome and experience measures (PROMs and PREMs) – need to be developed and used. Where feasible, patient choice should be given more weight. If there is a single representation of the change needed in the system, it is captured by the title of a 2015 book by Eric Topol, a US clinician: *The Patient Will See You Now*.

Payment and funding system reforms are required to support these changes. A drawback of Australia's current health system is that there are a series of budget silos. Hospitals are managed by state and territory governments, and jointly funded by both levels of government; general practice is funded and regulated by the Australian government; and community healthcare centres are funded and managed by state and territory governments. Key decision-makers in our system have no direct financial incentive to be efficient in their use of other parts of the system.

GPs and specialists are generally paid on a fee-for-service basis for items on the government-determined Medicare Benefits Schedule. This means clinicians do not face strong financial incentives to avoid high-cost activities (such as tests, referrals to specialists and hospital admissions), use lower-cost delivery methods (such as employing nurse practitioners or

phone-based consultations), or encourage coordinated care of patients or disease management. Moreover, fee-for-service introduces considerable rigidity into the management of care, and limits the incentives for proactive preventative healthcare. The Royal Australian College of General Practitioners has highlighted that SNAP – smoking, nutrition, alcohol and physical activity – should be a prime target for preventative care. Yet, extraordinarily, many people in the highest-risk categories received no advice from their physician in the previous 12 months. For example, around 80% of obese patients received no advice on improved diet or increased physical activity.

Countries with excellent academic student outcomes have pursued policies to attract high-quality teachers, including through financial incentives.

Governments should redesign hospital funding to create incentives to avoid hospitalisations through investments in public health and in community and primary care. More flexible funding pools at the regional level, comprising shared contributions from Australian and state and territory governments, would give general practice and other health professions scope to adopt more innovative models of care. Current activity-based funding encourages hospitals to be technically efficient, but it penalises them if they prevent hospitalisations. The commission proposes an approach whereby local hospital networks (LHNs) in alliances with primary health networks (PHNs) could draw from the new funding pools to cooperatively make investments outside a hospital setting (such as commissioning the services of GPs) to reduce costly hospitalisations and improve patient outcomes. The goal is principally to improve integrated care, but this approach will also reduce hospital costs, with LHNs recouping some of these.

The commission proposes the implementation of a 'blended payments'

model for GPs, retaining fee-for-service as a major portion of GP revenue, combined with risk-adjusted capitation payments. This would strengthen incentives for GPs to provide services via multidisciplinary teams, including having a greater role in preventative health and management of chronic conditions.

Financial incentives for improving quality and safety should not be overlooked. The commission recommends that Australian governments should:

- more quickly respond to authoritative assessments identifying low-value interventions ('Do not do' lists), and de-fund interventions that fail cost-effectiveness tests;

collect and divulge data at the hospital and clinician level for episodes of care that lead to hospital-acquired complications and for interventions that have ambiguous clinical impacts; and

- provide patients with plain English explanations of treatments that often lack efficacy.

The gains from reform are large, a reflection of the fact that healthcare represents around 10% of total GDP and has far-reaching impacts on people's capacity to work and participate in the community. The labour force participation rate of someone aged 25–49 and in good health is nearly 90%, but is only half this for someone in poor health. With the gradual uptake of all of the elements of the above package of measures, the gains could be around \$145 billion in constant prices over 20 years. This does not include some of the benefits of improved life expectancy and reduced suffering. While not usually counted in standard national accounts, in the period from 1913 to 1950 more than 40% of the increase in Australian living standards reflected improvements in life

expectancy, and it was still around 25% between 1973 and 2009 (Haacker, 2010). The sweeping reforms proposed by the commission would add to this often uncounted dividend.

Responding to student needs: education and workforce skills

Governments all recognise the critical role of the education system in developing skills and informed citizens, but the system has not been very responsive to those it is intended to serve.

In the school system, outcomes have been falling. An Australian 15-year-old in 2015 had a mathematical aptitude equivalent to that of a 14-year-old in 2000, notwithstanding more school funding, developments in pedagogy, and over 40 reviews of teacher education that have attempted to overcome persistent concern about school quality. Globally, the share of Australians with the poorest maths skills has been rising. There is evidence that new teachers have lower inherent proficiency than their predecessors. Teaching out of field has become endemic in some areas. For example, in information technology, about 30% of year 7 to year 10 teachers have weak training in the subject. This affects students and demoralises teachers, increasing teacher attrition rates. Countries with excellent academic student outcomes have pursued policies to attract high-quality teachers, including through financial incentives. There are moves afoot to change these problems, but their effectiveness is uncertain.

After experimental, but ill-managed, restructuring, the vocational education and training (VET) system has lost the confidence of employers and students alike. The VET sector is being repaired, but it will be some time before it can function properly. The priority now is that it reattain its capacity for high-quality vocational training. Governments should also recognise that a good system is not just about reaching a given competency level, and, over the longer term, seek to differentiate students by their level of proficiency above the minimum required standard. This enables better matching of workers' skills to employers' needs and creates strong incentives for students to be excellent and not just competent in their fields.

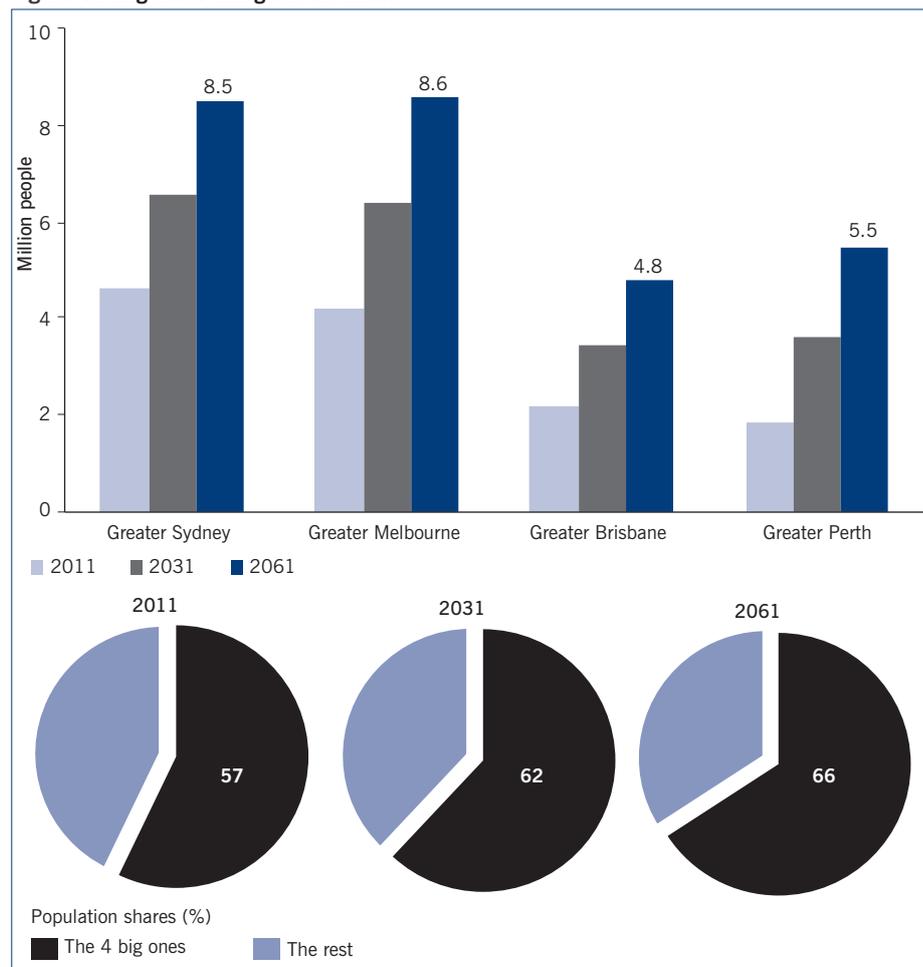
The Australian university sector has increased its vocational function, in part substituting for that of the VET sector, and has rapidly expanded its role in overall skill development. In 2011 the share of the population aged 15 years and over with a bachelor's degree or higher was 19%, and given present trends it could readily rise to over 40%. In 1971 the comparable figure was 2%.

This rapid increase has been accompanied by several major developments (Australian Productivity Commission, 2017c).

- Student attrition rates are higher, and progress in completing qualifications low. In 2014, more than 26% of students had not completed their degree programme within nine years of commencing.
- Full-time job outcomes have fallen, as have the wages of graduates compared with those with other qualifications. Students have become a major cash cow for universities, accentuated by the huge increase in the importance of revenues from foreign student fees. Students are cross-subsidising the research function of universities (Norton and Cherastidtham, 2015). That might be justified if there was a complementarity between research and teaching, but the empirical evidence of any such relationship is scanty.
- The debt associated with the Higher Education Loan Program (HELP) has spiralled. The value of outstanding HELP debt has tripled over the ten years to 2016, and now sits at around \$50 billion. Projections suggest that without new policies, this growing mountain of debt will reach \$200 billion by 2025.

These developments raise questions about the desirable role of Australian universities, and, in particular, the low status given to teaching. Teaching-focused positions have a poor reputation, with many academics viewing them as a low-pay, low-progression and low-value career pathway (Bennett, Roberts and Ananthram, 2017). Staff surveys indicate that while over 80% of academics think that effectiveness as a teacher should be highly rewarded in promotions, less than 30% think it actually is rewarded. University rankings – used as

Figure 3: Big cities will grow the most



Source: Infrastructure Australia, 2015

a promotional tool to attract students – most often refer to a university's research excellence, notwithstanding that this is largely irrelevant to students. Students themselves are not satisfied. Some 38% of university students said their education had not adequately developed their ability to solve complex problems.

It will be difficult to address the deeply entrenched cultural biases against university teaching, but several steps would help. First, universities should have some 'skin in the game', being rewarded for obtaining excellent student outcomes (Oslington, 2015; Sharrock, 2015). This would more closely align the interests of universities and their staff with those of the people paying the bills – students and taxpayers. The Australian government is already moving in this direction, and changes in the application of consumer law in a demand-led system mean that students have a legal capacity for redress (potentially including a right to repeat at no cost) if a university provides a defective service, just as for other service providers.

Second, the requirement that universities undertake both research and teaching is anachronistic, and should be removed, subject to strict regulatory supervision of the quality of the new institutions.

Third, new technologies offer scope for the digital disruption of the current university sector. In the internet age, the cost of the diffusion of information is zero, as evidenced by the explosion of massive open online courses. Traditional universities are themselves embracing online access, but a bolder move would be to develop a system that differentiates between how people acquire skills and the certification of their quality. For instance, in the United States, Udacity's nanodegree in self-driving cars draws on instructors from industry leaders such as Mercedes-Benz and Nvidia. Students pay a few hundred dollars per month for as long as it takes to finish the course, with rebates if they complete it within a year. The Achilles heel of a new model is that there is no highly respected certification

framework that signals the quality of any new credentials. This acts as a barrier to entry to new low-cost suppliers and limits self-learning. The Australian government should develop that framework.

Better functioning towns and cities

The overwhelming majority of Australians live and work in cities, increasingly concentrated in the three major sprawling metropolises clinging to the eastern coast – Melbourne, Sydney and Brisbane. About 80% of Australia's GDP is produced in cities, and 40% in our two largest, Sydney and Melbourne. In 2015, Melbourne grew by more people every five days than Hobart added in a whole year. On current

penalties imposed on those who choose to move (for either work or lifestyle reasons) and provide a more stable revenue source;

- improvements in public infrastructure provision and use. The commission particularly focuses on roads, where poorly conceived projects and waste are all too frequent, and technological change will make fuel excise an ever-diminishing source of revenue for funding roads as fuel efficiency and vehicle electrification rates rise;
- planning and land use policies, including the application of competition principles to land use regulation.

willingness to pay should inform where roads go. Road funds cannot realistically be adopted in one step. The lesson from major new government initiatives – the implementation of the National Disability Insurance Scheme and changes to the VET system – is that rushing is often the precursor to disappointing outcomes. The first step in road user charging should therefore be road pricing pilots in Australia's major capitals. Transurban has already undertaken a road pricing experiment in Melbourne. The value of more efficient use of the road network alone is estimated to be equivalent to approximately 0.7% of GDP in the long run, or a permanent increase to annual GDP of approximately \$20 billion. There would be additional allocative efficiency benefits from the closer matching of services to the preferences of road users, and fewer inefficiencies associated with poor project design and delivery.

Zoning restrictions have fundamental effects on competition in Australian cities. Provisions that explicitly or implicitly favour particular operators or set proximity restrictions between businesses should be banned. There should be a Hilmer-like² national agreement to apply competition policy principles to land use policies, where the key goal is to meet the long-term interests of the community, as in other competition policy.

Delivery of reforms

In some instances, governments at all levels can act autonomously to introduce the reforms to health, education and cities. Responsibility for the dysfunctional elements of higher education, for example, lies entirely with the Australian government.

However, without national agreement between all jurisdictions, many of the reforms proposed by the commission will languish. The Council of Australian Governments – the usual vehicle for cooperative policy initiatives – is currently a slow and capricious vehicle for reform. But it can be revived if state and territory governments' central role in, and understanding of, delivering services is recognised by the Australian government, and if the relationship between parties is less tainted by expectations that the

The Council of Australian Governments – the usual vehicle for cooperative policy initiatives – is currently a slow and capricious vehicle for reform.

trends, most growth is projected to occur in capital cities, so how cities operate is fundamental to both the quality of people's lives and national prosperity.

Cities are distinguished by their physical dimensions and high concentrations of people, which means that policies affecting the availability and use of space, organisation of activity and the pace and distribution of population growth particularly affect city liveability and productivity. While Australian cities currently score well on liveability, the pressures on their functioning are mounting. There is increasing traffic congestion, undue restrictions on housing supply and business investment from ad hoc and anticompetitive planning and zoning, some poor decisions about public infrastructure, and an unsustainable funding basis for roads. Stamp duties, while a bonanza in times of rising housing prices, are unfair and inefficient. The avoidable social cost of congestion alone was \$18.7 billion in 2015.

The commission's recommended reforms focus on:

- switching from stamp duties to taxes based on land value, which would avoid

The solutions to some of these issues are relatively straightforward, if sometimes politically fraught. A phased transition to land tax is already occurring in the Australian Capital Territory, proving its feasibility. And governments at least know how to avoid white elephants in infrastructure investments. Looking for cheaper substitutes to grand designs is an obvious one, such as limiting parking spaces on congested roads. More rigorous planning and detailed, hard-headed cost-benefit analysis should always precede project decisions, and the analyses should be used to determine investment priorities. Yet the Grattan Institute estimated that over the past 15 years, governments announced about 30% of transport infrastructure projects valued at over \$20 million before a funding commitment. Brisbane's Clem 7 Tunnel Freeway project exemplifies the waste. The initial net present cost was \$638 million, but its actual capital cost was 2.5 times higher and its actual patronage three times lower.

Road funding involves more elaborate considerations. Over the longer term, motorists will need to pay directly for their road use, and, as with other services, their

Australian government will pay for reforms. The fond, but fictitious, memory of national competition payments as a driver of reform in the 1990s ignores that such payments were ancillary rather than central drivers of change. Nowadays, the fiscal cupboard of the Australian government is bare, and, in any case, paying

parties to do things that are in their own self-interest is ill-justified. The commission has proposed some key items that should belong to a new reform agenda, but a good negotiated agreement should encourage state and territory governments to bring their own initiatives to a negotiating table.

- 1 This article draws from the Australian Productivity Commission's five-year productivity review (Australian Productivity Commission, 2017a), available at <https://www.pc.gov.au/inquiries/completed/productivity-review/report>.
- 2 Professor Fred Hilmer led a review of national competition policy, with its 1993 report being the blueprint for a wide-reaching microeconomic reform involving all Australian jurisdictions.

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Measuring Productivity in the Health Sector

Abstract

Over the next few decades governments will increasingly need to balance the new and growing demands facing the health system with a tighter fiscal outlook. The best way to protect standards while responding to these pressures will be to lift productivity. This article draws on a recent New Zealand Productivity Commission inquiry into state sector productivity and discusses the implications of this work for the health sector. It begins by highlighting the importance of health sector productivity, particularly given the fiscal outlook. It then discusses recent efforts to measure productivity in the health system, before outlining possible next steps in measuring the sector's productivity.

Keywords health sector, productivity, measurement, New Zealand

Why this topic?

The performance of the health sector matters. Not only is it a major area of government expenditure (about 21% of core Crown expenses in 2017) and a major employer in New Zealand, it is important for living standards and economic growth. Productivity growth

in the private sector relies on a healthy, well-educated population, whose efforts depend on good physical and social infrastructure (Atkinson, 2005). Indeed, by supporting the acquisition of human capital, the feedback loop between health sector outputs and economic growth can potentially be quite large, raising

'the possibility that some investments in health might, in effect, "pay for themselves" through their impact on overall incomes quite apart from any improvement in welfare' (Cullen and Ergas, 2014, p.15).

Yet while New Zealand's health sector often ranks highly in international comparisons of outcomes (see, for example, Cumming, 2017; Fullman et al., 2018; Schneider et al., 2018), questions have been raised over its productivity. This can be illustrated with Statistics New Zealand (2017) data on industry-level productivity. This data is compiled for industries in the so-called 'measured sector' (private sector industries) and for a number of state sector industries (including the health sector). As these are industry measures, both public and private providers are included in the health sector and data is not routinely published for sub-sectors. The data also does not explicitly account for changes in the quality of outputs or in the environment facing producers (these issues are discussed in more detail in the section on measurement below).

Nonetheless, this data showed that between 1996 and 2017 increases in the productivity of the state sector were largely

driven by increasing inputs (staff numbers and funding). In health the average annual growth in outputs of 3.8% reflected growth in inputs of 3.0%, with labour productivity contributing 0.8%.¹ The growth rate of the sector's labour productivity during this 20-year period was around half that of the measured sector (private sector industries) of 1.5%, which suggests that in a sizeable part of the economy (health accounted for 6.4% of total industry output), productivity growth was lagging. This gap between measured sector and health sector labour productivity largely reflected lower capital productivity in the health sector (lower productivity of inputs such as land and buildings, inventories, and equipment).

When seen in the context of the Treasury's work on the long-term fiscal outlook, this industry-level data provides food for thought. For example, if the assumed health sector productivity in the Long-Term Fiscal Model (LTFM) was to increase by half a percentage point a year, then, under a historical spending scenario, government health expenditure in the final year of the model (2059–60) would be \$114.7 billion rather than \$137.2 billion. In other words, providing the same level of services in the lower productivity scenario requires 16.4% more government expenditure than in the higher productivity one.

Productivity is not only important for fiscal reasons. The impact of demographic and technological changes on the level and nature of demand for key public services has been well canvassed (see, for example, Treasury, 2016). As one example of how demand is changing, since 2002 there has been a significant increase in the average age of hospital inpatients, which has, in turn, had implications for the medical complexity of care (Fraser and Nolan, 2017). From 2002 to 2014 the mean age (at admission) of inpatients increased by about 3.4 months a year and the median by about 7.1 months a year. To put this in context, over this period the median age of the New Zealand population increased by around 2.7 months a year. Trends like this can be expected to continue. At the same time, growth in the aggregate labour force will slow and pressure on government budgets will increase.² The result is that health sector managers can expect their

Table 1: Fiscal Outlook in the Long Term Fiscal Model (Historical Spending Scenario)

Year	2017	2032
Total Crown revenue (excluding Gains) (\$b)	101.0	193.5
Less Total Crown expenses (excluding Losses) (\$b)	99.7	206.1
Less Minority interest share of operating balance before gains/(losses) (\$b)	0.5	0.7
Total Crown operating balance before gains and losses (OBEGAL) (\$b)	0.7	-13.3
Nominal GDP (expenditure measure) (\$b)	259.2	489.9
OBEGAL as % of GDP	0.3%	-2.7%
Total health expenses (\$b)	15.4	33.0
Total education expenses (\$b)	14.1	27.8

Source: Treasury Long Term Fiscal Model

services to face increasing pressure as growth in inputs becomes more constrained. To maintain the quality of services they will need to focus on lifting productivity and shifting 'resources from less socially valuable old things to more socially valuable new things' (Cullen and Ergas, 2014, p.4).

The fiscal outlook

The Treasury's LTFM provides a valuable picture of the longer-term fiscal outlook. The most recent (2016) version of this model shows that if governments maintain a historical spending scenario they will start running permanent structural deficits – based on the operating balance before gains and losses – from about 2024–25. This scenario is based on historical policy settings and accounts for demographic and non-demographic changes (e.g., assumptions regarding how healthily people age) (Piscetek and Bell, 2016). Treasury does not update the LTFM annually and it is possible that these projections are now on the pessimistic side, particularly given the recent growth in tax revenues.

Indeed, the Fiscal Strategy Model (FSM) prepared as part of Budget 2018 shows no sign of a structural deficit emerging over the projected period (the FSM goes to 2032). This reflects different assumptions for factors like economic growth (and, in turn, tax revenues) and approaches to modelling government expenditure in the two models. The FSM and LTFM have different purposes and it makes sense for them to employ different assumptions. Nonetheless, comparing projections for health expenditure (including a share of operating allowances)³ in the two models shows that the FSM

projects a lower level of growth in this expenditure between 2017 and 2032 (4.5% in the FSM versus 5.2% in the LTFM) and that it suggests that expenditure growth will be slower between 2022 and 2032 than between 2017 and 2022, while the LTFM estimates that expenditure growth in the later years will be higher. These figures are before inflation and, based on data collated by the Institute for Governance and Policy Studies and NZIER, compare to actual growth in core Crown health expenditure of 5.4% between 1996 and 2016 and 4.6% between 2006 and 2016 (Institute for Governance and Policy Studies, 2018).

The discussion above highlights a range of fiscal choices. Broadly speaking, governments will be restricted to health spending growth at levels seen over the last decade – which will be challenging given cost pressures from demographic and technological change – or face fiscal deficits and/or lower spending growth in other areas, and/or require faster-growing tax revenues. Yet these fiscal choices can be made easier if governments also focus on lifting productivity. As Wilkinson and Acharya noted, 'faster productivity growth makes everything more affordable' (by growing tax bases and bending down services' cost curves) (Wilkinson and Acharya, 2014, p.22).⁴ However, the scale of the increase in productivity required should not be underestimated. As a thought experiment, the author estimated how much the annual productivity growth rate for the health sector in the LTFM would need to increase to allow expenditure in 2032 to fall to a level consistent with real per capita spending in 2017. In other words, what health sector productivity increase would offset all of the impact of demographic and technological

change on spending, *ceteris paribus*? The result was an increase of 4.2%, which, in the context of a current growth rate of health sector productivity of 0.8%, would be a very tall order. Current productivity growth in the health system is a long way from where it needs to be.

The state of the art

Fortunately, health is an area where – both internationally and within New Zealand – relatively good progress has been made in the measurement of state sector productivity. Lau, Lonti and Schiltz (2017) showed that among OECD countries, health was the part of the state sector where governments were most likely to measure productivity. This, however, needs to be seen in the context of a general neglect of these measures, with only 12

been tough going. There are data gaps, missing paradigms, and communication issues. The analytical capacity and capability across the sector appears to be in short supply. Measures that are part of operational processes appear more enduring but that could be expected. Meaningful succinct measures to populate performance frameworks have been elusive. (p.5)

Knopf then contrasted the experience of productivity measurement with the development of health targets. She attributed the higher levels of support for the health targets vis-à-vis productivity measurement to technical constraints, perceptions of key stakeholders, and generic expectations around public sector monitoring frameworks. Productivity

making the best possible use of resources such as funding and labour. Measured properly it should account for changes in the quality of services (see the article by Gemmell, Nolan and Scobie in this issue of *Policy Quarterly*). A comprehensive performance framework for the state sector should include productivity as one dimension. Indeed, improving productivity is a key step towards improving the final outcomes of the health sector. It is not possible to achieve the best possible health outcomes for New Zealanders unless health services are productive. It may, for instance, be possible to decide what outcomes are desired and to perhaps even predict the likely contribution of specific outputs to these outcomes. But unless the health system can effectively convert the resources available into outputs, it will be unlikely to maximise desired outcomes.

However, as important as productivity is, it is necessary to also recognise what productivity measures do not show. As the Productivity Commission has noted (2017), an observed change in productivity may reflect factors outside the control of health sector managers. Indeed, one key difference between the state and private sectors is the greater requirement for accountability considerations in the state sector. The allocation of inputs (e.g., funds and workers) in the state sector rightly remains subject to public law and administrative requirements designed to ensure that they are used in a lawful, transparent and accountable manner. Yet, as the Productivity Commission (2015) noted, when agencies manage performance risk through highly specified contracts (that describe the inputs to be used, the processes to be followed and the outputs to be produced), they can reduce the incentives and opportunity for innovation, limit the flexibility of providers to respond to changing needs of clients, and limit the scope for providers to work together. This is especially important for the health sector, as models of care need to evolve as technological changes allow treatment of previously untreatable diseases, conditions that once required hospital care are able to be treated in other settings (such as primary care), and the need for minimum safe size leads to specialist and other services being concentrated in larger

[Elizabeth Knopf] noted that there was a need to ‘advise on meaningful measures of efficiency and productivity (including developing the productivity story) that would be useful to the health sector’

of 32 countries, including New Zealand, measuring health productivity.

Since 2013 Statistics New Zealand has published annual estimates of health productivity (their estimates go back to 1996). As well as these ‘national accounts’ measures, district health boards regularly measure their productivity over a range of services (District Health Boards, 2017). Other studies, including benchmarking exercises, have been undertaken by organisations such as the Health Research Centre at Victoria University of Wellington, the Health Roundtable and the Treasury. Yet this work on productivity has faced challenges. Knopf (2017) reviewed 15 examples of attempts to measure productivity by national health sector organisations over the past 20 years. She found that no progress in measurement over time was identifiable (p.3), and that:

Attempts to measure efficiency/productivity in the health sector have

measures were seen as not being meaningful or even being ‘negatively or intuitively wrong’, or creating the wrong incentives. She noted that there was a need to ‘advise on meaningful measures of efficiency and productivity (including developing the productivity story) that would be useful to the health sector’ (pp.5-6). Likewise, district health boards have noted the challenges posed by the lack of agreement on methodologies for measuring productivity (District Health Boards, 2017).

Productivity, reallocation and diffusion

The discussion above illustrates the problems that can arise when concepts like productivity are misunderstood. Often productivity is seen as being synonymous with increasing hours of work or cutting budgets. This is wrong. Productivity is a measure of the outputs produced for a given set of resources (inputs), or, in other words, the effectiveness with which inputs are transformed into outputs. It is about

settings (which can be reflected in scale effects or economies of scope).

This has two key implications for the measurement of health sector productivity. The first is that, as emphasised by the Productivity Commission (2017), productivity measures should be treated as one input into conversations about performance, rather than the sole factor with high-stakes impacts (e.g., not tied to financial incentives). The second is that there is likely to be value in a broader focus on innovation (especially the diffusion of new processes and technology) rather than just on productivity per se. Indeed, these two concepts are related. Research on the private sector shows that the two key drivers of productivity growth are diffusion and the reallocation of capital and labour (Conway, 2016). The forces of reallocation tend to be weaker in the state sector (reflecting lower levels of competition and a smaller role for consumer choice), which means diffusion of innovation needs to play a greater role in driving productivity growth (Dunleavy and Carrera, 2013). Fortunately, measuring diffusion in the state sector is often relatively straightforward, given the greater ability to directly observe activities or outputs. This contrasts with private firms, where innovation cannot often be directly observed, meaning measures of the number of firms engaged in innovative activity can range from 0.2% to 40% (Wakeman and Le, 2015).

The question of how to measure

While the preceding discussion highlights the importance of measuring health sector productivity, there are still outstanding questions regarding how to go about measuring productivity in the state sector (Productivity Commission, 2018). It would be naive to take methods developed for private firms and think they could simply be applied to the publicly funded health sector. But this does not mean that the productivity of health services cannot be measured. It simply means that the productivity of these services should often be measured differently to the ways in which it is measured in the private sector. For example, a general feature of service industries is that it is relatively difficult to measure outputs compared to measuring outputs of goods-producing

industries. And in the state sector there are additional considerations. As well as the accountability considerations discussed above, there is an absence of 'market clearing prices', as these services are often either provided without charge or partially subsidised (Dunleavy, 2016; Gemmill, Nolan and Scobie, 2017). In the private sector, data on prices plays a key role in measuring productivity by providing information about the relative value of different outputs (and changes in quality) and serving as weights when aggregating them (e.g., into industry or national measures). In the health sector this role can be filled through using cost weights to aggregate outputs, but it is important to recognise that these weights will reflect the

assessment of the health sector. It also reinforces the importance of considering what is driving observed changes in productivity, and, if necessary, how these results compare with other sources of evidence. This is why Atkinson emphasised the need to supplement productivity measures with independent evidence (what he called a process of 'triangulation' (Atkinson, 2005, p.51)).

An often-cited challenge in measuring health sector productivity is the need to account for differences that organisations face in their operating environments and for any changes in these environments over time. Key features that can be relevant include: the characteristics of the clients of the services (e.g., age, socio-economic

[This article] shows how the history of productivity measurement in the sector has at times been tough going, but that – given the future demands facing the sector, along with the tightening fiscal outlook – this work is only going to gain in importance.

value producers put on services and not how consumers value them (Productivity Commission, 2018).

There can also be differences in goals and, as also noted above, market structure. Compared to private sector firms, which may have goals like increased market share or shareholder value, some tasks in the state sector have relatively complex goals. As Tavich (2017) noted, in many cases standard productivity concepts are compatible with state sector tasks, but for others, using these standard measures is a challenge. She argued that it is possible that some useful measures could be developed for these other tasks, but this involves moving from productivity measures into other forms of performance assessment. This reinforces the conclusion that productivity measures should be just one element of a broader framework for the

background, pre-existing health status); the size and scope of the organisations (e.g., whether hospitals have specialist units); market structure (e.g., presence of other suppliers/competitors); and the overall performance of the economy. There is also the need to consider how the quality of services differs between organisations or changes over time. The importance of these dimensions can be illustrated in the examples below.

- Differences in operating environment: differences in the performance of general practices may, for example, reflect the socio-economic status of their patients as well as the performance of their staff. Failing to account for these differences could mean measures overstate the performance of practices that draw patients largely from advantaged backgrounds.

- Changes in quality over time: suppose that the number of patients treated in a public hospital grows at a slower rate than labour and capital inputs. Measuring productivity on this basis would tell a story of falling productivity. But also suppose that the quality of care increased and readmission rates fell. In this case the change in measured productivity would be missing an important part of the story.

There are several approaches to accounting for differences in operating environments (Productivity Commission, 2018). It could be possible to measure the outputs related to different population subgroups separately (segmenting the population) and treat them as distinct outputs; the providers studied could be compared to those from similar environments; and volumes of outputs could be adjusted for differences in the operating environment (e.g., severity of treatments as reflected in case-mix). There is also a sizeable literature on applying quality improvement approaches to healthcare (ibid.). Marshall (2009), for example, showed how statistical approaches first developed in the manufacturing sector could illustrate quality issues in healthcare.

A final concern regarding measuring productivity is a practical one: whether this will require the collection of new data (which comes with a cost). But valuable data already exists in the health system (District Health Boards, 2017) and it is possible to go a long way in measuring productivity by increasing the utilisation of existing data (Australian Productivity Commission, 2017; Downs, 2017). As district health boards have noted, the health sector 'has a range of IT systems that support the delivery of services in an operational context, for example theatres, radiology, laboratories. Often these systems do not feed directly into national collections but generally support clinical

coding processes and other analytical processes, such as costing and production planning' (District Health Boards, 2017). Greater utilisation of this data should be the focus. This requires thinking about data access, standards and linking: for example, whether the right people have access to the right data. As the New Zealand Nurses Organisation (2017) has noted, the better use of data is an important step in providing the care needed for patients.

Conclusion

This article has drawn on a recent Productivity Commission inquiry into state sector productivity (Productivity Commission 2017, 2018) and discussed the implications of this work for measuring productivity in the health sector. It shows how the history of productivity measurement in the sector has at times been tough going, but that – given the future demands facing the sector, along with the tightening fiscal outlook – this work is only going to gain in importance. Further, rather than (perhaps unhelpfully) labelling sectors as 'laggards', the latest techniques in state sector productivity measurement could encourage a greater focus on questions like health sector innovation (especially the diffusion of new processes and technologies).

Exploiting the potential of these new measures, however, requires further work. Agencies need guidance on how to measure and understand their productivity and there is scope for greater sharing of lessons across government. This is an area where the health sector could make a valuable contribution, with some of the techniques and approaches being used in the sector (e.g., District Health Boards, 2017) already being at the New Zealand frontier (Productivity Commission, 2018). The Productivity Commission has also recently published guidance for analysts and will continue to support the development of an

informal network in this area through holding regular Productivity Hub and Government Economics Network (GEN) sessions.

But other agencies need to make an investment too. For example, given the potential benefits from the greater use of administrative data, agencies need to continue to work on sharing and using data across government in safe ways. Agencies also need to recognise that measuring productivity should be a regular part of assessing the performance of their organisation. This requires ongoing resourcing and an openness to using and developing productivity measures. The measurement of state sector productivity is a developing field and approaches will evolve as techniques and data improve. Yet this is no reason for not getting started. Productivity measures improve the more you use them.

- 1 This sector includes hospitals, medical and other healthcare services, and residential care services and social assistance. It also includes providers in both the state and private sectors, with the private sector accounting for 57% of industry GDP (production measure) in 2016.
- 2 Note that population ageing can also be reflected in the age of the health workforce. For a general discussion of workforce ageing issues see Koopman-Boyden et al., 2014.
- 3 Total health expenditure in each year of the FSM is assumed to reflect both the allocation for total health expenses and 36% of each year's allocation for operating allowances.
- 4 As well as on health, this will require a focus on education spending and New Zealand Superannuation. The health sector is the focus of this article, while a companion article in this issue of Policy Quarterly discusses the education sector (Gemmell, Nolan and Scobie, 2018). Issues relating to New Zealand Superannuation are not discussed in this article but have been well canvassed elsewhere (see, for example, Nolan, 2018).

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Norman Gemmell, Patrick Nolan
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Quality Adjusting Education Sector Productivity

Abstract

This article examines how quality-adjusted productivity indices for the education sector may be constructed and proposes methods for making such adjustments to basic measures of labour and multifactor productivity growth. Results highlight the need for careful measurement, showing that measures unadjusted for quality are unlikely to provide sufficiently robust signals about changes in productivity performance in the education sector on which policy advice could be built. Our evidence suggests that quality adjustment to both inputs and outputs can make substantial differences to conclusions about productivity growth trends over 2000–15 compared with unadjusted indices.

Keywords productivity, quality adjustment, education

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The measurement of productivity in the market sector of the economy is now well established, with estimates by industry group regularly published by Statistics New Zealand. Yet while Statistics New Zealand also publishes some estimates of productivity in the non-measured sector, particularly for areas such as education and health, this is still a developing field.¹

The limited information we have about the public sector suggests that improvements in productivity have lagged well behind those in the market sector. While the growth of outputs in the public sector has been comparable to that of the market sector, most of that growth is attributable to increased inputs: more people producing more outputs. Consequently, over the last two decades the average growth rate of labour productivity in the public sector, as conventionally measured in national accounts, has been about 0.2% per year, compared with 1.5% in the market sector (Nolan, Fraser and Conway, 2018). Similar results are seen in a number of other countries. Australia, for

example, managed only 0.3% per year (Gemmell, Nolan and Scobie, 2017b).

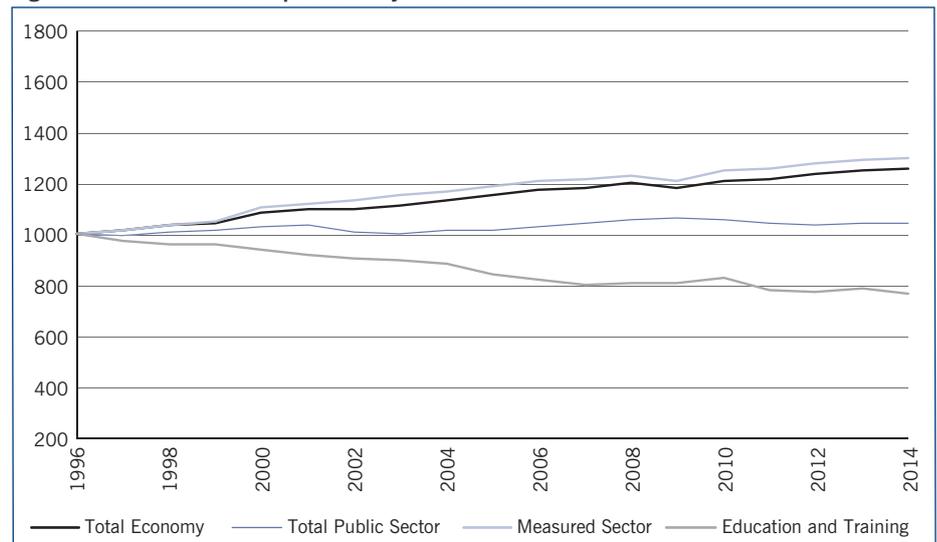
Yet it could be that these existing estimates for the public sector are not giving an accurate picture. It is widely acknowledged that measuring productivity in the public sector faces additional challenges to those encountered in the market sector (Productivity Commission, 2018). For example, one challenge in measuring productivity in public services is that typically there are no market prices for the services or they are offered at highly subsidised prices. As a result, unlike for the market sector, conventional price weights cannot be used to aggregate diverse inputs and outputs or as an indicator of changes in quality.² There is a sizeable literature that discusses addressing aggregation issues through the use of producer prices (cost weighting). But guidance is less developed on how changes in quality can be accounted for.

This article reports on two recent studies that quality adjust publicly available data on the productivity of the public education sector in New Zealand (Gemmell, Nolan and Scobie, 2017a, 2017b). The primary objective is to demonstrate that how productivity is measured matters. While we make no attempt to offer a single definitive measure, the range of measures we report provide insights into the importance of the methodology. In short, there are a number of ways to measure educational productivity; the results will depend on the approach chosen to deal with quality adjustments. After summarising existing measures based on national accounts data, we present a range of estimates for productivity in both the school and tertiary sectors, using different methods of quality adjustment.

National accounts measures

Statistics New Zealand regularly publishes estimates for the education sector as part of their annual releases of industry-level productivity measures (Statistics New Zealand, 2013, 2017; Tipper, 2013). The education and healthcare sectors (in addition to central and local government) were given priority as these are areas where most progress has been made in defining output measures. Defining the output of collective services, such as defence, police or fire services, remains relatively difficult.

Figure 1: Trends in labour productivity (1996-2014)



Source: Statistics New Zealand

Output measures are based on a fixed-price value-added, GDP production approach. Value added is defined as output minus intermediate consumption. Once output measures have been defined, their growth rates are computed. The growth rates of the activities are then combined into a single output index for the sub-sector using cost weights for the different components of output which reflect their relative importance.

More specifically, in the case of education and training, overall output is constructed by combining preschool education (contributing 8% of value added to the sector), school education (contributing 50%), tertiary education (contributing 33%) and adult, community and other education (contributing 8%) (Tipper, 2013). The output indicator for each sub-sector is based on cost-weighted numbers of equivalent full-time students (EFTS). Cost weights are derived from financial data on expenditures for each activity. A proportion of the activities is not measured (such as the research outputs of tertiary education). Consistent with Statistics New Zealand (2010, p.18), the growth rates of these later activities are assumed to match those of the measured activities.

In the case of inputs, measures of labour and capital used in the production of the activities are estimated and combined. The labour input is based on hours paid, while the capital input is estimated by applying the user cost of capital concept to the total capital stock used in the industry. The latter is

constructed using the perpetual inventory method, which sums, and depreciates, annual investment over a prior period (Tipper, 2013). An exogenously given rate of return of 4% is applied to all industries in the estimation of the user cost of capital.

Figure 1 illustrates the long-run trends in labour productivity based on those measures. These statistics reveal a picture of productivity growth in the public sector lagging well behind that of the so-called measured (mainly market) sector. Furthermore, data on the education and training sub-sector suggests it has experienced a long-run decline in productivity that appears to be ongoing. For over two decades the annual average rate of productivity growth in education and training has been 1.5%.

However, this data is not quality adjusted. Tipper (2013) argued that the decision not to make explicit adjustments for quality in the education and health measures reflected the absence of an internationally agreed set of standards and limitations of the data. There is, however, an implicit quality adjustment contained in the Statistics New Zealand approach. As the measures have been compiled at a disaggregated level, this allows for changes in the composition of output. Yet this method only captures that part of the total potential changes in quality that are associated with compositional shifts (Sharpe, Bradley and Messenger, 2007).

This discussion poses a fundamental question: is the apparent continuous decline in labour productivity in the

Table 1: Annual productivity growth rates of school sector (%)

	2002–08	2008–14	2002–14
Student numbers over staff FTEs	-1.6	-0.4	-1.0
Student numbers over real school revenue	-2.5	-0.9	-1.7
Student numbers over real spending on staff salaries	-4.1	0.2	-2.0
Student numbers adjusted for NCEA level 2 pass rates over staff FTEs	0.8	1.7	1.2
Student numbers adjusted for NCEA level 2 pass rates over real school revenue	-0.5	1.5	0.2
Income-weighted output over staff FTEs	0.6	-0.9	-0.2
Income-weighted output over real school revenue	-0.3	-1.4	-0.9

Source: Authors' calculations

education sector a consequence of the particular methodology and assumptions employed or is it a reflection of a real ongoing decline? This question becomes especially salient when national accounts measures are compared with cross-country studies (largely focusing on schools), many of which have suggested that the New Zealand education system is relatively efficient by international standards (e.g., Afonso and Aubyn, 2005; Sutherland et al., 2007; Schreyer, 2010). More recent work (Dutu and Sicari, 2016) has, however, suggested that the efficiency of New Zealand's school sector has deteriorated.

Quality-adjusted measures of school productivity

The presence or otherwise of quality adjustments can make a substantial difference to measured productivity and plays an important role in the interpretation of productivity data (Maimaiti and O'Mahony, 2011). For example, in the United Kingdom, where the Office for National Statistics quality adjusts education productivity data, between 1997 and 2011 measured output in this sector grew at an annual average rate of 2.7%. Of this, the estimated quality adjustment accounted for 90%, or an annual rate of growth of 2.5% (Caul, 2014, p.8).

However, while important, adjusting basic estimates of public sector productivity for quality is complex. As Schreyer and Lequiller (2007) noted, information beyond that contained in the national accounts will generally be needed to adjust for quality and, as quality is multidimensional, a single approach is unlikely to be adequate. To illustrate a broader suite of approaches to quality

adjustment, Gemmell, Nolan and Scobie (2017b) first computed unadjusted or basic measures for labour productivity and multifactor productivity (MFP). A sample of their results for the 2002–14 period is reproduced in Table 1. These are the measures that are widely reported internationally. Both measures use total student places as the proxy for output of the school system; inputs for labour productivity are based on Ministry of Education data on the numbers of full-time equivalent (FTE) teaching staff (including principals, management, classroom teachers, resource teachers, guidance counsellors and therapists), and for MFP they are total school revenue (including both core Crown expenditure and non-government revenue).

Various adjustments to these basic productivity measures were then introduced. First, on the input side, clearly not all staff FTEs are the same: differences in age, qualifications, type of position and experience may be important. However, at the aggregate level no suitable data was available to make these adjustments. A simpler (less data-intensive) approach was thus taken: real (inflation-adjusted) expenditure on staff salaries was used as a proxy for quality. This was based on the supposition that variations in the hours of paid work and the composition of the labour force were reflected in salaries paid. However, as the Productivity Commission (2018) noted, this approach requires careful consideration as it can be sensitive to the ways in which wage rates are set in different sectors. On output measures, two adjustments were made based on student attainments: (1) drawing on PISA scores, and (2) drawing on the share of students leaving with NCEA level 2 (or equivalent).

A further adjustment was made to capture educational outcomes as distinct from outputs of the school system. Following international studies, such as Murray (2007) and O'Mahony and Stevens (2009), this was based on expected earnings by educational attainment level. This involved a two-step process: first, output was adjusted for the domestic attainment of students; the average real expected income for students based on this attainment was then estimated and multiplied by the number of students in each category. The expected real income was based on average weekly incomes from the New Zealand Income Survey at three NCEA attainment levels (1, 2 and 3 or their equivalent) and adjusted for unemployment rates for each group.

This work illustrated both the importance and the difficulty of quality adjusting sector-level productivity data. Policy decisions (e.g., regarding smaller class sizes) were reflected in the basic labour productivity measures. Further, when the measure of labour input was adjusted in an effort to capture quality changes (e.g., through using data on real salaries), this labour productivity performance also worsened. But there are caveats. These include questions over the use of salaries as a proxy for quality of inputs – particularly given the nature of public service labour markets (e.g., whether a change in salaries reflects quality/compositional changes or changes in government policy) – and the importance of missing inputs such as the previous performance of students (needed for measures of value added).

Nonetheless, a similar story emerged from measures that adjust outputs based on attainment in international assessments (such as New Zealand students' PISA scores), where performance has worsened. This reflects a decline in aggregate PISA points (an average annual decline of 0.1%), which itself reflected a larger fall in the average PISA score (an average annual decline of 0.3%). However, there were differences in measured attainment according to international and domestic assessments, with an increasing proportion of students leaving school with at least NCEA level 2 or equivalent. Consequently, (labour) productivity based on a measure that

adjusted for domestic attainment (e.g., the proportion of students achieving NCEA level 2) increased between 2002 and 2014. This difference between international and domestic assessment points to the need to better understand what measures of attainment reflect the performance of New Zealand schools. Similar questions have been raised recently in the United Kingdom, where the Office for National Statistics had to revise its approach to quality adjusting education quantity when practices regarding students sitting exams changed.

Finally, measures adjusted for final outcomes (in this case the performance of school leavers in the labour market) also suggested falling productivity, but they can be subject to attribution problems. Indeed, given the improved domestic attainment noted above, the decline in these measures reflected changes in unemployment and real wage growth following the global financial crisis. With the use of sector-level data it would not be valid to conclude that changes in these measures were directly attributable to the performance of schools; they may, for example, also reflect differences in the economic context facing different cohorts of school leavers. To estimate the incremental value of school education on earnings, it would be necessary to use linked unit record data.

Quality-adjusted measures of tertiary productivity

Gemmell, Nolan and Scobie (2017a) also considered approaches to quality adjusting the productivity of tertiary providers. The approach taken was similar to that taken to school productivity, but, as some tertiary providers (particularly the university sector) can be seen as ‘multi-product firms’ – producing both teaching and research outputs – they also considered approaches to cost weighting different outputs into a single output index.

Tertiary teaching productivity

The teaching productivity growth rates in the tertiary sector were calculated for three sub-sectors: universities, institutes and polytechnics (ITPs), and wānanga. In 2015 the shares of student numbers in the three sub-sectors were 57%, 33% and 10% respectively. For ITPs and wānanga it was assumed that all staff FTEs and real

Table 2: Annual average productivity growth rates of tertiary sector teaching (2000-15)

	Basic	With wage-adjusted input	With completion-adjusted output	With earnings-adjusted output
Labour Productivity Growth Rates (%)				
Universities	-0.5	-1.4	0.9	1.1
ITPs	0.7	0.0	3.9	4.0
Wānanga	4.2	1.0	5.0	4.0
Total sector	0.2	-0.6	1.9	1.8
Multifactor Productivity Growth Rates (%)				
Universities	-0.3	n.a.	0.8	1.3
ITPs	0.7	n.a.	4.4	4.0
Wānanga	3.1	n.a.	7.2	2.9
Total sector	0.3	n.a.	3.3	1.0

Source: Authors' calculations

expenditure could be allocated to teaching activities. For universities, academic staff were assumed to spend 60% of their time teaching (and the remainder researching), research staff were fully allocated to research outputs, and all other staff were allocated to the production of teaching outputs. Further, for universities the shares of total expenditure and salaries attributed to teaching were based on the share of total university expenditure which went to teaching (defined as total expenditure minus research expenditure).

As with the analysis of productivity growth in schools, some basic measures were first developed and a series of adjustments for quality were then considered. The results are presented in Table 2. The first column lists the estimates of basic productivity growth based on student numbers and teaching staff FTEs for labour productivity and on teaching expenditures for MFP. The overall growth of productivity was positive although very modest, dominated by negative teaching productivity rates for the university sector, which, as noted above, accounted for around 57% of the student numbers in the sector. High growth rates for wānanga (around 10% of the sector) are in part because they started from a low base of student numbers soon after inception.

The basic rates were then adjusted by proxies for quality and the adjusted estimates are in the next three columns in the table. As in the case of schools, and following York (2010), staff FTEs were weighted by inflation-adjusted salaries as a proxy for changes in the composition of teaching staff over time. Further, rather

than raw student numbers, completion rates were used to provide a better measure of output. These completion rates were adjusted by NZQA credit weights for different types of qualifications to help account for possible changes in quality over time (e.g., students being directed to easier courses). Finally, outputs were adjusted in line with a human capital framework, in which education is viewed as an investment, with the pay-off taking the form of higher expected future earnings.

As the results in the table illustrate, productivity growth rates were lower for the adjustment based on salaries. This reflected the effect of a growth in salaries greater than growth in FTEs, which effectively raised the level of inputs relative to the basic case and consequently led to lower labour productivity growth rates. In contrast, both labour productivity and MFP were substantially higher in all sub-sectors once quality-adjusted measures based on completions and expected earnings were incorporated.³

The use of measures based on expected earnings merits further discussion. An advantage of this approach is that it captures the outcomes of the education process in a single, economically interpretable form, though at the cost of excluding benefits not reflected in earnings. Examples include Murray (2007), O'Mahony and Stevens (2009), Hanushek (2011) and Barslund and O'Mahony (2012). Yet, of course, as Hanushek (2015) acknowledges, there are limitations to using expected earnings as a measure of the value of education. First, it can be influenced by selection bias, where students

Table 3: Annual average productivity growth rates in the university sector

	Teaching	Research	Overall
Labour Productivity Growth Rates (%)			
	Credit and income weighted completions per teaching staff FTE	Citation weighted research output per PBRF adjusted research staff FTE	
2000-06	3.4	0.7	1.8
2006-15	0.4	6.0	4.0
2000-15	1.6	3.8	3.1
Multifactor Productivity Growth Rates (%)			
	Credit and income weighted completions per \$ teaching expenditure	Citation weighted research output per \$ research expenditure	
2000-06	1.8	3.6	2.9
2006-15	-0.6	5.7	4.0
2000-15	0.4	4.8	3.6

Source: Authors' calculations

enrolling in additional education are self-selecting. Second, historical average earnings profiles for different levels of qualification (that also ignore heterogeneity around that average) are typically used as the basis for assumed future earnings. Third, while any earnings premium is often attributed to education, some portion may well reflect innate ability, family background, health status, subsequent employer-based training, the performance of the economy, and so on.

University research productivity

An important output of the university sector is research, for which a basic measure is simply the count of research outputs (books, journal articles, conference papers, etc). To derive a quality-adjusted measure, Gemmell, Nolan and Scobie (2017a) weighted the number of publications by the average number of citations, on the grounds that more extensively cited works were likely to be of higher 'quality'. This is one of a number of possible approaches to weighting research output (see Gemmell, Nolan and Scobie, 2017a, p.19 for a fuller discussion). The citation data was drawn from the Web of Science and SCOPUS.

In relation to research inputs, the authors estimated the number of university research staff FTEs. Further, as there was no simple indicator of changes in quality of research staff, a quality adjustment of the labour input was based on the results of three Performance-

Based Research Fund (PBRF) reviews (2003, 2006 and 2012). Key results are presented in Table 3. Labour productivity is calculated as the quality-adjusted research output over the quality-adjusted labour input, and MFP is based on the quality-adjusted research output over university expenditure on research. Since expenditure specifically on research is not available across universities, this has been estimated on a pro rata basis from universities' teaching- and research-related income. Estimates for research productivity and for teaching productivity were combined using cost weights. These weights reflected the cost shares of these outputs based on the share of total university expenditure accounted for by each activity.

A number of significant findings emerge from the results in Table 3. First, the rates of research productivity growth are generally substantially above national productivity growth rates in the market sector of the economy. This applies to both the labour and multifactor productivity indices. Second, there is an acceleration in both sets of growth rates after 2006. These research productivity results are therefore consistent with the hypothesis that added incentives for research created by the PBRF scheme resulted in an increase in both the quantity and quality of research outputs and a concomitant rise in research productivity. Similar findings were reported by Smart (2009, 2009a, 2013), Margaritis and Smart (2011), Smart and Engler (2013) and Buckle and Creedy (2018).

Conclusions

This article has examined how quality-adjusted productivity indices for the education sector may be constructed, and proposed a number of methods for making quality adjustments to basic measures of the growth rates of labour and multifactor productivity. While we recognise that none of these fully captures relevant quality dimensions for educational inputs or outputs, we would argue that they provide additional useful information beyond the 'basic' productivity measures more commonly used.

It should be stressed that the results in this article identify *changes* in productivity; they do not address the issue of the absolute *levels* of educational productivity, since all measures have been based on an index set at 100 in 2000. It is conceivable that productivity growth could appear favourable when compared to other sectors, while at the same time levels of productivity remain below par. In addition, our results relate to only one dimension of the overall performance of the education sector. Performance has many dimensions, including contributions to the wider society, with productivity representing but one element – albeit an essential and often-neglected one.

The estimates here reinforce the finding of Statistics New Zealand (2017) and the OECD (Dutu and Sicari, 2016) that there has been a fall in school productivity in New Zealand since 2002. Interestingly, there was only one exception to this trend: productivity improved when the proportion of students leaving school with the equivalent of NCEA level 2 or higher was accounted for. The difference between this series and others points to the need to better understand what measures of attainment reflect the performance of New Zealand schools.

Further, when looking at tertiary sector productivity, a striking result is that most quality adjustments lead to estimates of substantially faster productivity growth in New Zealand tertiary education than the simple unadjusted measures reveal. These results are consistent with a marked improvement in the productivity of research within universities following the introduction of the PBRF (Buckle and Creedy, 2018) and an expansion in student numbers among some providers over the early part of this century.

More generally, the results in this article highlight both the importance and the difficulty of quality adjusting state sector productivity data. Results can be sensitive to the methodology and approaches employed and be influenced by factors largely outside managers' control, such as policy decisions to lower class sizes or increase teachers' pay. But these are not reasons for giving up on measuring the productivity of the New Zealand education sector. Indeed, as this article also shows, it is possible to develop reasonable measures

of dimensions like quality with publicly available sector-level data. With more detailed data, better measures could be developed. The key is to ensure that any measures developed are treated as one (albeit essential) element of a broader framework for the assessment of the sector

based on overseas evidence, conclude that up to 0.5% might be attributable to grade inflation..

Acknowledgements

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- 1 For a discussion of issues regarding measuring health sector productivity, see a companion article by Patrick Nolan in this issue of *Policy Quarterly*.
- 2 For a discussion of measurement challenges in the measured sector, see Pells (2018) in this issue of *Policy Quarterly*.
- 3 It is possible that some of the growth in productivity may have arisen from so-called grade inflation over time. Gemmell, Nolan and Scobie (2017a) explore this issue and,

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Productivity Measurement in the Digital Age

Abstract

Mismeasurement of productivity is one possible explanation for the global productivity slowdown in recent decades. This article discusses the challenges of measuring productivity in the digital age. The article covers some background about the productivity slowdown and about productivity measurement, the pressure that the growth in the digital economy is putting on productivity measurement, some estimates of mismeasurement from other countries, and the implications for New Zealand. The main conclusion is that, despite measurement issues, the productivity slowdown in New Zealand and elsewhere cannot simply be written off as measurement error. A further conclusion is that the digital economy has many benefits that fall outside conventional productivity measurement.

Keywords productivity slowdown, productivity mismeasurement, digital economy, digital technologies

Robert Solow once famously quipped that ‘you can see the computer age everywhere but in the productivity statistics’ (Solow, 1987). This comment seems as relevant – if not more so – today as when it was made 30 years ago. We experience the value from new digital technologies every day at work and in our leisure. Yet, at the same time, recent global productivity growth has been sluggish.

Productivity growth has been slowing worldwide

Since the mid-2000s, productivity growth has been declining in many countries. This decline has been substantial, long-lasting and across the board (van Ark, 2016). Globally, labour productivity growth (measured as output per worker) has only moderately slowed from 2.6% per year, on average, in the 1996–2006 period to 2.4% in the 2007–14 period (ibid.). The slowdown in global multifactor productivity growth has been much more dramatic, declining from 1.3% per year in the 1996-2006 period to only 0.3% in the 2007-14 period. New Zealand has seen this productivity slowdown too, but the slowdown here predated that in many other countries and was less severe.

A number of explanations have been given for the global productivity slowdown, many of which relate to technology. Some argue that today’s technological innovations may not be as transformational as those in the past (Gordon, 2016, cited in Manyika et al., 2017). Conversely, others argue that the gains from technology are yet to

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emerge. For example, the new digital economy may be in the ‘installation phase’ rather than the ‘deployment phase’ (van Ark, 2016), causing a delay between recognition of a technology’s potential and its measurable effects (Brynjolfsson, Rock and Syverson, 2017).

Others argue that the diffusion of technology across firms has weakened. Skill mismatches, competition failures, investment constraints and other factors may have slowed the diffusion machine (OECD, 2015). Another explanation is that the 1995–2004 period was an anomaly. With the internet, and the reorganisation of distribution sectors, etc., many things came together at once. This may have been a one-time upward shift in the level of productivity rather than a permanent increase in its growth rate (Byrne, Fernald and Reinsdorf, 2016).

This article focuses on mismeasurement in the digital economy¹ as a possible explanation for the slowdown (see, for example, Adler et al., 2017). If productivity measures are failing to adequately capture new and improved digital products, ‘true’ productivity growth may be higher than measured productivity growth.

Why we care about productivity

Productivity is a measure of the efficiency with which inputs (labour, capital and raw materials) are converted into outputs (goods and services) (Gordon, Zhao and Gretton, 2015). The reason we care about productivity is that improving productivity means that we are making more of New Zealand’s limited resources, which provides us with more choices. It means, for example, that there are more goods to consume for the same amount of inputs; people can have more leisure time while producing the same amount of goods; and fewer natural resources are required to produce the same amount of output (Fox, 2007).

Over the long term, increasing productivity is the only way to sustainably increase incomes (Sharpe, 2002). This is because the other main source of economic growth—growth in inputs—is unsustainable, as inputs will become increasingly constrained. For example, as the New Zealand population ages, the number of hours worked by New Zealanders (a

measure of labour input) will be restricted. Productivity growth, on the other hand, is not constrained by the size of the population or other factors. Productivity growth is sustainable through technological advances. This is why Paul Krugman (1994) famously said: ‘Productivity isn’t everything, but in the long run it is almost everything.’

Productivity is not the only thing that matters. Productivity growth on its own may do little for inequality or poverty, for example (Sharpe, 2002). Productivity measures don’t capture the potential or contribution of those not in paid employment, and so do not indicate the efficient allocation or uses of labour from a societal perspective. But lifting productivity is highly relevant for New Zealand. While New Zealand has

about production. Productivity therefore generally only covers things that are produced and that consumers pay for. Second, productivity is a volume measure. The volume of output has two components: quantity – the number of units (of a good or service); and quality – the description of the characteristics of each unit (Office for National Statistics, 2007). For example, a better (higher-quality) pair of shoes can be thought of as providing more ‘running services’. The same concept applies to inputs. For example, higher-skilled (higher-quality) labour represents a higher volume of labour. A key difference, though, is that a higher volume of labour reduces productivity, as labour is an input, whereas a higher volume of output increases productivity.

Measuring productivity involves

Productivity measures don’t capture the potential or contribution of those not in paid employment, and so do not indicate the efficient allocation or uses of labour from a societal perspective.

historically been very successful at getting people into work, it has had a consistently poor productivity performance (Conway and Meehan, 2013). Reasons for this poor productivity performance include New Zealand’s small and insular domestic markets, weak international connections, capital shallowness, and weak investment in knowledge-based capital (Conway, 2016). This poor performance contributes to comparatively low incomes in New Zealand.

Productivity concepts and measurement

Productivity is commonly defined as: ‘a ratio of a volume measure of output to a volume measure of input’ (OECD, 2001). Productivity rises when the volume of output increases more rapidly than the volume of input, and falls when the volume of input increases more rapidly than the associated output.

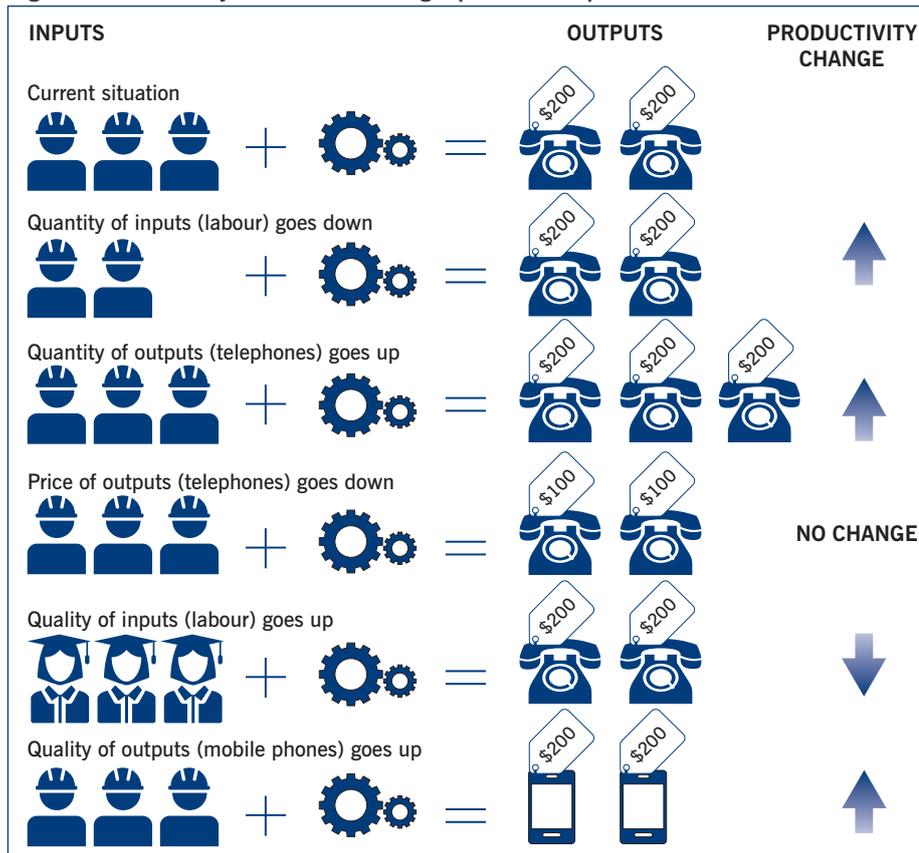
There are two important points to note from this definition. First, productivity is

dividing some measure of the volume of output by some measure of the volume of input. One commonly used measure of labour productivity is GDP per hour worked.

Prices play a key role in productivity measurement. When markets are functioning efficiently, the ratio of one market price to another reflects the relative appreciation of the two products by those who purchase them (Stiglitz, Sen and Fitoussi, 2009). In other words, dimensions of quality prized by consumers tend to be reflected in prices. A key issue from a productivity measurement perspective is determining whether a price rise reflects general inflation or improvements in quality. Quality improvements represent an increase in volume, while general inflation does not.

The relationship between prices, quality and volumes is therefore an ongoing issue for measurement. This is challenging in the services sector, as services are often customised and so it is difficult to

Figure 1: Productivity is about converting inputs into outputs



Source: Author

distinguish between quality and price changes (Bean, 2016). It is also challenging in relation to digital products and services, as quality and price changes can move in different directions for these products and services. For example, the power and quality of computers has increased tremendously in recent decades, while the price has fallen dramatically.

Figure 1 provides a stylised example of how changes in the quantity, quality and price of outputs and inputs affect productivity. For example, in the second row, a lower quantity of labour is used compared with the status quo (first row), so productivity has increased.

Why we need to understand the digital economy

While the digital economy presents challenges for productivity measurement, it provides opportunities to lift New Zealand’s productivity performance – through, for example, the adoption of new digital technologies. Given New Zealand’s distance from major markets, there are benefits from a shift to a more ‘weightless’ economy based on trading knowledge-intensive products (Conway, 2017).

Making the most of new digital technologies implies some changes in economic structure, which requires smooth resource reallocation across industries (ibid.). This structural change has a number of policy implications, including for the labour market, as people need to be equipped with new skills in order to adapt to change.

However, Conway (2016) showed that technology diffusion and resource allocation do not work as well as they could in New Zealand. Reasons include that some New Zealand firms – particularly ones operating in small and insular regional markets – do not face much competitive pressure. These firms can lack incentives to invest in new technologies, and can linger as small, unproductive firms, rather than either grow or exit the economy. These firms can get left behind in the digital age.

Growth in the digital economy is putting pressure on measurement

A number of studies have tried to estimate the effects of the digital economy on productivity mismeasurement. As discussed later, current estimates suggest that mismeasurement of productivity

arising from the digital economy is likely to have played a fairly minor role in explaining the global productivity slowdown.

Many of the measurement issues relating to the digital economy are not new. For example, issues such as consumers receiving free media services paid for via advertising (e.g., television channels) have been around for a long time (Ahmad and Schreyer, 2016). But the growth in the digital economy is increasing the potential scale of mismeasurement. Therefore, what is new is the scale of the problem. In addition, there is significant uncertainty about the scale of the problem. For example, the composition of IT investment has shifted toward components – such as software – for which measurement is more uncertain (Byrne, Fernald and Reinsdorf, 2016).

An important point to note is that some of the measurement concerns conceptually fall outside GDP. Many aspects of the digital economy, such as consumers’ involvement in the production process, have not conventionally been included in GDP (and thus productivity measures). GDP is only concerned with market production, so generally only products and services that consumers pay for are currently included. GDP does not include the consumer surplus (or unpaid-for benefits) from digital products.

Table 1 provides more details on some of these issues. Note that digital products such as computers and other IT products appear on both the output and the input side of the productivity ratio. This means that, for multifactor productivity, mismeasurement of IT products has offsetting effects. While much of the table relates to digital products as outputs, many of the same issues apply to digital products as inputs.

Mismeasurement is unlikely to explain the productivity slowdown

A number of studies have estimated the role of mismeasurement in the global productivity slowdown. Many of these studies have focused on the United States (see, for example, Syverson, 2016; Byrne, Fernald and Reinsdorf, 2016), but some have considered productivity mismeasurement in other OECD countries (see, for example, Ahmad and Schreyer, 2016; Ahmad, Ribarsky and Reinsdorf,

Table 1: Challenges for productivity measurement arising from the digital economy

Issue	Examples	Estimates of scale of effect	Potential remedies
<p>Prices and quality – new and improved digital technologies may not be fully identified, thus under-stating output volume growth in GDP (so productivity may be <i>under-stated</i>).</p> <p>Assets such as ICT may be under-stated in the capital stock (an input), so MFP may be <i>over-stated</i></p>	<ul style="list-style-type: none"> · ICT equipment such as computers · Software · Communications services · Many other digital products 	<ul style="list-style-type: none"> · Estimates range from around 0.2 to 0.7 percentage points pa of GDP growth across countries · Substantial variation in countries' treatment of ICT price movements · Effect on MFP somewhat offset by ICT being an input as well as an output 	<ul style="list-style-type: none"> · Improve price and quality adjustment methods
<p>Free and subsidised consumer goods – free digital products are not included in GDP (so productivity may be <i>under-stated</i>), although consumers do pay for them to some extent via advertising and firms' use of consumer data</p>	<ul style="list-style-type: none"> · Free apps for smartphones · Facebook · Google · Skype 	<ul style="list-style-type: none"> · Imputing values for free media products has a minimal impact on GDP levels (at most 0.1% pa of GDP), with negligible impacts on GDP growth rates 	<ul style="list-style-type: none"> · Improve price and quality adjustment methods · Supplement with other measures
<p>Free assets produced by households – free 'public goods' which use volunteer labour are not captured in GDP (so productivity may be <i>under-stated</i>)</p>	<ul style="list-style-type: none"> · Wikipedia · Linux 	<ul style="list-style-type: none"> · Wikipedia – up to 0.1% pa of global GDP if a fee were charged 	<ul style="list-style-type: none"> · Exclude from GDP, as conventionally volunteers' services are valued at zero · Supplement with other measures
<p>Peer-to-peer services – consumer-to-consumer transactions facilitated by digital technologies are not fully captured in GDP (so productivity may be <i>under-stated</i>).</p> <p>Assets such as vehicles are not fully captured in the capital stock (so MFP may be <i>over-stated</i>)</p>	<ul style="list-style-type: none"> · UberPop · AirBnB · E-Bay 	<ul style="list-style-type: none"> · Uber – effect of including vehicles in capital stock is very small 	<ul style="list-style-type: none"> · Use tax administrative data to better capture output and inputs
<p>Consumers as producers – households' involvement in the production process is not captured in GDP (so productivity may be <i>under-stated</i>)</p>	<ul style="list-style-type: none"> · On-line travel booking · Self-check at airports · Self-service in supermarkets 	<ul style="list-style-type: none"> · Not known but growing 	<ul style="list-style-type: none"> · Exclude from GDP, as conventionally services provided by households for their own consumption are excluded
<p>Cross-border trade – some production is recorded in the (low-tax) country in which it is registered, rather than the country of economic ownership (so productivity may be <i>under-stated</i>); this also affects the capital stock (so MFP may be <i>over-stated</i>)</p>	<ul style="list-style-type: none"> · IP products e.g. R&D and computer software and databases · Knowledge assets e.g. human and organisational capital 	<ul style="list-style-type: none"> · Knowledge assets not included in GDP are typically larger than those that are · Despite this, it is estimated that incorporating intangibles makes little difference 	<ul style="list-style-type: none"> · Reallocate income flows to the country of the parent company (so use Gross National Income rather than GDP) · Carefully interpret cross-country comparisons

Source: drawn from Ahmad and Schreyer, 2016; Ahmad, Ribarsky and Reinsdorf, 2017

2017). These studies have used different methodologies and data, but their findings are reasonably consistent (Brynjolfsson, Rock and Syverson, 2017). The consensus appears to be that, while mismeasurement can explain some of the slowdown, it probably accounts for only a relatively small proportion (Manyika et al., 2017). This implies that the slowdown is a real effect rather than illusory.

Measuring a measurement problem is challenging. Estimates of productivity mismeasurement vary markedly, and there

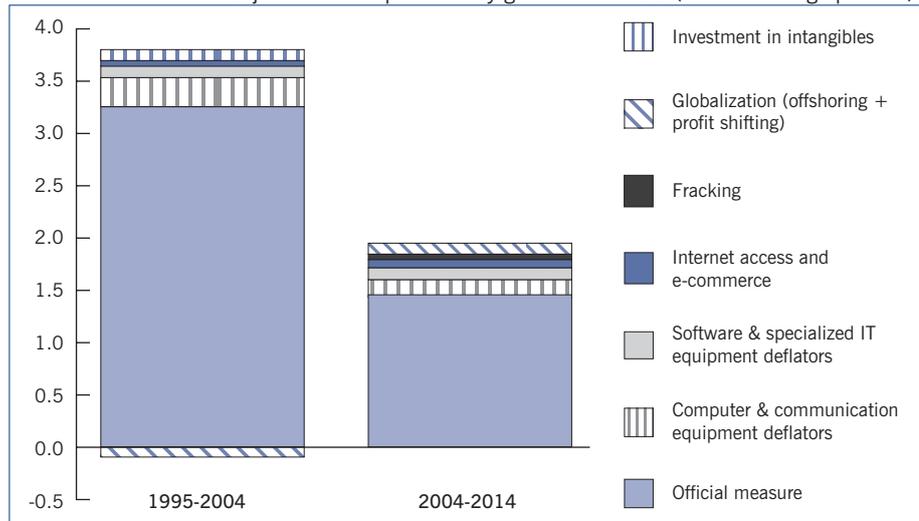
is considerable uncertainty around the estimates. For example, one US study (Syverson, 2016) reviewed estimates of the unpaid-for gains to consumers from internet access. The author calculated that the lowest of these estimates accounts for a tiny fraction of the productivity slowdown, while the largest accounts for up to one-third of the slowdown.

One highly cited study (Byrne, Fernald and Reinsdorf, 2016) found little evidence that the productivity slowdown in the US arises from growing mismeasurement of

the gains from innovation in IT-related goods and services. The authors gave three main reasons:

- Mismeasurement of IT hardware was already significant before the slowdown. Because the production of these products has fallen, the effect on productivity was larger in the 1995–2004 period than since. Also, IT mismeasurement affects GDP and labour productivity more than multifactor productivity (as IT appears as both an input and an output in

Figure 2: Accounting for mismeasurement doesn't add much
 Official and adjusted labour productivity growth in the US (annual average percent)



Sources: Adler et al., 2017, using data drawn from Byrne, Fernald and Reinsdorf, 2016

multifactor productivity, which has offsetting effects).

- Many of the consumer benefits from smartphones, Google searches and Facebook are, conceptually, non-market, and so fall outside the market production measured by GDP.
- Other measurement issues that the authors did quantify are quantitatively small relative to the slowdown.

Figure 2 shows that the effect of adjusting US labour productivity growth for some of these factors is reasonably modest. The largest contributing factor to the adjustment is computer and communication equipment price deflators, reflecting the challenges of price and quality adjustments discussed above.

Overall, these authors' estimates would add only about 0.3 percentage points to GDP growth per year for the US economy. This is small relative to the 1.8 percentage points slowdown in labour productivity growth per year over 2004–14 compared to the preceding decade.

It is hard to know how New Zealand compares

It is difficult to be sure how New Zealand compares to other countries in terms of potential productivity mismeasurement, as New Zealand has not featured in recent studies that have directly compared countries. Some indirect factors tend to suggest New Zealand could compare favourably, and other indirect factors do not.

In relation to general measurement issues, Statistics New Zealand follows best

practice guidelines for productivity measurement, such as those from the OECD (see OECD, 2001), and continually refines its productivity measures. New Zealand is reasonably well placed in relation to some measurement concerns. For example, New Zealand has relatively good data on ride-sharing companies due to the use of tax administrative data in productivity measurement, and to the ride-sharing market being subject to regulation.

Some insights may be gained from considering the relative importance of the digital economy to New Zealand compared with other countries. If the digital economy features comparatively strongly in New Zealand, then it seems plausible that the associated measurement challenges are prominent too.

Assessing the importance of the digital economy is not an easy task, as there are numerous definitional issues (see OECD, 2017a). However, the OECD's most recent digital economy outlook report (OECD, 2017b) suggests that New Zealand is a comparatively digital nation. New Zealand appeared in the top half of OECD rankings for many of the measures included in the report, such as the proportion of tertiary graduates in ICT, the proportion of employees in the ICT sector, and the penetration of fixed broadband in the population. In particular, New Zealand devoted the largest share of telecommunications revenue to telecommunication investment, reflecting the roll-out of broadband. The significance of the digital economy to New Zealand

tentatively suggests that the associated productivity measurement challenges may be comparatively significant too.

Other insights may be gained from considering the extent of mismeasurement in countries similar to New Zealand. One such country is Australia, which arguably has some characteristics similar to New Zealand, such as distance from major markets. Australia is included in some comparative studies about distinguishing between price and quality changes – a factor that is assessed as quantitatively the largest contributor to productivity mismeasurement. For example, Ahmad, Ribarsky and Reinsdorf (2017) estimated productivity mismeasurement due to inadequate price and quality adjustment of digital products in a number of OECD countries, including Australia. The implied adjustments to GDP growth were lower in Australia (0.02 percentage points per year) compared with most of the countries included in the analysis (around 0.2 percentage points per year), which appears to largely reflect patterns of ICT output and investment in the Australian economy. Assuming that ICT price adjustment methods, and the composition of ICT, in Australia and New Zealand are similar, this tentatively implies that the scale of this source of potential mismeasurement may be small in New Zealand compared with other OECD countries.

Conclusions and policy implications

Robert Solow's comment that the computer age can be seen everywhere but in the productivity statistics seems as relevant today as when the comment was made 30 years ago. Growth in the digital economy creates opportunities and challenges for productivity and its measurement.

The adoption of new digital technologies provides an opportunity for New Zealand to lift our productivity performance. From a policy perspective, the key issue is how best to capitalise on this opportunity, and how to ensure a smooth transition path.

The digital economy has many benefits to New Zealanders that fall outside conventional productivity measurement. The key issue here is how best to measure these benefits. Statistics New Zealand and the Ministry of Business, Innovation and

Employment are currently developing a Digital Nation Domain Plan, which should provide an opportunity to do this. This domain plan identifies enduring questions about New Zealand's digital transformation, and any gaps in the data that need to be filled to address these questions. The enduring questions include some about the impact of New Zealanders' engagement in digital technologies (Statistics New Zealand, 2018), and so potentially could cover the unpaid-for benefits from digital products.

The digital economy creates challenges for productivity measurement. Mismeasurement is estimated to have played a fairly minor role in the global productivity slowdown. However, mismeasurement is likely to be growing. This means that productivity growth rates need to be interpreted with care, and that our ability to analyse productivity trends over time is hampered. Stable mismeasurement of productivity levels would be less of a worry.

It is important to continually improve the measurement of productivity. Improving methods for making adjustments for price and quality changes to outputs (and inputs) appears to be particularly important. Developments that Statistics New Zealand has planned or underway include the greater use of transaction or scanner data, administrative data and web-scraped data in measuring price and quality changes (Bentley and Krsinich, 2017). These types of data are valuable for their richness and timeliness, and – compared with surveys – reduced respondent burden.

The digital economy is therefore itself part of the measurement solution. The use of administrative and other 'big' data provides opportunities to capture new types of transactions (ibid.). One example is to use big data to transform hedonic or regression-based methods (ibid.). Hedonic price adjustment essentially 'unbundles' the

contribution to prices of different characteristics of a product.

Overall, productivity measures play a unique role in our understanding of the economy: they tell us about how efficiently New Zealand's resources are being used. Despite the challenges the digital economy poses for measurement, for the most part productivity measures still appear to capture 'true' productivity, and to broadly reflect the underlying concepts they are targeting.

¹ 'Digital economy' means an economy that is based on digital computing technologies.

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Matt Boyd and Nick Wilson¹

Existential Risks

New Zealand needs a method to agree on a value framework and how to

quantify future lives at risk

Abstract

Human civilisation faces a range of existential risks, including nuclear war, runaway climate change and superintelligent artificial intelligence run amok. As we show here with calculations for the New Zealand setting, large numbers of currently living and, especially, future people are potentially threatened by existential risks. A just process for resource allocation demands that we consider future generations but also account for solidarity with the present. Here we consider the various ethical and policy issues involved and make a case for further engagement with the New Zealand public to determine societal values towards future lives and their protection.

Keywords Existential risk, future lives, public engagement, risk mitigation, value framework

Most policy work focuses on present concerns to existing people. Political leaders and public policy workers typically consider benefits over a limited time horizon – such as just the time before the next election. But some social projects involve benefits many decades into the future: public infrastructure (roads, bridges, hospitals, civic buildings), establishing national parks and marine reserves, and establishing treaties such as the Montreal Protocol (on ozone depletion) or the Paris Agreement (climate change).

Sometimes we exhibit concern for the welfare of people beyond our lifetimes. For example, we consider how to store nuclear waste safely over thousands of years. People sometimes consider injustices done to past generations as well, through present-day settlement of claims relating to past treaties, such as the 1840 Treaty of Waitangi in New Zealand.

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Existential risks

Larger-scale existential risks are events or processes which could cause the extinction of the human species, or end organised human civilisation. These include widespread nuclear war, runaway climate change, biodiversity loss, ecological crises, synthetic bioweapons, superintelligent artificial intelligence run amok, asteroid impacts, and interstellar events such as gamma ray bursts (Bostrom and Cirkovic, 2008; Rockstrom et al., 2009).

There is growing literature on the potential value of preventing existential risks (Bostrom, 2013; Matheny, 2007; Tonn and Stiefel, 2014), along with issues of intergenerational justice (Adler, 2009; Arrhenius, 2000; Arrhenius and Rabinowicz, 2010; Broome, 2005; Gosseries and Meyer, 2009; Meyer, 2018; Narveson, 1967; Tarsney, 2017; Weitzman, 1998). In 2014 the World Economic Forum global risks report made no mention of many human existential risks, yet the 2017 report specifically addresses failures in cooperation on climate change and the threat of weaponised artificial intelligence, and the fact that governing institutions remain reactive and slow moving (World Economic Forum, 2014, 2017).

New Zealand publications discuss some issues of long-term or existential risk management (Boston, 2017; Boyd and Wilson, 2017; Council of the New Zealand Ecological Society, 1985), but there is as yet no coordinated response to existential threats. This is despite the *Bulletin of the Atomic Scientists* announcing that the symbolic Doomsday Clock, representing the threat of human destruction, has recently advanced to two minutes before midnight (Bulletin of the Atomic Scientists, 2018).

In this article we outline several philosophical approaches one might take when valuing future people. We then argue that when there are several coherent positions available to policymakers, we ought to have public engagement and community debate to ensure sustainable policy responses and long-term investments consistent with public views. We explain how this might be done using emerging empirical philosophical strategies. The reason for all this is that if we do value future people, and we are capable of

mitigating existential risks, then perhaps we ought to do that.

We then present our own utility calculations for the number of future New Zealand life-years at risk – including when discounting is used – although we note that utility calculations may not be the only important considerations, pending the outcome of the public engagement we describe.

New Zealand needs an agreed framework for how we value future lives

Valuing future lives

An important question shaping how we act today is, ‘what do we owe to future people?’ The answer can range from ‘everything’ (even to the point of overdemandingness on our own lives and resources) through to

Temporal partiality

If we think about the present, we may find that we treat different humans differently, here and now, for supposedly legitimate reasons. For example, a person may be praised for spending \$100,000 on an operation to save her sister, even though she could have spent \$100 to save each of 1,000 starving children. It can be argued that obligations to people diminish with distance and degree of personal relatedness. Close human relationships matter in all societies and this person may not be condemned for saving her sister in this way, even though there was a moral opportunity cost. Heyd articulates a similar idea in terms of ‘solidarity’ (Heyd, 2008). Such considerations of partiality arise frequently in policy discussions: for

We may value the lives of future generations, and perhaps have obligations towards their well-being, or we can deny that their lives have value.

‘nothing.’ We may value the lives of future generations, and perhaps have obligations towards their well-being, or we can deny that their lives have value. We now describe some different ways in which a society might choose to value human life in the future. We emphasise that it is unclear which view New Zealanders take on average as a population and how diverse these views are.

Some ‘person-affecting’ views of morality posit that acts can only be wrong if they affect someone, but future people don’t presently exist (Parfit, 1984). That said, we have little difficulty grasping the wrongness of imposing risks on future people. A ‘risky policy’ which results in predictable deaths in 300 years still seems bad, irrespective of who is actually killed (ibid.). It is the predictability of the deaths that is important rather than the actual people who might be killed. These future people would still regret our present decisions. However, it could be the case that we should give lesser weighting to the value of future lives through some rate of discounting or temporal partiality.

example, around aiding refugees versus investing in local people.

It may also be the case that our obligations to distant people diminish similarly with time. This adds weight to the case for some level of discounting of the value of future lives. We may not be condemned if we fail to prevent an extinction event far in the future.

Some strict utilitarians might challenge the woman who committed \$100,000 to save her sister, because relatedness and distance should not matter: all human lives should be considered equally valuable and if we can save 1,000 rather than one, we should (Singer, 1972). Such a utilitarian might claim that resources should be used for those in the world in greatest need, right up to the point of marginal utility to the individual with resources available. This is a very demanding conception of morality (Sonderholm, 2013); however, most developed societies demonstrate some level of obligation to distant people through various assistance programmes. But it is not obvious to what degree we should value people distant in time.

A further problem for the temporal partiality position is that if we are partial towards the present, then it looks like the value of righting past wrongs must also diminish. If temporal partiality in favour of the present is permitted, then, given a symmetrical relationship between past and future, we might be justified in discounting reparations for wrongs of past generations such as slavery, conquest or breach of treaties.

Actual versus statistical lives

Sometimes we discriminate in favour of known individuals in present danger rather than statistical lives at risk (Weale, 1979). For example, intensive care units

also justify some discounting of the value of future lives.

However, human life is a qualitatively different kind of good from other resources. This is in part because human lives are not obviously tied to estimates of inflation/depreciation and future value as material goods are. Therefore, there seem to be no good reasons to prefer one discount rate over another. Indeed, most authors writing on intergenerational justice seem opposed to discounting future lives (Matheny, 2007; Gooseries and Meyer, 2009). The consideration of whether to apply a discount rate, and what the rate should be, is important in this context, because the choice among discount rates will have

present person's future life-years irrespective of social circumstances (for example, through healthcare provision), then this ought to apply to future people as well. For example, future people might have a right to a life of natural length. Furthermore, according to some moral frameworks, if it is within our power we might be obliged to ensure future people enjoy levels of well-being at least equivalent to those enjoyed by present people.

In general, to the extent that ethics is impartial, and thus the well-being of one person does not automatically trump the well-being of someone else, then distance in relatedness, location, and perhaps time will lose relevance. Additionally, most ethicists seem to agree that impartiality must be at least some part of ethical thinking. This is because a totally partial ethic is moral egoism (concern only for oneself), and this is not what most people mean by an ethical view. Therefore, we must to some degree consider the well-being of those other than ourselves. It seems *prima facie* reasonable to posit that this consideration for others might need to extend beyond our own society in order to have fully informed ethical deliberation. We must at least consider lives distant from ourselves when considering the rightness of our own actions, and this perhaps ought to extend to future lives or societies as well.

In general, to the extent that ethics is impartial, and thus the well-being of one person does not automatically trump the well-being of someone else, then distance in relatedness, location, and perhaps time will lose relevance.

expend heroic amounts of resources on individuals. This is inconsistent with claims that it is generally wrong for a funding organisation to fund individual 'rescue' over mass prevention (Hope, 2001).

Current prevention activities, such as providing clean water and sewerage systems, immunising a population to achieve herd immunity, and taxing alcohol and tobacco, are interventions on a known population, with known statistical pay-offs. Robust research has established the risks and probabilities. However, for existential risks the issue of prevention is more complex, as it may involve intervening with respect to a less well-defined population (future people) for a possible pay-off (the existential threat may or may not occur).

Furthermore, we are more uncertain of the needs of future people. They may be very much more wealthy than we are now, with technology we can't imagine. This uncertainty around the commitment of resources to avoid an existential risk may

significant implications on calculated value when we are looking far to the future.

Fairness about existence

Equity or fairness considerations are often used in conjunction with utility when determining policy. Rawlsian considerations of justice apply a fairness principle and offer us a social contract under a 'veil of ignorance' to illustrate the uncertainty, prior to our existence, of our circumstances (male or female, privileged or not privileged, and so on). According to this argument, we should construct society so that circumstances are fair regardless of who we are (Rawls, 1971). Of course, ignorance applies to *when* we exist as well.

Under such terms, creating a safe environment for everyone presently and maintaining this level of welfare for future people would constitute fair policy. Such considerations have been used to argue for moderation of present resource use and environmental protection (Norton, 1989). If fairness demands that we protect a

Public reason

Bostrom assumes that it does not matter when a life exists, and therefore we ought to spend vast resources protecting the many billions of future lives (Bostrom, 2013). However, it is exactly these kinds of assumptions that we need to test at the level of the New Zealand population through public engagement. We suggest that the leap from 'future lives matter' to 'future lives matter equally with present lives' needs close consideration. Indeed, Bostrom in fact agrees with this point when he argues:

In a similar vein, an ethical view emphasising that public policy should be determined through informed democratic deliberation by all stakeholders would favour existential-risk mitigation if we suppose, as is plausible,

that a majority of the world's population would come to favour such policies upon reasonable deliberation (even if hypothetical future people are not included as stakeholders). (ibid., p.23)

It is exactly the conclusions of 'reasonable [public] deliberation' that we need. Consideration of these issues must precede, and will shape the use of, any discount rate on the value of future lives. Public engagement will help inform policymakers as to which risk mitigation rule is appropriate, especially considering that substantial diplomatic effort and financial resources might be needed to address certain existential risks.

The human project

Finally, there is an important distinction between considering future 'people' or future 'life-years' and considering future 'generations'. The latter are critical components of the 'human project', such as the continuity of cultural, scientific and technological endeavours across generations. Humans particularly value these projects (Scheffler, 2013), and the long-term persistence of such projects depends on subsequent generations actually existing.

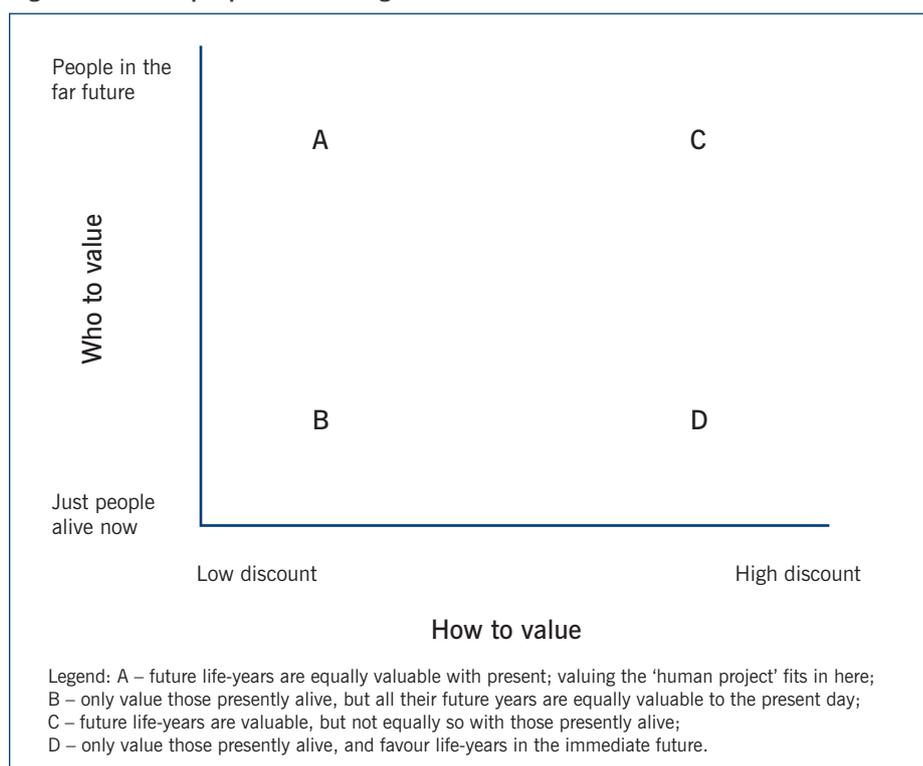
In particular, Scheffler argues that we need future humans in order that many things can matter to us now. In his view the imminent end of our species would produce widespread 'apathy, anomie, and despair ... and ... a pervasive loss of conviction about the value or point of many activities' (ibid., p.40). If this is accurate, then the existence of people after we die is an important condition of things mattering to us now. While not denying the general importance of self-interested motivation, Scheffler concludes that: 'there is a very specific sense in which our own survival is less important to us than the survival of the human race' (p.73).

We add that, importantly, when considering actual threats of human extinction, by protecting known lives in present danger we are also protecting future lives in potential danger.

A concept space of value

In summary, there is a range of positions New Zealand society could take with

Figure 1: A concept space for valuing future lives



respect to future lives. These are illustrated in Figure 1. Once we have evaluated the worth of the 'human project', our uncertainty about the future, who is deserving of consideration, and possible discounting of future lives, we will know whether our position as a society is nearer to A, B, C or D.

We can establish which of these frameworks to apply through public engagement

As argued above, there is no doubt that humanity faces a range of existential threats. However, it is unclear what action against these threats we should take, given that we can approach the future of humanity from these different philosophical perspectives. Various perspectives may be defensible, and which approach best coheres with the intuitions of New Zealand people is unknown, yet such information should be a critical input into decision making in a democratic society with limited resources (Bromell, 2012; Gluckman, 2011). The process by which decisions about the investment of public resources are made must be a just process (Daniels and Sabin, 1997), and public policy requires us to engage with diverse others in public reasoning (Freiberg and Carson, 2010; Nussbaum, 2000).

In undertaking such deliberation, then, policymaking requires both evidence and morality. Policymakers informed with the best evidence cannot unilaterally decree morality. There is no avoiding the 'normative jungle' in policymaking (Gruen, Kelly and Gorecki, 2011). We need a public exchange of reasons informed by relevant evidence (Rawls, 1987). The research question, 'Which value framework encompassing future people and protection of the human project best coheres with the views of New Zealanders?' needs to be explored.

Recent innovations in philosophy import empirical methods from the social sciences, which many ethicists see as an important adjunct to philosophical enquiry (Kahane, 2013; Tanyi and Bruder, 2014). These methods access ordinary people's intuitions to supplement the investigations of ethicists and philosophers. This synergistic method can bolster philosophical reasoning and offer novel insights, such as previously unrecognised distinctions (Deery, Davis and Carey, 2014).

Some experimental philosophers have gone further than seeking intuitions about abstract or concrete situations and employ questionnaire scales and statistical techniques such as factor analysis to reveal

Figure 2: Projected cumulative number of lives lived in New Zealand for different time periods

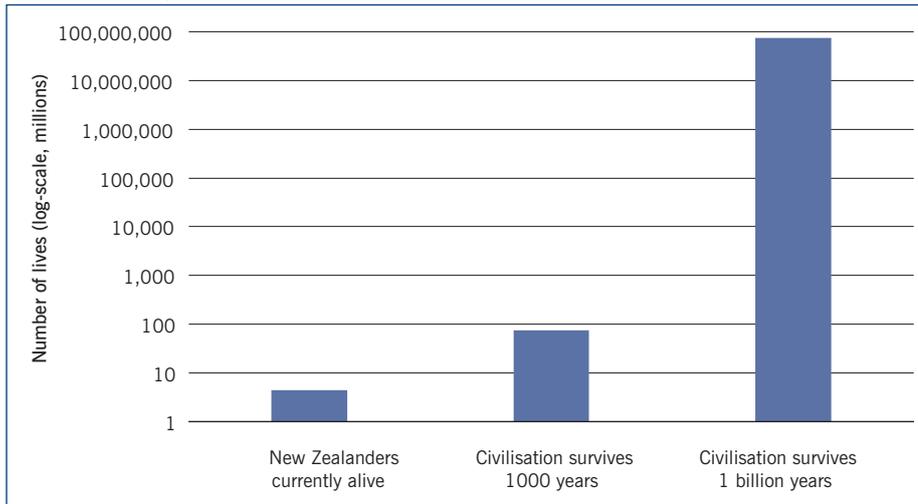
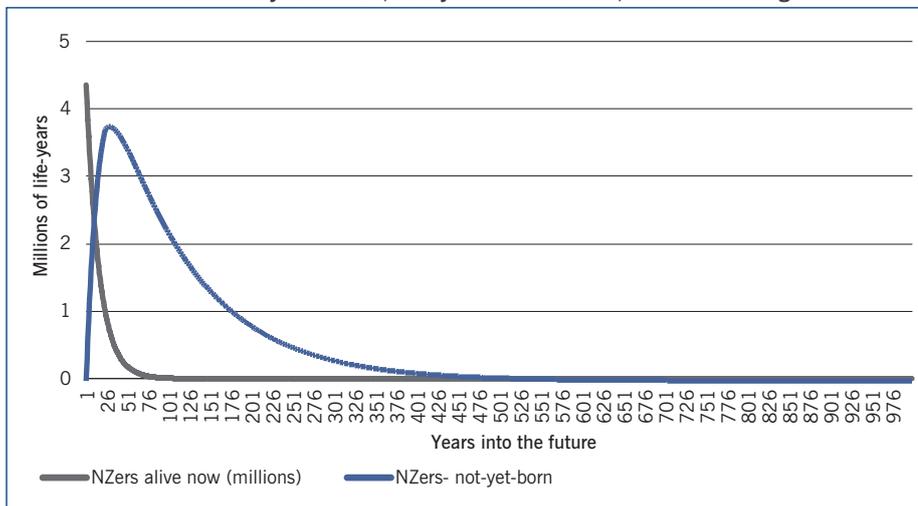


Figure 3: Annual life-years lived by New Zealanders currently alive and New Zealanders not yet born (1,000-year time horizon, 1% discounting)



the structure of survey data collected (ibid.; Nadelhoffer et al., 2014). This methodology has not yet been explored in the domain of future lives and intergenerational justice.

We suggest that New Zealand policymakers are obliged to gather reasoned public opinion, perhaps through the use of key informant interviews, citizen juries, hui, surveys or the like. The aim of public engagement is to access New Zealanders’ values and reasoning. Questions, vignettes or discussion topics should aim to access not just judgments about value, but also preferences, given the potentially large opportunity cost of acting to mitigate certain existential risks. Qualitative and quantitative methods could be used to seek reasons behind the intuitions about the value of future lives and the ‘human project’.

Utility is currently a central concern to the New Zealand government when setting policy. We see this in areas of health

resource allocation or transport safety, for example. Treasury’s cross-government CBAX modelling tool prompts for explicit input of utility (New Zealand Treasury, 2017). Although not the only measure of value, utility is likely to remain central to policy decision making. The outcome of public engagement in the domain of existential risk will determine which utility calculations policymakers must undertake when calculating the costs and benefits of investing in prevention of existential threats. (For example, should we calculate the number of life-years at risk of those presently alive, or of all future New Zealanders? And should we apply a discount rate to future life-years or not?) These calculations will determine what level of investment in preventing existential threats is justified. Furthermore, should we decide to invest in mitigation, we know that policies that require some sacrifice are

more likely to be adopted successfully following extensive engagement and dialogue with interested and affected parties.

In sum, we need to know which of the philosophical positions outlined (A to D in Figure 1, or variations of them) the New Zealand public actually hold or would support on further reflection; crucially this must include determination of Māori views. We can then supplement the value position with evidence on the probability (of existential threats) and the utility of action (number of life-years at risk). But it should be noted that perverse conclusions are possible when considering the utility value of growing future populations. To avoid such perversity it would be wise to limit considerations to thinking about a stable population continuing into the future, perhaps at New Zealand’s current level.

Example calculations for a possible rational investment in risk reduction

How many New Zealand lives are at risk?

Published utilitarian calculations have considered the value of all future lives, whether Earth-bound or dispersed across the universe (Bostrom, 2003, 2013; Jebari, 2014). Here we provide calculations for the number of New Zealand lives at risk under certain assumptions of time horizon (how far in the future lives matter) and discount rate (how much more important are lives now than in the future).

We don’t know which utilitarian position the New Zealand public would favour, let alone if utilitarianism itself would be the favoured ethical framework. However, policymakers, under the burden of necessity to act, might accommodate both uncertainty and consilience among value frameworks by applying some moderate discount rate to calculations of future lives, pending the outcome of comprehensive public engagement on what is literally an issue of our very existence.

Figure 2 shows the astronomically large cumulative totals of New Zealand lives that are possible in the future (i.e. around 75,000 billion (75x10¹²) lives for a stable six million population for the expected remaining billion (109) years of Earth being habitable). Even these numbers are potentially miniscule compared to

population growth if future New Zealanders join others to become colonists on other planets (Bostrom and Cirkovic, 2008).

Figure 3 shows a view of the next 1,000 years (where we assume a stable population of six million New Zealanders from the year 2040 onwards). Our analysis suggests massive potential numbers: i.e. a cumulative total of 70 million life-years among those already alive (14% of the total) and 515 million life-years among New Zealanders not yet born (at a discount rate of 1%). At what is probably an unreasonably high discount rate of 3%, the total life-years involved in this time period is still 186 million, of which 53 million is among those who are alive now (28% of the total).

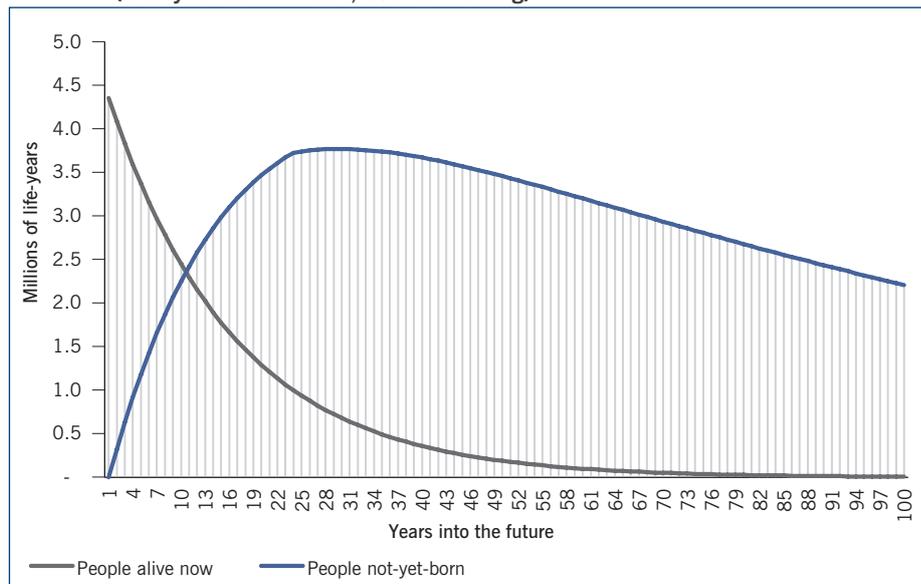
A more constrained time scale of just 100 years into the future is one in which some New Zealanders born recently may still be alive throughout and which many of their not-yet-born children will live through (Figure 4). For this period, life-years among the not-yet-born dominate in just ten years' time and comprise 81% of the cumulative 363 million life-years (discounting at 1%).

So, no matter how we calculate it, even conceding that we may care only about presently existing New Zealanders, the numbers of lives and life-years at risk from an existential threat is massive. This is important, because although the probability of an existential threat may be unknown, it is non-zero.

The probabilities of existential threats

As a simple exercise, we consider the following: (1) valuing a life-year at per capita GDP (around NZ\$45,000 (Kvizhinadze et al., 2015)); (2) the 585 million future New Zealand life-years at risk (70+515 million – see figures above – for a 1,000-year horizon, discounting at 1%); (3) a probability of 0.1% of an existential threat occurring in the next year. Given these values, it would be rational for New Zealand society to invest up to NZ\$26 billion in eliminating that risk (though of course by working cooperatively with other countries the cost could be vastly reduced). Yet the probability used in this example may be unrealistically low; some estimates put the risk over the course of the 21st century at 25% or more (Matheny, 2007). Indeed, Lord Martin Rees gives

Figure 4: Annual life-years lived by New Zealanders currently alive and not yet born (100-year time horizon, 1% discounting)



21st-century human civilisation equal odds (Rees, 2003).

Preventive measures are often thankless investments, because if the disaster fails to befall us, it is often not clear whether it was prevented or simply never eventuated. We need to seriously study these probabilities and mitigation costs (Bostrom, 2013). Investment in the analysis of these risks will allow rational prioritisation.

However, we may never be able to accurately measure the probability of many events (we need to be able to estimate probability, cost of mitigation and utility in order to rank interventions). The theory of 'black swans' (very rare disruptive events) (Taleb, 2007) is a metaphor that describes completely surprising events, with major effect, that can be inappropriately rationalised after the fact. History is full of high-profile, hard-to-predict and rare events that are beyond the realm of normal expectations. Taleb argues that we must build uber-robust or 'antifragile' systems against black swans because we cannot predict them (Taleb, 2012). This might necessitate resilience-style coping measures that are general in nature rather than attempting to prevent specific catastrophes (Jebari, 2014).

Some global catastrophic risks are more likely in the near future than others. Rees has wagered that by 2020 'bioterror or bioerror' will lead to one million casualties in a single event (Kupferschmidt, 2018). The most important countermeasure would be to strengthen our ability to

contain such an incident. Nuclear war may also have a significant near-future probability given recent developments (Bulletin of the Atomic Scientists, 2018), while the risk of other threats will probably rise over time – for example, from superintelligent artificial intelligence (Bostrom, 2014).

If we find that the public privilege the value of the future life-years of presently existing people, and discount those of future people, then we find a shifting window of value that moves through time, with a fairly short time horizon (i.e. only ten years using a discount rate of 1%: see Figure 4). It will be existential risks that have the highest probability of occurring in this window which we should probably be most concerned about (perhaps nuclear war). We would then be rational to prioritise such risks according to likelihood and cost of prevention/mitigation. Recent research has attempted to devise novel methods to communicate the level of risk by colour coding in these uncertain settings (Turchin and Denkeberger, 2018).

Once the relevant risks and mitigation strategies (and costs) are identified, we must consider the present opportunity costs of taking action. Preferences in evaluating these costs and the benefits could be grounded in the views obtained from public engagement. We would also need to consider the present co-benefits of taking action. For example, action to mitigate an existential risk from climate change might reduce the burden of near-

future flood damage and other disruptions to agriculture. Ultimately, four factors will drive decision making: the potential impact (including the extent that the risk may really be existential); the probability of occurrence; the capacity to reduce the risk; and the cost of risk reduction. All public expenditure has opportunity costs, and ideally the different risk mitigation strategies will be evaluated for relative cost-effectiveness. Even so, some may be cost-saving (for example, removing government subsidies to the oil and gas exploration industry as one component of preventing further climate change).

New Zealand is a small country, but we can contribute to global knowledge about how to define, approach and prepare for existential threats. New Zealand has previously campaigned for nuclear arms control and could work with likeminded countries to strengthen action against climate change. New Zealand has had

successes in terms of governments looking to the longer term, including the New Zealand Superannuation Fund, Earthquake Commission and Children's Commissioner, but we could go further and strengthen future-oriented commitments (Boston, 2017). Once we know what New Zealanders think, we can engage on the international stage to build resilience.

Conclusion

No matter how the number of future lives and life-years is calculated, the result is that gargantuan numbers of currently living and, especially, future people are potentially threatened by existential risks. Policymakers should therefore give more consideration to the future and preventing such existential risks. Of all the risks to things we value, some are urgent and some are important, and we need to focus on those that are both urgent and important (Bostrom, 2014, p.256). A just process

for resource allocation demands that we consider future generations but also account for solidarity with the present. We need to establish what New Zealand society wants and values. We need to know what people think about the future life-years of people alive now and those not yet born. The philosophical attitude towards future people that a global community takes will determine the kinds of utility calculations that are required. There are threats that demand action now, such as nuclear war, and, as we move forward, understanding of our values will inform appropriate policy to rationally and optimally address other existential risks.

¹ Matthew Boyd conducted literature searches, interpreted the data, wrote the manuscript and contributed important philosophical content. Nick Wilson conceived the idea, performed data analysis and interpretation, and contributed important intellectual content at manuscript drafting stage. The authors declare that they have no competing interests.

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The UK Climate Change Act an act to follow?

Abstract

The New Zealand government recently announced an intention to make the country carbon neutral by 2050. Interest has been expressed in using the United Kingdom's Climate Change Act 2008 as a model to achieve this goal. However, more needs to be done to critically review the UK legislation's applicability to the New Zealand context. This article identifies some of the issues emerging from a ten-year review of the UK act. It is hoped that close consideration of these issues will inform New Zealand policy and legislative development.

Keywords UK Climate Change Act, Zero Carbon Bill, Paris Agreement, mitigation, adaptation, policy development

Climate change is an urgent and complex global problem. Nations need to simultaneously address current impacts and reduce the risk of future impacts through aggressive mitigation over short time frames. To

contain global temperatures well below the dangerous 2°C threshold and pursue all efforts to limit the temperature increase to 1.5°C, the 2015 Paris Agreement requires national pledges for carbon reduction. However, the United Nations Environment

Programme has found that the gap between national reductions needed and national pledges made is 'alarmingly high' (UN Environment, 2017). Pledges cover only one-third of what is needed to meet the Paris Agreement's goal. Furthermore, the time frames are very short. The gap must be closed by implementation of more ambitious pledges by 2030. Achieving this target requires more ambitious pledges to be made by 2020. In response, the New Zealand government intends to create new legislation to achieve a net zero emissions target by 2050 (Mathiesen, 2017). There is interest in using the design of the United Kingdom's Climate Change Act 2008 as a model. However, much has changed in the intervening ten years and New Zealand must think carefully about the design of its legislation. The outcomes must be fit for purpose in terms both of international realities and of the New Zealand domestic context.

This article outlines some of the issues New Zealand should consider when designing its proposed Zero Carbon Act. It draws upon a ten-year review of the UK

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Climate Change Act 2008 recently published by the Grantham Research Institute on Climate Change and the Environment (Fankhauser, Averchenkova and Finnegan, 2018), and discussions with Grantham Research Institute and other policy experts. It also uses selected literature critiquing the Climate Change Act. It is not based on exhaustive analysis of available research. Given that policy development may proceed with some pace, due to our short electoral cycles, it is important to put these issues into the public domain as promptly as possible.¹ In this regard, recent indications of emerging bipartisan support from the National Party may (not necessarily) expedite the policy and legislative process (Bridges, 2018).

Overview of the UK Climate Change Act 2008

The Climate Change Act adopts a long-term carbon target of an 80% reduction in net national emissions from 1990 levels by 2050 (s1). Net emissions are the sum of all gross national emissions less the amount of carbon removed from the atmosphere, through sinks such as forests. While this target was set before the Paris Agreement, it is still relatively ambitious. Many national pledges under the Paris Agreement use 2005 as a relative benchmark, which requires less emissions cutting than a 1990 target. It is also significant for being clearly framed as a legal duty upon the secretary of state. Amendment of the 2050 target is possible, but only through parliamentary assent, supported by 'significant developments' in current scientific understanding (s2).

To achieve this target, the act provides for carbon 'budgets' (or interim targets) every five years. These budgets have been described as 'stepping stones' towards the 2050 target, as they set a (theoretically) achievable progression of emissions reduction in place (Parliamentary Commissioner for the Environment, 2017). These are set in law by the secretary of state 12 years ahead (ss 4 and 34). This progressive budget setting was thought to achieve a good balance of predictability – so industries were prepared in advance for the need to change – and flexibility (Weeks, 2017). To ensure budgets remain on track to be met, the government must report to Parliament on proposals and

policies to achieve present and future budgets. If a budget is not met by its deadline, the government must explain to Parliament why and how this will be rectified (s19). This has not yet been necessary, as the first two budgets were comfortably met, and the country is currently on track to meet its third, 2018–22 budget (Committee on Climate Change, 2017).

The act also established the independent Committee on Climate Change to provide expert advice on setting budgets and strategies to achieve them (ss 33–5). A chairman and between five and eight members make up the Committee on Climate Change, appointed by national authorities and representative of a range of experience and knowledge relevant to

on preparing for climate change, allowing for more localised responses to climate change impacts (s64).

This model has enjoyed considerable success up to the present day, making it highly regarded. So far, five budgets have been set. Two budgets have been met and even exceeded, largely through converting the UK's energy generation from predominantly coal burning to cleaner sources. The UK is also on track to meet its third (2018–22) budget.

At the time of enactment, the Climate Change Act enjoyed bipartisan support. After the 2005 election, Friends of the Earth conducted the Big Ask campaign, which lobbied for greater climate change laws in the UK, with significant public buy-in. This

While the Climate Change Act has the reputation as being the global gold standard in climate change law, some weaknesses are now becoming evident ten years on.

establishing a low-emissions economy (schedule 1). The committee's main functions are to advise the secretary of state of the level of the next carbon budget and how to meet it, and to report on current progress in meeting present and future targets (ss 34 and 36). It has no decision-making role but its monitoring and public progress reports do provide some accountability to government efforts.

The act also covers national law on climate change adaptation, or preparing for the impacts of climate change such as sea level rise and changes in precipitation patterns. However, this has more limited scope than its provisions for emissions reduction. The government must assess local climate change risk and develop proposals and policies within an adaptation programme in response to this risk (ss 56 and 58). The Committee on Climate Change also plays an advisory role and monitors progress made in achieving the proposals and policies within each programme (ss 57 and 59). Finally, the act permits government to issue advice to other devolved authorities

inspired competition between the Labour government and their Conservative opponents over who would champion the climate change cause globally. The UK hosted the 2005 G8 summit, giving Prime Minister Tony Blair the opportunity to elevate the priority given to climate change. The 2006 Stern Review also had global influence, concluding that inaction on climate change would be far costlier to economies than acting to mitigate now (Stern, 2006). These events coincided with a strong economy (which is generally more favourable for environmental policy) and efforts to develop bipartisan support. Many have since speculated that without this unique political environment, the Climate Change Act would never have passed. Today it is seen as an exceptional model of climate change legislation, which some countries, such as Mexico and Sweden, have used to design their own climate change law.

Climate Change Act concerns

While the Climate Change Act has the reputation as being the global gold

standard in climate change law, some weaknesses are now becoming evident ten years on. The country has enjoyed success with satisfying its first two, and likely three, carbon budgets. However, the fourth budget (2023–27) requires a much steeper reduction than previous budgets. Previous success has come largely from targeting ‘low hanging fruit’, such as coal-fired electricity generation (Committee on Climate Change, 2017). It is unclear how the UK will fare meeting its newest budget (2023–27), now that innovation and potentially systemic change are necessary to do so. The Committee on Climate Change has now determined that a ‘policy gap’ exists in achieving future targets (ibid.).

Recent government delay in creating policy to meet budgets has been one of the many concerns raised by the committee. Importantly, the Climate Change Act

overlap and together suggest that climate change is no longer being treated as an urgent national priority in the UK.

The committee’s most recent progress report is highly critical of the government’s efforts, noting that the UK is no longer on track to meet emissions targets in the 2020s and 2030s and calling for urgent action. It highlights recent cancellation of important programmes, including Zero Carbon Homes, and the lack of policies across the economy, including around transport, buildings and agriculture (Committee on Climate Change, 2018b). These deficiencies are undermining the stability and certainty the Climate Change Act was intended to achieve.

New Zealand’s interest in the UK act

New Zealand’s interest in the Climate Change Act is recent, yet strong. The UK’s success was brought to public attention

Climate Change Act. The current intention is to draft a climate change bill by October 2018 (Office of the Minister for Climate Change, 2018). An Interim Climate Change Committee was established in April 2018 to focus specifically on the agricultural and renewable energy sectors. It is expected that the findings of this committee will also inform development of the Zero Carbon Act. Public submissions were opened in June 2018, guided by the Ministry for the Environment’s discussion document. This document discusses the ‘highly regarded’ UK model, and it is apparent that the proposed Zero Carbon Act is largely based upon it. Currently up for public submission are included the nature of the target (whether carbon or all gases should be targeted to be reduced to ‘net zero’ by 2050); the nature of proposed budgets, such as their duration and their flexibility to be changed; and the role of the proposed climate change commission (advisory board or decision-maker?) (Ministry for the Environment, 2018). While these issues are pertinent, by the proposals being based so closely upon the Climate Change Act, an assumption is created that it is the best model for New Zealand.

Prior to the release of the discussion document, the parliamentary commissioner for the environment released a report considering some of the challenges of the UK model for New Zealand, with particular concern about the very different emissions profile and system of environmental law (Parliamentary Commissioner for the Environment, 2018). The following section outlines additional concerns to be considered, which, in the opinion of the authors, warrant close attention. Some, but not all, of these issues have been identified in the discussion document. As Sir Geoffrey Palmer recently pointed out, legislation takes time to design and enact and details ‘matter a great deal’ (Palmer, 2018). Ultimately, the task is to create enduring legislation that translates international commitments into domestic goals that are implemented and achieved.

Political commitment

As noted above, Climate Change Act commentary frequently highlights the importance of building bipartisan political support prior to its enactment.

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predates the Paris Agreement, which demands more ambition than the act’s target will deliver (Committee on Climate Change, 2016). This could be met by adjusting the 80% by 2050 target and developing more ambitious carbon budgets to meet it. However, no legal penalty mechanism exists if government fails to reach a carbon budget. The act relies primarily upon political sanction, subject to the possibility of judicial review (see the discussion below). The government may also meet budgets using internationally traded carbon credits, which appears increasingly relevant in light of new infrastructure strategies at odds with climate change mitigation, such as the Heathrow extension and local fracking. The Committee on Climate Change has criticised the use of international carbon credits, which do little to reduce national emissions at source (Committee on Climate Change, 2017). All these issues

in early 2017, when Lord Deben, the chair of the UK’s Committee on Climate Change, visited the country. Much like the Stern Report, Lord Deben used economic reasoning and long-term policy stability to argue in favour of bipartisan climate change action. This visit built upon the efforts of some New Zealand politicians to build cross-party consensus, reports demonstrating how the economy could transition to achieve radical emission reductions, and the advocacy of Generation Zero. Following this, successive parliamentary commissioners for the environment and the New Zealand Productivity Commission have published documents expressing general favour for the Climate Change Act (Weeks, 2017; Parliamentary Commissioner for the Environment, 2017, 2018).

In 2018 the new New Zealand Labour government also expressed interest in basing new climate change law on the

This determined the strength of key elements (e.g., the target, statutory five-yearly carbon budgets and the role of the Committee on Climate Change). However, as successive budgets become more difficult to meet there is concern that the act may not be adequately designed to prevent policies from backsliding (Fankhauser, Averchenkova and Finnegan, 2018). In short, there is real concern about the growing gap between budgets and policies robust enough to deliver on them. This observation demonstrates the importance of crafting legislation that can maintain and build political commitment reflective of the growing urgency of climate change. A general question is whether the commission should have the role of proactively engaging the public, as part of building the support needed to maintain and strengthen political commitment. Also needing close consideration is whether the government should be under a duty to demonstrate how its various policies will actually 'add up' to deliver on successive carbon budgets. This would facilitate timely scrutiny while providing greater certainty about carbon policies (in addition to the budgets) for investors, the public and successive governments. It may also assist with identifying how outcomes in different policy sectors support or contradict one another. New Zealand policymakers may also wish to consider the inclusion of statutory response times between budget adoption and the formulation of policy to meet the budget (Fankhauser, Averchenkova and Finnegan, 2018). While the discussion document proposes that the public should submit on what should happen if a budget is not met, this topic is not discussed further and no proposals are made.

While political consensus has held in the UK, ensuring progressive (and more ambitious) policy development for four budgets, there is no guarantee that this will endure. There are no legal protections in the Climate Change Act. Given the weaknesses of New Zealand's constitutional arrangements, policymakers may wish to consider whether the proposed Zero Carbon Act should be entrenched. While this may be politically very difficult, we should keep in mind the existential threat posed by climate change, together with

critical human rights issues and the difficulties of legal action to compel government action (Palmer, 2018).²

Scope and integration

The Climate Change Act is narrowly focused on climate change. This reflects a fundamental choice made at the time to pursue climate change policy separately from broader integrative concepts such as sustainable development (Fankhauser, Averchenkova and Finnegan, 2018). It is also reflective of a strategic focus on climate change and energy, rather than more complex sectors such as agriculture and forestry. This narrow focus should be given very careful consideration in New Zealand. Apart from the well-known differences in emissions profiles, our environmental legislation is very different

integration of climate change mitigation and adaptation across a broader suite of policy sectors.

In the UK, the institutional framework supporting the Climate Change Act reflected a primary focus on the energy sector. However, the dedicated Department for Energy and Climate Change recently merged with another department, creating the Department for Business, Energy and Industrial Strategy. It is not clear yet whether this change will resolve what is considered inadequate integration of climate change policy across the whole of UK government. As New Zealand's emissions profile is significantly different from the UK's, policymakers will need to give very careful consideration to the supporting institutional framework and how this can foster integration of climate

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from that of the UK. 'Sustainability' and 'integrated resource management' are hallmarks of our law, even in the absence of a national sustainable development strategy (Bosselmann, 2015). More recently, New Zealand has become a signatory to the United Nations 2030 Sustainable Development Goals, which require integrated domestic implementation of all 17 goals. This includes a range of social and economic matters relevant to the issue of achieving 'just transitions' toward a low-carbon economy that is also adapting to the effects of climate change. A strong sustainability framework addresses social justice *and* the critical matter of ecological limits, in an integrated manner. Other important trends include the Treasury's development of a Living Standards Framework, which, if implemented, could significantly change New Zealand's national accounting processes (New Zealand Treasury, 2018). In short, a strong sustainable development framework may be an important aspect of achieving

climate policy between key emission sectors and government institutions. If possible, New Zealand needs to avoid emerging limitations of the UK Climate Change Act: it has not been able to adequately address the emergence of inconsistent policy development (such as airport extensions and fracking) and cancellations of policy at short notice. Nor has it had adequate influence over housing, transport and labour policy (Fankhauser, Averchenkova and Finnegan, 2018; Committee on Climate Change, 2018b).

A related issue for New Zealand is whether the Zero Carbon Act should take a comprehensive all-emission-sectors approach from the outset. The interim committee has so far only been tasked to advise on agriculture and renewable energy. The discussion document does call for public submissions on whether just carbon or all greenhouse gases should be targeted. This discussion indicates that there may be a nuanced approach in New Zealand regarding different sources of emissions

and types of gases.³ The UK experience suggests that all sectors should be included, preferably from the start. In the UK it has been suggested that aviation and shipping should be accounted for under the Climate Change Act, and there has been delay in achieving this partly because they were not included at inception (s30; Fankhauser, Averchenkova and Finnegan, 2018).

Finally, how will the Zero Carbon Act integrate with other policy and legal frameworks? The New Zealand emissions trading scheme is an obvious case for close consideration and was the focus of the parliamentary commissioner for the environment's recent report (2018), but what about other legislation that is currently underutilised, including the

climate change action (e.g., through urban planning and transport) and misses an opportunity to engage the public more directly in climate change policy.

Mitigation and adaptation

It is less well known that the Climate Change Act creates a national policy framework for adaptation, in addition to mitigation. A subcommittee on adaptation works to a five-year cycle, beginning with a comprehensive climate change risk assessment, followed by a national adaptation programme. Relative to mitigation, adaptation policy has been slower to emerge and received less attention, resulting in 'more planning than action' (Fankhauser, Averchenkova and Finnegan, 2018). While this may be

[Climate Change] Act is surprisingly domestic in its scope' (Fankhauser, Averchenkova and Finnegan, 2018). The international context is one factor that must inform the Climate Change Act budgets, but they remain unilateral and a matter of domestic policy. This is only partially due to the act predating the Paris Agreement. Legislative incorporation of international obligations was not the act's intention. Its continuing domestic focus affords the UK government considerable flexibility. Nevertheless, the Committee on Climate Change and other commentators have noted that the Climate Change Act will need to be made compatible with the Paris Agreement (ibid.) and its emerging architecture. This could include changing the target to 'net zero emissions' (as proposed in the Zero Carbon Act discussion document), enhancing the relevance of the national pledge (known as nationally determined contributions, or NDCs), or addressing climate finance and adaptation obligations together with the role of international carbon credits (ibid.). All these issues are important, but, more critically, policymakers need to address whether (and if so how) the Zero Carbon Act can be crafted to enable domestic interest groups to use it to facilitate the progressive development of ambitious NDCs (clearly linked to the Paris Agreement global warming limit of well under 2°C and preferably 1.5°C), together with timely compliance. NDCs are currently unilateral and non-binding, but are to be progressively strengthened over time, according to emerging principles (Brown et al., 2018). As such, NDC content and implementation is currently reliant on a combination of trust and 'naming and shaming'. This could be greatly enhanced through the design of the Zero Carbon Act, the objective of which is to link the NDC process with the domestic budgets in terms of their ambition and compliance. More generally, how can domestic legislation be constructed to overcome a range of accountability (and other) gaps in international commitments and provide for evolution of the Paris Agreement architecture? In considering the complex interaction between international norms and domestic law, analysis of legal action by Plan B against the UK government and

... the Committee on Climate Change and other commentators have noted that the Climate Change Act will need to be made compatible with the Paris Agreement (ibid.) and its emerging architecture.

Land Transport Management Act, the Building Act and the Energy Efficiency and Conservation Act? More generally, how will the Zero Carbon Act achieve integration with the role of local government under the Local Government Act and Resource Management Act (RMA)? Significant changes in the roles and capacities of subnational government have occurred since the Resource Management (Climate Change and Energy) Amendment Act 2004, which confirmed centralisation of mitigation. A strong case can be made for returning mitigation responsibilities to local government through the RMA policy and regulatory framework, which includes an integrated guidance role from central government (Harker, Taylor and Knight-Lenihan, 2017). Again, the UK experience may be instructive. The Climate Change Act adopts a very top-down approach which fails to integrate with local governments' potential to contribute to

due to teething problems with the first assessment and adaptation programme, it also raises a much more fundamental issue: whether mitigation and adaptation should continue to be treated as related, but largely separate, policy sectors and, if not, what the appropriate institutional arrangements should be. The discussion document proposes to treat climate change adaptation in exactly the same way the Climate Change Act does, in a top-down manner and as an issue largely separate from climate change mitigation. However, this may be a critical opportunity to consider the emergence of 'climate compatible development', which treats the need to lower emissions and anticipate impacts while improving human well-being and ecological integrity as intimately connected tasks (Mitchell and Maxwell, 2010).

Incorporation of international obligations

It has been said: 'For a law dealing with a global environmental problem, the

the outcomes of the Thomson case⁴ in New Zealand will be instructive (Plan B, n.d.).

On the face of it, the potential Zero Carbon Act target of ‘net carbon zero by 2050’ might be compatible with the Paris Agreement, which requires a ‘balance between sources and sinks in the second half of the century’ (article 4). However, how this ‘net’ element is defined, accounted for and achieved will be critical and the timelines (for keeping within the Paris Agreement warming limit) depend upon emission rates.⁵ The Paris Agreement also requires peaking of emissions as soon as possible and rapid reductions thereafter (article 4). In this respect, it is notable that even though the Climate Change Act explicitly provides for the use of international credits to meet budgets, the consensus has been that targets should be met solely through domestic action (Fankhauser, Averchenkova and Finnegan, 2018). As noted above, the Committee on Climate Change recently reiterated that credits (outside the EU system) should not be used to meet budgets, as this distracts from domestic reductions. Despite this, international credits are still given consideration in the discussion document and are open to public submission. Given New Zealand’s past reliance on international credits and problems with the emissions trading scheme, this will be a critical issue requiring explicit consideration. More generally, legislation needs to be carefully crafted regarding domestic reduction at source and the role of carbon sinks.

Given the limited global carbon budget, New Zealand could consider the applicability of the ‘carbon law’ (or an equivalent for all gases) for creating quantifiable rather than percentage reductions, delivering a halving of gross emissions every decade (Rockström et al., 2017). However, this approach would require a different model from that currently proposed by the Zero Carbon Act.

Role and composition of the commission

The independent and expert Committee on Climate Change is considered the ‘fulcrum of the UK climate change architecture’ (Fankhauser, Averchenkova and Finnegan, 2018). It recommends successive budgets and monitors policy

performance on both mitigation and adaptation. As an independent and expert technical body, it is seen as better equipped to take a more credible long-term view of policy (including budgets) than politicians. It also plays a critical role in monitoring and reporting processes intended to hold the government to account. It produces annual progress reports to Parliament, evaluating whether the government is going to remain within the budget. Government must respond within a statutory time frame. At the start of a budget, it will comment on the policies formulated to meet that budget. At the end of a carbon budget, the committee provides a detailed report on policy performance. In a recent report, it stated

concerning how prescriptive legislation can and should be about policy priorities, processes, objectives and a requirement that policies ‘add up’ (i.e., it can be demonstrated how they are intended to actually achieve budgets). In other words, how should the government’s discretion to determine policy options be reconciled with a statutory duty to achieve a budget?

Careful consideration of these and related issues may result in an enhanced evaluative role for a New Zealand climate change commission. Related to this is the politically sensitive matter of an enforcement role. It is generally considered that lack of enforcement powers is necessary to prevent an independent body from becoming politicised. However, given the urgency and

While the Climate Change Act has the reputation as being the global gold standard in climate change law, some weaknesses are now becoming evident ten years on.

of the new UK Clean Growth Strategy: ‘whilst some new policies are announced in the Strategy, the detailed policies and measures to meet the targets are not, in general, set out ... a gap in meeting the fourth and fifth carbon budgets remains’ (Committee on Climate Change, 2018a, p.5). As previously noted, its most recent report criticised government policy and called for urgent action. However, the Committee on Climate Change does not act as a legal enforcer. Nor does the Climate Change Act include legal sanctions for failure to deliver adequate policy or to meet carbon budgets. Instead, it relies on political and public pressure and the possibility of judicial review proceedings by third parties (see legal accountability, below).

Some commentary has criticised the role of the Committee on Climate Change, claiming that it does not evaluate government policy as such, and in particular that it does not provide hard-edged scrutiny (Church, 2015). This criticism raises a broad range of issues

human rights implications of climate change policy (together with the difficulties of judicial review – see below), some form of enforcement role should not be dismissed either for the commission or (in the alternative) for another independent body. The parliamentary commissioner for the environment is currently limited to a commissioner of inquiry role, with investigatory reports delivered to Parliament.⁶ There may be merit in considering an enhanced role for the commissioner or the creation of a new entity. In short, if some form of enforcement role for a climate change commission is not politically achievable or desirable, other options should be considered. The constitutional implications of creating a commission (or other independent agency) with a legal enforcement role also need to be carefully examined, as this may be considered a threat to New Zealand’s parliamentary supremacy. In this regard, it is important to note that the Committee on Climate Change does not have a decision-making role; it merely recommends carbon

budgets. Interestingly, Brexit has triggered UK debate about replacing the significant legal enforcement role of the EU Commission on environmental regulation with an independent environmental watchdog, potentially capable of taking legal action against government (Hill, 2017).

The role chosen for the New Zealand commission (together with the scope of the Zero Carbon Act) will need to be carefully matched with relevant expertise. This could be legislated for, in a similar manner to RMA provisions on expertise of environment commissioners. In this regard, expertise to ensure policy evaluation against the principles of the Treaty of Waitangi will be a key consideration. This has the potential to lead to a far more holistic understanding of policy, reflecting a Māori worldview of human–nature relationships and social justice. Consideration should also be given to ensuring representation of the interests of Pasifika communities and future generations. The composition of the New Zealand commission needs to balance the chosen ‘public role’ with its technical advisory role, particularly in relation to budget recommendations. It also needs to reflect expertise of all relevant policy and governance sectors, including local government. Funding mechanisms to ensure impartiality and fulfilment of its statutory role will also be essential (Fankhauser, Averchenkova and Finnegan, 2018).

Legal accountability

Related to a potential enforcement role for a New Zealand commission (or other independent body) is the issue of judicial review. The Climate Change Act omitted

any gateway provisions relating to appeals, including legal standing. This has led to uncertainty about aspects of judicial review proceedings. Questions to be considered include whether there should be express provision for matters such as statutory duties versus discretions; what elements can be reviewed; grounds for review; legal standing; and remedies (Fankhauser, Averchenkova and Finnegan, 2018). Given the burdens (and potential benefits) of legal action on climate change for citizens and public interest groups, additional elements to support legal action, such as legal aid, merit consideration ((Fisher, Scotford and Barritt, 2017).⁷ Decisions on these matters will be particularly important if the New Zealand commission (or other body) does not have legal enforcement powers. More generally, it has been suggested that many elements of judicial review warrant a radical rethink, given the particular challenges of climate change and the harms that can ensue (ibid.). In short, the balance between policy discretion and prescription needs to be carefully considered both in political terms and as it relates to judicial review proceedings.⁸ Finally, innovative climate change legislation for New Zealand could include the emerging environmental law principle of non-regression (Krämer and Orlando, 2018) and enhanced provisions for access to official information (Palmer, 2018).⁹

Conclusion

The Climate Change Act is largely considered a success in terms of the way climate policy has been conducted in the

UK, including the development of an empirical evidence base, regular reporting, enduring political consensus and certainty over carbon budgets. Significant transformation has occurred in the energy sector (Fankhauser, Averchenkova and Finnegan, 2018; Department for Business, Energy and Industrial Strategy, 2018). However, New Zealand policymakers need to carefully consider the extent to which it is a model fit for purpose for the critical decade leading up to 2030 and beyond. The objective of this article has been to raise some issues relevant to that task. New Zealand (and the world) has limited time both to achieve radical emission reductions and to address impacts.

- 1 For a current and comprehensive guide to the development of climate change legislation, see Averchenkova, Fankhauser and Nachmany, 2017.
- 2 An alternative suggestion proposed by Sir Geoffrey Palmer involves constitutional reform, including the provision of an environmental right (Palmer, 2018).
- 3 Any exclusion or alternative treatment for methane as a short-lived gas needs to be very carefully investigated and justified.
- 4 *Thomson v The Minister for Climate Change Issues* [2017] NZHC 733.
- 5 Recent research concludes: ‘The 1.5 and 2°C warming targets are reached in 17–18 years and in 35–41 years, respectively, if the carbon emission rate is assumed to remain at its present-day value’ (Goodwin et al., 2018).
- 6 Sir Geoffrey Palmer (2018) considers the potential role of the Waitangi Tribunal, in addition to the parliamentary commissioner for the environment.
- 7 A recent Grantham Research Institute report notes that climate litigation has generally strengthened regulation and thus has a constructive influence. However, it can be a double-edged sword and be used to weaken or oppose regulation (Nachmany et al., 2017).
- 8 Sir Geoffrey Palmer (2018) notes judicial review is a limited mechanism for holding the New Zealand government to account for its climate change policy. To strengthen accountability, he proposes significant constitutional changes, including introduction of an environmental right. He argues that New Zealand needs a robust legal framework beyond single purpose legislation.
- 9 This principle is intended to ensure that accepted norms are not amended in a manner which weakens those norms. A constitutional right to the environment may have a similar influence.

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Andrew V. Shelley

A Framework for Counter-Unmanned Aircraft System Regulation in New Zealand

Abstract

The malicious or negligent use of unmanned aircraft systems (UAS) – usually referred to as ‘drones’ – gives rise to significant risks. While the risky behaviours are subject to existing legal sanctions, the apprehension of perpetrators can be difficult, and traditional regulatory controls, such as licensing drone operators, may be ineffective. ‘Counter-UAS’ (C-UAS) systems that defend against unmanned aerial systems are emerging internationally as a way to address the latent threat. Potential legal issues with the implementation of C-UAS in New Zealand are briefly surveyed. I propose the adoption of a licensing system for C-UAS similar to that already adopted in civil aviation regulation.

Keywords Drones, unmanned aircraft systems, counter-UAS, C-UAS, regulation, New Zealand

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Recent research suggests that there may be over 280,000 New Zealand-resident drone users, with another 200,000 overseas visitor users each year (Colmar Brunton, 2017).¹ Behind these statistics, drones seemingly have an ever growing number of uses, but they also give rise to potentially significant risks that may not be managed well by our existing regulatory framework. A malicious actor could easily fly a drone into the path of an airliner, deliver contraband to prisons or drop an improvised explosive device over a sports stadium without ever being at risk of detection by authorities. A significant risk also exists that an individual who is negligent or reckless, rather than malicious, could also cause harm by flying into the path of an aircraft, or crashing at a public event. While all of the activities identified are subject to existing legal sanctions, the identification and apprehension of perpetrators can

be difficult, and traditional regulatory approaches, such as licensing drone operators, may be ineffective. This article considers the beneficial role of 'counter-UAS' – systems intended to counter or defend against unmanned aerial systems – and proposes the adoption of a licensing system to enable counter-UAS (C-UAS) to be adopted in New Zealand.

The threat

In 2015 a small drone carrying radioactive material was flown onto the roof of the Japanese prime minister's residence (BBC, 2015). In the years since then unmanned aircraft have increased in sophistication: drones manufactured by DJI, the most popular brand of drone worldwide, have object avoidance technology, allowing them to be flown close to structures with minimal risk of collision. The Syrian civil war and the subsequent war against ISIS in Syria and Iraq has seen the use of small drones to drop improvised explosives and grenades (Gibbons-Neff, 2017; Watson, 2017). However, the planned use of drones by non-state insurgent groups predates the Syrian civil war. For example, Ballard et al. (2001) report that in early 1994 the Japanese cult Aum Shinrikyo attempted to use a remote-control helicopter to deliver the nerve agent sarin against a target; however, the helicopter crashed during testing (Bunker, 2015). Small drones have not, to date, been used in terror attacks in the West, but authorities are concerned that attempts will be made (Hughes, 2015).

Small drones have been used to deliver contraband – particularly drugs, weapons and mobile phones – to prisons in both the United Kingdom (Glanfield, 2015) and the United States (Brandes, 2015). In the United Kingdom it was reported that 120 drones were seized flying contraband into prisons over a 23-month period (Drury, 2017). Drones have also been used to aid criminal activity, such as reconnaissance for potential burglaries (Barrett, 2015). These concerns are equally relevant to New Zealand as they are to the United Kingdom and United States.

New Zealand has seen five recent incidents where the presence of drones closed airports and required manned aircraft to divert or enter a holding pattern. On 6 March 2018 a drone was observed in

airspace near the approach path for aircraft landing at Auckland International Airport. Approximately 20 aircraft entered a holding pattern while air traffic control halted operations for 30 minutes, and a Boeing 777 aircraft arriving from Japan diverted 500km to Ohakea airbase to refuel (New Zealand Herald, 2018a). Less than three weeks later, on 25 March, a drone approached to within approximately five metres of another Boeing 777 landing at Auckland International Airport (Lawrence, 2018). On 6 April 2018 a drone was seen at 1,200ft above ground three nautical miles from Auckland International Airport, resulting in seven flights being delayed (Boyle, 2018). Three days later, on 9 April 2018, operations at Whenuapai air force base were suspended when a drone came

have characteristics that make them particularly vulnerable in the event of a collision with a drone: many have turbine engines subject to the same risk of destruction as airliner engines; main rotor blades can fracture on impact with a drone; and tail rotors are likely to be destroyed on impact with a drone, which could result in severe spinning of the helicopter. Helicopters also often operate at low level, in the same airspace as small drones, including for rescue and firefighting purposes. Due to the high risk of collision, and potential severity of the outcome, helicopter firefighting operations are suspended if a drone is seen close to the firefighting operations (Stuff, 2017).

On a purely economic front, electric power infrastructure, particularly overhead

On a purely economic front, electric power infrastructure, particularly overhead power lines and outdoor switchyards, is vulnerable in the event of a drone crash.

within 60m of a helicopter flying at 3,000ft above ground (New Zealand Herald, 2018b). On 23 April a passenger flight was delayed at Tauranga because of a drone seen 1.6km from the end of the runway (Motion, 2018).

Simulation results suggest that a 3.6kg drone could fracture the turbine blades of a jet aircraft, rapidly destroying the entire engine (Mackay, 2015; Wasserman, 2015). Known as an 'uncontained engine failure', such an event can cause significant structural damage to the aircraft (Australian Transportation Safety Bureau, 2013) and even a catastrophic fire, as occurred to a British Airways Boeing 777 in Las Vegas in 2015 (Gates, 2015). On 17 April 2018 a mid-air uncontained engine failure on a Boeing 737 aircraft in the United States resulted in the death of a passenger and injuries to eight others (National Transportation Safety Board, 2018).

Drones are also of concern to light aircraft, including helicopters. Helicopters

power lines and outdoor switchyards, is vulnerable in the event of a drone crash. Careless rather than malicious use of small drones has resulted in power outages of varying severity. Drones have crashed into overhead power lines, causing power outages affecting hundreds of people (Farivar, 2015; Serna, 2015; Green, 2017) and even starting a fire and damaging vehicles (Brilbeck, 2017). In New Zealand, a drone caused a power outage affecting 200 homes in 2015 (Stuff, 2015). While more power outages are currently caused by cars crashing into power poles than by drones, the potential for a drone to fly into the switchyard of a major substation or power station means that the potential effect of a drone is much greater than that of a car.

Existing regulatory provisions

Drones are regulated as aircraft under the Civil Aviation Act 1990, and subject to the provisions of the Civil Aviation Rules (2015), part 101. Part 101 specifies

restrictions such as not flying higher than 400ft above ground level, not flying over people without their consent, not flying over property without the consent of the occupier or owner, not flying within 4km of an aerodrome without the agreement of the aerodrome operator, and not flying in controlled airspace without the approval of air traffic control.

Research conducted for the Civil Aviation Authority found that 56% of New Zealand-resident drone users and 55% of overseas-resident drone users in New Zealand self-identified as being aware of the rules and having at least a basic knowledge of those rules (Colmar Brunton, 2017). For New Zealand-resident drone users, awareness of specific rules ranged

require a willingness by the courts to impose sanctions that reflect the seriousness of the harm or potential harm. In the realm of workplace safety, the New Zealand courts have considered it 'abhorrent to calculate in dollar terms' the value of a life,² and reparations ordered by the courts have only been a small fraction of the \$4.21 million value of a statistical life calculated by the Ministry of Transport (2017).

If the courts did award a sum reflective of that value, properly adjusted for probability of detection (Polinsky and Shavell, 1992), the amount would be so high that perpetrators would essentially be judgment proof and there would still be insufficient deterrence against operating a

survey of 746 vehicles being driven in Auckland, 79% of drivers elected to participate in the survey, and of those drivers 1.1% were unlicensed (Blows et al., 2005). Notwithstanding the prohibition on using a hand-held cell phone while driving, in the 2017 calendar year the New Zealand Police recorded 23,412 offences of using a hand-held device for calling or texting while driving (New Zealand Police, 2018).

Thirty five per cent of New Zealand drone users do not consider that drones pose a risk to aviation safety (Colmar Brunton, 2017), which suggests that they would also view enforcement of the relevant Civil Aviation Rules as lacking legitimacy. Watling and Leal (2012) report statistically significant negative correlations between the likelihood of violating specific driving laws and the perceived legitimacy of enforcement of that particular law. It therefore seems likely that licencing of drone operators would not solve the problem of compliance.

Licensing also does not change the fact that the casual bystander will not be able to determine who is flying a particular drone, let alone whether the pilot is licensed or unlicensed. There is, therefore, likely to be an ongoing problem of potentially hazardous use of drones, and this problem is likely to persist regardless of any licensing regime that may be proposed.

Counter-UAS technology

Against this backdrop it would seem to be common sense that action should be taken to restrict the ability of drones to operate in certain circumstances. As with most issues of human safety, prevention of harm is generally preferable to allowing the harm to occur and then compensating the victims' families or punishing the perpetrator. Thus, in the health and safety arena the best control is considered to be elimination of a hazard, and the next best control is to isolate the hazard so that people are physically separated from it. The use of explicit regulatory controls is particularly relevant when private parties are incapable of paying for the full magnitude of harm done (Shavell, 1984).

In an ideal world, therefore, we might envisage the use of a force field to exclude drones from an area where there was a high risk of harm being caused, thus meeting

As with most issues of human safety, prevention of harm is generally preferable to allowing the harm to occur and then compensating the victims' families or punishing the perpetrator.

between 56% and 78% of users, with only 35–59% always complying with those rules.

Need for further measures

Drone users may cause significant harm, whether through ignorance, negligence, recklessness or intentional acts. Licensing may help solve the problem of ignorance, and may reduce negligence, but is unlikely to solve the problem of recklessness or intentional acts.

From a law and economics perspective, the law (and the attendant penalties for breaking the law) results in individuals internalising the social costs of their actions, and generally making more socially efficient decisions as a result. However, the characteristics of drones are such that it may be extremely difficult to identify and locate the operator of an errant drone; hence, laws may often be unenforceable against a drone operator. It is impossible to enforce a law if the perpetrator cannot be found.

Even if the perpetrator could be found and apprehended, appropriate incentives

drone in a dangerous manner. In such circumstances some form of ex ante regulation is appropriate to reduce the likelihood of harm occurring (Shavell, 1984). For drones, relevant measures include licensing and C-UAS.

Licensing is insufficient

Licensing is common to a number of activities that are considered to pose a hazard to third parties. For example, licenses are required to drive cars, fly aeroplanes and possess firearms, even if the relevant activities are to be performed privately. Licensing is typically coupled with a knowledge test, and consequently could eliminate the knowledge deficit evident in the Colmar Brunton (2017) survey.

However, licensing, even when coupled with surveillance and enforcement, does not prevent unlicensed individuals from engaging in the activity, or licensed individuals from undertaking the activity in an unsafe manner. For example, both cars and drivers are licensed. In a random

the health and safety requirement to isolate people from the hazard. While force fields remain the realm of science fiction, technology exists that can take control of errant drones, forcing them to land in a safe area or potentially destroying the intruding drone.

One option is the use of radio or GPS jamming. Radio jamming involves the use of 'a radio transmitter ... to disrupt or prevent the reception of radiocommunications' (New Zealand Gazette, 2011). This basic principle can be applied to disrupt the control signal from a transmitter or ground control station to a drone. A number of commercial jammers are available for drones, such as the Battelle Systems 'Drone Defender' shoulder-mounted radio 'gun' (Matyszczyk, 2015), the hand-held 'Dronebuster' by Radio Hill Technologies (Blighter Surveillance Systems, 2016), and the DroneShield 'DroneGun' deployed by Australia at the 2018 Commonwealth Games (Cooper, 2018).

The Blighter Surveillance Systems 'Anti UAV Defence System' (AUDS) is a much larger, military-grade C-UAS which utilises radar to detect drones at a range of up to 10km for larger drones, and smaller drones at a range of up to 3.6km (Blighter Surveillance Systems, 2017). Another large-scale detection and jamming system has been developed by Airbus Defense and Space (Airbus, 2015).

US/Australian firm Department 13 has developed a radio-based system called 'Mesmer' that does not utilise jamming (Department 13, 2017). This system relies on what Department 13 describes as 'protocol manipulation' (Department 13, 2016), which involves intercepting the radio signals used to control the drone, identifying the protocol being used, then transmitting commands to completely take over control of the drone. The drone can then be instructed to leave the area or to land in a safe zone.

Some drones would make it through such electronic controls, so a second layer of defensive measures may also be required in some circumstances. Firearms and lasers can both be used to knock a drone out of the sky (Rees, 2018). Another option is the C-UAS grenade which releases streamers that will foul a drone's propellers, causing it to crash (Wong, 2018).

A number of alternative methods of drone interdiction have been developed which neither knock the drone out of the sky nor utilise jamming. Eagles have been trained to hunt small drones in both the Netherlands (Zhang, 2016; Cade, 2016) and France (Samuel, 2016; Roberts, 2017). Nets may also be used to entangle a drone: nets may be shoulder-launched (OpenWorks, 2016), draped from a drone (Economist, 2015) or fired from a drone (Goodrich, 2016; Goppert et al., 2017; Horiuchi et al., 2016).

International experience

Other countries have already taken steps to allow or enable the use of C-UAS. As noted earlier, Australia deployed C-UAS for the Commonwealth Games. The

Department of Justice to be a potential target for terrorism or other criminal activity' (the Safeguarding America's Skies Act, 2018). The actions allowed by both pieces of legislation include warning the operator, seizing control of the drone, destroying the drone, and the like. Importantly, these provisions relate to assets or facilities located in the United States or its territories, and are therefore focused on domestic security rather than security during war or war-like situations.

Legal issues

The biggest difficulty with implementing C-UAS in New Zealand is not the technology but the legal environment. The Aviation Crimes Act 1972, the Radiocommunications Regulations

The biggest difficulty with implementing [counter-UAS] in New Zealand is not the technology but the legal environment.

United States is undertaking trials of the AUDS system at selected airports (Waitt, 2016), and the United Kingdom reportedly used the AUDS system to protect against drones at the royal wedding in May 2018 (Williams, 2018). Like New Zealand, all of these countries are subject to the Montreal Convention (see below), so the convention need not prove a barrier to taking action against drones.

The United States has recently enacted legislation that explicitly allows a range of actions to be taken against drones that potentially threaten the safety or security of a broad range of assets or facilities. The National Defense Authorization Act for Fiscal Year 2018 (2017) allows action to be taken against drones that potentially threaten assets or facilities related to national security. Additional legislation has been introduced into Congress to enable the Department of Justice and the Department of Homeland Security to also take action against drones in a wide range of circumstances, including 'penal, detention, correctional, and judicial operations' and 'mass gatherings or events that are reasonably assessed by the

(Prohibited Equipment – Radio Jammer Equipment) Notice 2011 (New Zealand Gazette, 2011) and the Crimes Act 1961 all potentially raise impediments to C-UAS.

While not all C-UAS technologies will damage or destroy a drone, many do. A drone that is executing a pre-programmed flight path may also be unresponsive to the technologies that would seek to gain control and redirect it to another location. However, a drone is considered to be an aircraft, and hence subject to the same regulatory provisions as all other aircraft. The Montreal Convention (United Nations, 1975) prohibits any person from destroying an 'aircraft in service' or causing 'damage to an aircraft in service which renders the aircraft incapable of flight'. While the Montreal Convention includes the qualification that these acts are performed 'unlawfully and intentionally', New Zealand's codifying legislation – the Aviation Crimes Act 1972 – omits this qualification and specifies a maximum term of imprisonment of 14 years. These prohibitions are clearly reasonable in respect of manned aircraft, but less obviously so in respect of unmanned

aircraft operating in an area where they have potential to cause significant harm.

Important questions remain as to what C-UAS measures can legitimately be adopted. Under the Radiocommunications Regulations the jamming of radio communications is prohibited unless the person holds a licence allowing the use of radio jammer equipment. The only entity licensed to operate jamming devices is the Department of Corrections, which means that equipment that can jam drone control signals could potentially be used at prisons but nowhere else. Should this restriction

others. From an economic perspective, reasonableness and proportionality suggest that the cost associated with an action should not be greater than the benefit achieved from the action. This economic test requires that the expected (i.e. probability weighted) cost of any harm to third parties is included in the cost of self-defence. Self-defence that complies with this restriction will be efficient. The economics suggests that taking preventive action against drones is likely to be efficient (and thus reasonable or proportionate) in situations where a high magnitude of harm

action might not be the use of reasonable force, and might instead be considered reckless and subject to prosecution under the Crimes Act. Inter alia, recklessness requires knowledge of the type of harm that *might* occur (France, n.d., section CA20.27), but not necessarily that the risk is seen as significant or likely to eventuate (ibid., section CA20.26). Prosecutions for reckless conduct are also possible under section 47 of the Health and Safety at Work Act 2015, without any necessity for harm to have occurred.

Prosecution requires a decision by the relevant prosecuting authority that it is in the public interest for a prosecution to occur. It is possible that the prosecuting authority may decide that a particular C-UAS action not be prosecuted. However, that does not provide certainty as to future non-prosecution, and may instead simply serve to allow a pattern of behaviour to develop that strengthens the future case for a public interest prosecution. Furthermore, it is untenable for law enforcement agencies to rely on such a strategy. As Chief Justice Sian Elias stated in *Hamed v R* (2011):

Trespass ... provides no assistance when the drone is operating other than above the land where the protected activity takes place, such as when operating in the approach path to an airport or in controlled airspace generally.

remain, or should other security agencies also be able to utilise jamming devices in certain circumstances?

Protocol manipulation systems which seize control of a drone avoid the problems attendant with destroying or damaging a drone, but potentially contravene the prohibitions in the Crimes Act of interfering with a computer system (section 250) and accessing a computer system without authorisation (section 252). The vendor of such a system could potentially contravene the prohibition against making, selling or distributing software 'that would enable another person to access a computer system without authorisation' (section 251). The sale and use of such systems would therefore appear to require an explicit recognition in law that C-UAS are exempt from this prohibition.

The law generally recognises a right to the use of reasonable force in self-defence and in defence of others, with common law defences recognised by section 20 of the Crimes Act and specific defences recognised in sections 39–43 and section 48, among

could result, such as at major airports, mass gatherings or critical national infrastructure.

In the event of a shooting in defence of another, the defences in the Crimes Act have been considered sufficient to avoid police officers being charged for accidentally killing a third party who happened to be in the line of fire (Independent Police Conduct Authority, 2012). Thus, these defences might generally provide protection for any counter-UAS action taken where the party taking action believed that there was an imminent threat to people – such as when a drone is flying in the approach path of an airliner, or towards or over a mass gathering, or into a protected area around a VIP – and some harm to a third party occurs as a result of the C-UAS action.

However, there are circumstances in which the legal basis for taking action is less clear. Consider, for example, C-UAS action taken against a drone flying in the approach path to an airport, but there is no airliner approaching. In the absence of imminent harm to people the C-UAS

The courts cannot remedy the deficiency [of explicit legislative authority] through approval of police action taken in the absence of lawful authority without destruction of important values in the legal system, to the detriment of the freedoms guaranteed to all.³

It could be argued that trespass might provide an avenue for taking action against errant drones. There are, however, a number of complexities in the practical application of trespass to drones (Shelley, 2016). Trespass also provides no assistance when the drone is operating other than above the land where the protected activity takes place, such as when operating in the approach path to an airport or in controlled airspace generally.

Proposal

The legal issues described above suggest that specific legislative authority may be required for C-UAS, as has occurred in the United States. The relevant legislative changes need not be 'all or nothing'. As with other potentially hazardous activities,

the ability to operate could be restricted to those who have been licensed to do so. In general terms, it is efficient to set an ex ante regulatory framework coupled with potential ex post liability (Kolstad, Ulen and Johnson, 1990). The standards specified in regulation are minimum standards, requiring less than the socially optimal level of precaution (ibid.). The threat of ex post liability, provided by the prospect of being required to defend in court the reasonableness of actions taken, then ensures an efficient outcome.

The standard licensing model employed by the Civil Aviation Authority and by the New Zealand Space Agency is consistent with the theoretical ideal. The relevant regulations generally specify a minimum level of safety, but complying with those regulations does not absolve the licence holder from liability arising under the Civil Aviation Act 1990, the Health and Safety at Work Act 2015, or tort. Furthermore, the licence must specify how they will comply with the relevant regulations, which enables the licence holder to elect operating procedures that are most efficient for their specific circumstances.

The same approach could be adopted for the operation of C-UAS: a regulation for obtaining a licence for the operation of C-UAS could be promulgated, with

potential operators of C-UAS being required to submit operating procedures for approval in order to obtain a licence. The licensing process adopted by the Civil Aviation Authority issues operator licences for a maximum period of five years, ensuring that the licensed entity is subject to regular regulatory scrutiny. As C-UAS technology matures the need for licences may be obviated, or alternatively the increasing capabilities of C-UAS may reinforce the need for such systems.

For the time being, radio jamming should be reserved to security agencies, but rather than a blanket authorisation being granted to those agencies, it may be more appropriate to require that an agency obtain an authorisation from the C-UAS regulator and from the Radio Spectrum Management group. The literature suggests that such a dual oversight model may be more efficient than a single unified regulator (Laffont and Martimort, 1999), primarily because it reduces the possibility of regulatory capture.

Conclusion

The policy issues to be addressed in relation to C-UAS are not particularly difficult. The right to peaceful use of a drone does not override the right of others to go about their daily lives free

from harm, and there are circumstances in which it is clearly efficient to allow self-defence against drones. We put fences around high lookouts and along cliff edges to prevent people falling; we regulate to require isolation of dangerous machinery; we can and should implement policy now that allows relevant parties to implement systems to reduce the potential for drone-related harm by preventing drones from accessing the areas where they will cause most harm. There should never be the opportunity for drones to fly in the approach and departure paths of our major airports, major infrastructure should be protected from errant drones, and people should be able to attend events and gatherings free from the prospect of drones being an agent of harm. There are important questions about the range of measures that can and should be used for C-UAS, but a flexible licensing system may be the most appropriate way to address such questions.

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- 1 This article is derived from material prepared for a PhD thesis in the School of Economics and Finance, Victoria University of Wellington, supervised by Emeritus Professor Lew Evans and Dr Paul Calcott. I would like to thank three anonymous reviewers for helpful comments and suggestions. All errors are my own. Address for correspondence: Andrew.Shelley@xtra.co.nz.
 - 2 *Department of Labour v Sir Edmund Hillary Outdoor Pursuit Centre of New Zealand* [2010] DCR 26.
 - 3 *Hamed v R* SC 125/2010 [2 September 2011] at [1].

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Timothy Irwin and R. John Irwin

The Housing Haves and Have-Nots

the house price boom and inequality of wealth in New Zealand

Abstract

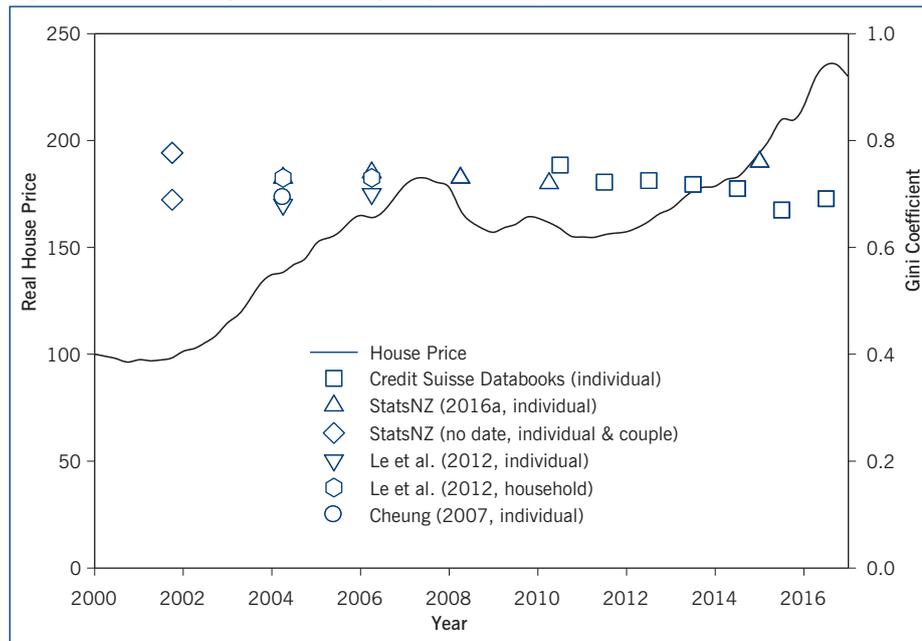
The rise in house prices since the turn of the millennium seems likely to have increased the inequality of wealth in New Zealand. On average, house-owners were wealthier than others before the boom, and during the boom real house prices more than doubled. Yet the available data shows little evidence of an increase in inequality in wealth or even of a growing proportional disparity between the net wealth of property owners and others. Difficulties in accurately measuring these changes in wealth are reviewed.

Keywords wealth, inequality, housing, Gini coefficient

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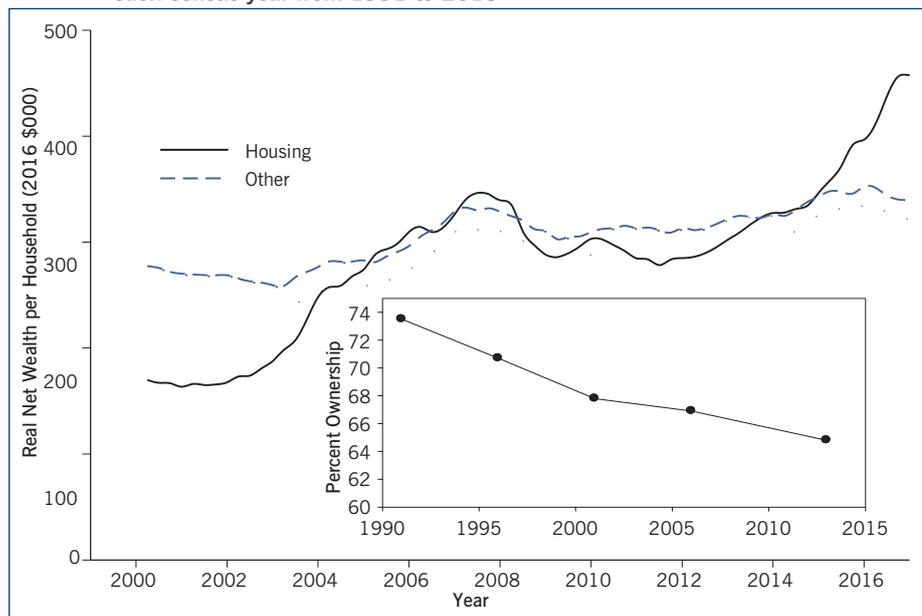
Though house price booms do not necessarily increase the inequality of the distribution of wealth, a plausible case can be made for the New Zealand boom's having done so. As Rashbrooke (2014) writes, 'Fewer and fewer people own their own home; those that do have seen the value of those homes increase sharply. Since half of all our assets are held in the form of housing, this (along with other things) means that wealth inequality has almost certainly been increasing'. Equb and Equb (2015, ch.1), Johnson (2015) and Rashbrooke (2015, ch.3) make similar points. Yet the available data shows little evidence of an increase in the inequality of the distribution of wealth over the period of the boom, or even of a widening gap in wealth between those who own housing (the 'housing haves') and those who do not (the 'have-nots'). This article investigates this puzzle and suggests some possible explanations.

Figure 1: Real house prices and inequality of wealth, 2000–16



Sources: All Residential House Price Index downloaded on 5 June 2017 from <http://www.rbnz.govt.nz/statistics/key-graphs/key-graph-house-price-values>; Consumers Price Index downloaded on 5 June 2017 from <http://www.rbnz.govt.nz/statistics/m1>; Credit Suisse Research Institute (various years); Cheung (2007); Le et al. (2012); Statistics New Zealand (n. d., p. 28); Statistics New Zealand (2016a, p. 25) and email from Michelle Griffin on 9 June 2017.

Figure 2: Real net housing and other wealth per household, 2000–16
The inset shows the percentage of households owning their own home in each census year from 1991 to 2013



Sources: Reserve Bank aggregate household balance sheet (C22), 30 May 2017, downloaded from <http://www.rbnz.govt.nz/statistics/c22> (accessed 5 June 2017); Consumers Price Index as for Figure 1; Statistics New Zealand, Dwelling and Household Estimates, March 2017, downloaded from http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/DwellingHouseholdEstimates_HOTPMar17qr.aspx (accessed 11 June 2017). Home-ownership rates are from censuses.

The puzzle

Consider first the housing boom. In real terms, the price of housing rose by 135% between the March quarter of 2000 and the December quarter of 2016 (see Figure 1 and, for a longer view, Easton, 2017). Per household, real net housing wealth increased by 169%, while other net wealth increased by 22%; housing’s share of net wealth thus rose, from 38% to 57%

(Figure 2).¹ All the while, the proportion of households owning houses was falling, from 67.8% in 2001 to 64.8% in 2013 (Figure 2, inset). And at the beginning of the boom the housing haves were already wealthier than the have-nots (see below). Thus, it seems like a case of the rich getting richer and the poor failing to keep up.

As explained below, the available evidence of the distribution of wealth is

less robust, but what evidence there is suggests no clear change in inequality during the period of the boom. Figure 1 summarises the evidence on wealth Gini coefficients, for both individuals and households, from surveys conducted between 2001 and 2015. Stats NZ, for example, reports an increase in the Gini coefficient for individual inequality from 0.73 to 0.74 between 2003/04 and 2005/06, then a fall to 0.72 in 2009/10, before another rise, to 0.76 in 2014/15 (Stats NZ, 2016a, and email from Michelle Griffin, 9 June 2017), but as explained below the significance of the last change is clouded by a difference in survey methods. Over the whole period, and the entire set of estimates, no clear trend emerges. (Chapple et al., 2015, estimate a wealth Gini coefficient for 38-year-olds in about 2010/11, which is not shown in Figure 1.) Some estimates of inequality in income or consumption also show little change over the period (Creedy and Eedrah, 2015; Perry, 2017; Ball and Creedy, 2016; Irwin and Irwin, 2016; Wilkinson and Jeram, 2016), though there is evidence of an increase in income inequality before 2000, which might have been expected to cause a delayed increase in inequality of wealth, assuming it was associated with an increase in the inequality of savings (see Bertram, 2015, p.44).

To investigate this puzzle, we examined previously unpublished data on the net wealth of the housing haves and have-nots. The housing haves are individuals who own property, including ‘owner occupied dwellings, other residential and non-residential real estate (including commercial), timeshares but [excluding] ownership of land only’ (Stats NZ explanatory note included with unpublished data on 26 June 2017). As Table 1 shows, the housing haves were on average much richer than the have-nots throughout the period, but the proportional gap between them did not widen, and if the data is accepted at face value actually narrowed.²

What might explain these results? Are there reasons why the housing boom did not cause growing inequality between the housing haves and have-nots or in the total population? Or might problems in the data have concealed the changes?

Factors that might have caused inequality not to rise

Contrary to the argument sketched in the first paragraphs of this article, a housing boom could reduce inequality (Davies, 2009; Crampton, 2016; Kuhn, Schularick and Stein, 2018). True, it is likely to increase the gap between the middle class and the poor, but it is also likely to reduce the gap between the middle class and the rich, much of whose wealth is in financial assets. The catch-up might be expected to be particularly important relative to the very rich, making it hard to measure properly in survey data, which tends to undercount the upper tail of the distribution (Cheung, 2007, p.6; Stats NZ, 2016a, p.33; Piketty, 2014). Although this explanation might help explain the lack of strong evidence for an increase in inequality, it does not explain the evidence in Table 1 that the housing have-nots kept up with the haves.

In principle, this evidence could be explained if the housing have-nots saved more than the haves (perhaps in part with the goal of buying a property) and benefited disproportionately from the considerable appreciation in the value of businesses during the period; since its inception in early 2003, the S&P/NZX-50 index of New Zealand share prices appreciated even more rapidly than house prices. That this explains the results is unlikely, however. First, total net housing wealth grew much faster than net other wealth, which also includes bank deposits and other assets that did not appreciate sharply (Figure 2). Second, the housing have-nots appear to save *less* than the haves (Le, Gibson and Stillman, 2012, §3.3) and, consistent with this, business and financial assets are concentrated in decile 10 (Rashbrooke, Rashbrooke and Malano, 2017).

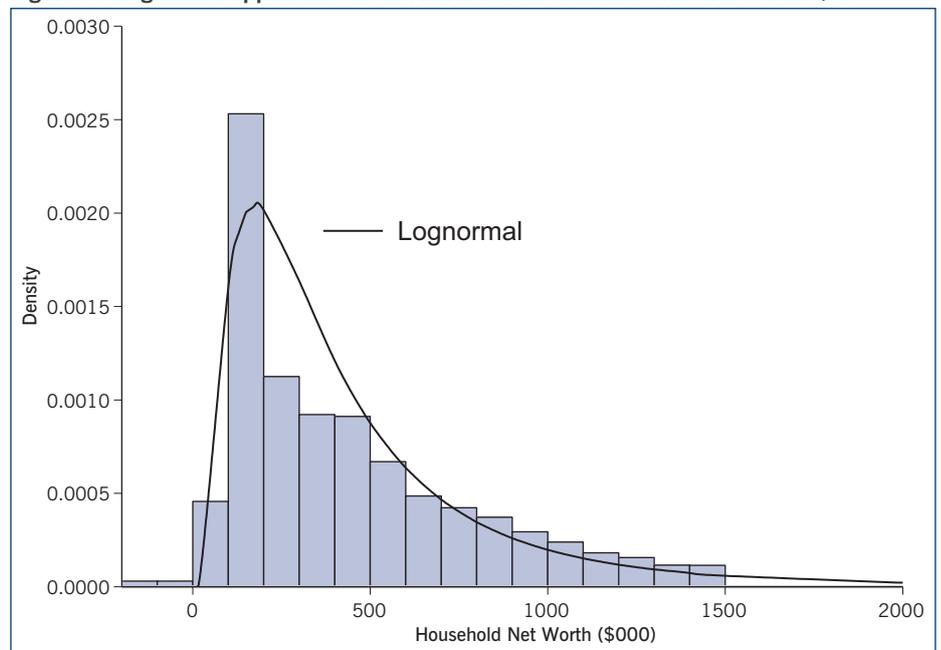
Other factors could also have played a role. At any point in time, some housing haves will have only just bought their property and may thus possess little net wealth, while some have-nots may have recently sold their property and be rich because of the housing boom. In addition, the boom especially affected Auckland (Kendall, 2016) and the median Aucklander was, at least in 2003/04, poorer than the median resident of any of the other five reported regions (Cheung, 2007, p.16).

Table 1: Mean and median net wealth of housing haves and have-nots, thousands of New Zealand dollars, except shares, 2001–15

	2001	2003/04	2005/06	2007/08	2009/10	2014/15
Means						
Haves	309	245	309	358	387	435
Have-nots	86	70	99	116	118	191
All	203	156	197	227	241	297
Wealth of have-nots/ wealth of haves	0.28	0.29	0.32	0.32	0.30	0.44
Medians						
Haves	184	146	187	226	246	267
Have-nots	3	10	13	14	16	12
All	68	61	71	84	95	87
Wealth of have-nots/ wealth of haves	0.02	0.07	0.07	0.06	0.07	0.04

Source: Stats NZ, email, 26 June 2017

Figure 3: Lognormal approximation of New Zealand household net worth 2014/15



Notes: The minimum and maximum values of the distribution are unavailable and were arbitrarily set to -\$200,000 and \$20,000,000 in estimating the lognormal function with Cowell's (2011) inequality calculator for grouped data.
Source: Stats NZ, Household Economic Survey, 2014–15, spreadsheet "hh-net-worth-stats-2015-tables", table 1.04, and authors' calculations.

Limitations of the data

It is also possible that inequality in the population as a whole and between the housing haves and have-nots did increase without this showing up in the data.

First, there are the limitations of the Gini coefficient in describing changes in the distribution of wealth. For example, it is known that it does not fully capture a shift in wealth towards the upper end of the distribution (Gastwirth, 2014). In addition, Gini coefficients and other indices of inequality may not unambiguously rank degrees of inequality. This can arise when

the Lorenz curves for the distributions intersect (Atkinson, 1970). This possible ambiguity could be ruled out if the distribution of wealth were lognormal, because Lorenz curves for lognormal distributions never intersect (Cowell, 2011, ch.4). That the lognormal distribution can provide a reasonable approximation for the distribution of wealth is illustrated by the example for New Zealand household wealth shown in Figure 3. Other examples are provided by Kleiber and Kotz (2003). Nevertheless, a lognormal fit cannot be exact for net wealth, which can be negative,

and the shape of the distributions may have changed over the period because, for example, the housing boom increased the wealth of the middle-class relative to that of both the poor and the rich. Some indicators of inequality may reflect changes of this kind more readily than the Gini coefficient. We report Gini coefficients because they take into account the whole distribution.

Further, any changes in inequality may have been obscured by sampling and other errors in the surveys underlying the estimates of the Gini coefficient, as well as changes in survey design. The first of the surveys was the household saving survey, conducted during August–November 2001 (Ramsey, 2006; Stats NZ, n.d.). Then there were four surveys of family, income and employment (SoFIEs) that included a module on wealth, in the years ending September 2004, 2006, 2008 and 2010 (SoFIE waves 2, 4, 6 and 8) (see, e.g., Cheung, 2007; Scobie, Le and Gibson, 2007; Rashbrooke, Rashbrooke and Molano, 2017). Finally, there was a household economic survey, conducted in the year ending June 2015 (Statistics New Zealand, 2016a). The differences in survey names are associated with differences in survey methods (Statistics New Zealand, 2016b), so although sampling errors and response biases, as well as questions about the definition of wealth (Crampton, 2016), create problems for the interpretation of all reported changes, the changes between 2001 and 2003/04 and between 2009/10

and 2014/15 may be especially unreliable owing to different survey methods.

Timing issues may also have prevented the surveys from detecting the full effects of the housing boom. On the one hand, as Figures 1 and 2 show, some of the price appreciation took place before the first survey, in mid-2001, or after the last survey, in 2014/15. On the other hand, the surveys do not always report current property values. The SoFIEs may have adjusted official valuations for general movements in house prices (Ramsey, 2006, p.8), but the household saving survey and the household economic survey did not (Stats NZ, n.d., pp.60, 137; 2016a, p.27). As a result, the property values reported in the 2014/15 survey were often several years old: of 809,010 dated valuations, about a third are for 2012 or earlier. In addition, the surveys may also have failed to record fully the appreciation of houses owned by trusts (see Statistics New Zealand, n.d., ch.11; Ramsey, 2006, p.8; Statistics New Zealand, 2016a, pp.11–12).

Conclusion

To sum up: it is possible that New Zealand's housing boom did not increase wealth inequality in New Zealand, as is suggested by the available Gini coefficients. It is also possible that the effect was concealed by factors including changes in survey methods, problems tracking property owned by trusts, problems recording up-to-date property values, and the precise relationship between the timing

of the surveys and the timing of house-price boom. If the boom turns to bust, as suggested by analyses that detect a bubble (Greenaway-McGrevy and Phillips, 2016), there will be further opportunities to examine the link between house-price changes and inequality.

- 1 In the statistical framework underlying the Reserve Bank data, households' ownership of investment properties is treated as an investment of the business sector, with households' equity in the properties recorded among their financial assets (Reserve Bank of New Zealand, 2017, p.9). We therefore estimate net housing wealth as the difference between the two memo items appended to the household balance sheet; i.e., as QC1 (total housing assets) less QM22 (total housing loans). We estimate net other wealth as households' financial assets (QA) less their liabilities (QB) other than housing loans (QB11), all less their equity in investment properties, which is the difference between the memo items and non-investment housing wealth (QC6 – QB11); i.e., as QA – (QB – QB11) – [(QC1 – QM22) – (QC6 – QB11)]. It follows, after cancelling terms, that the sum of our two series is total net worth: QA – QB + QC6.
- 2 Also worth noting is that the means and medians in Table 1 imply that wealth is distributed very unequally among the housing have-nots. The ratio of the mean to the median is an indicator of inequality because it shows the degree to which wealth is skewed to the right and therefore concentrated above the median. In the 2014/15 survey, the mean–median ratio was 1.6 for the housing haves and 15.9 for the have-nots. If the distribution of the wealth was lognormally distributed (an assumption we discuss below), the Gini coefficient would be 0.52 for the haves and 0.90 for the have-nots. To see why, note that the Gini coefficient, G , of a lognormal distribution is given by $G = 2\Phi(\sigma/\sqrt{2}) - 1$, where $\Phi(\cdot)$ is the normal distribution function and σ is the standard deviation of the logarithms (see Cowell, 2011, Appendix A). Moreover, $\sigma = \sqrt{2} \sqrt{\ln(\bar{r})}$, where \bar{r} is the mean–median ratio, so $G = 2\Phi(\sqrt{\ln(\bar{r})}) - 1$.

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New Zealand Retirement Income Policy as an ‘Eco-system’

Abstract

The New Zealand retirement income system involves a range of policy areas and initiatives beyond New Zealand Superannuation and KiwiSaver. These interact with each other, and with wider social and economic trends. The potential for prolonging working lives, self-funding/decumulation and trends in homeownership need to be considered alongside the sustainability of current policy settings. A unified policy approach is required to ensure the adequacy of retirement incomes for older people and also intergenerational equity.

Keywords Superannuation, retirement income, fiscal costs, decumulation, policy change

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The retirement income framework in New Zealand can best be seen as an interdependent system, involving a range of policy areas and initiatives which interact with each other and with underlying economic trends, social trends and attitudes. This can be depicted diagrammatically as in Figure 1. The central objective of the system, as shown in the diagram, is to ensure that all older New Zealanders¹ have an adequate retirement income: that is, sufficient income to ensure that they are able to ‘belong to and participate in the community’ (Royal Commission on Social Security, 1972). Adequacy relates not just to the level of New Zealand Superannuation (NZS) and its ongoing fiscal sustainability, but also to supplementary payments, workforce participation, health services, housing support, and the ability to run down accumulated savings and assets. To achieve this objective requires policies which recognise the interdependence of the system as a whole.

In their 2016 review of retirement income policies, the Commission for Financial Capability recognised the wider implications of an ageing population, and suggested:

the retirement income framework is an eco-system, meaning ‘a complex network’ or ‘interdependent system’. The all-dominating subject of age of eligibility [for NZS] cannot be addressed without also acknowledging the interdependencies: the ageing workforce, the role of KiwiSaver, decumulation options, and more. (Commission for Financial Capability, 2016, p.4)

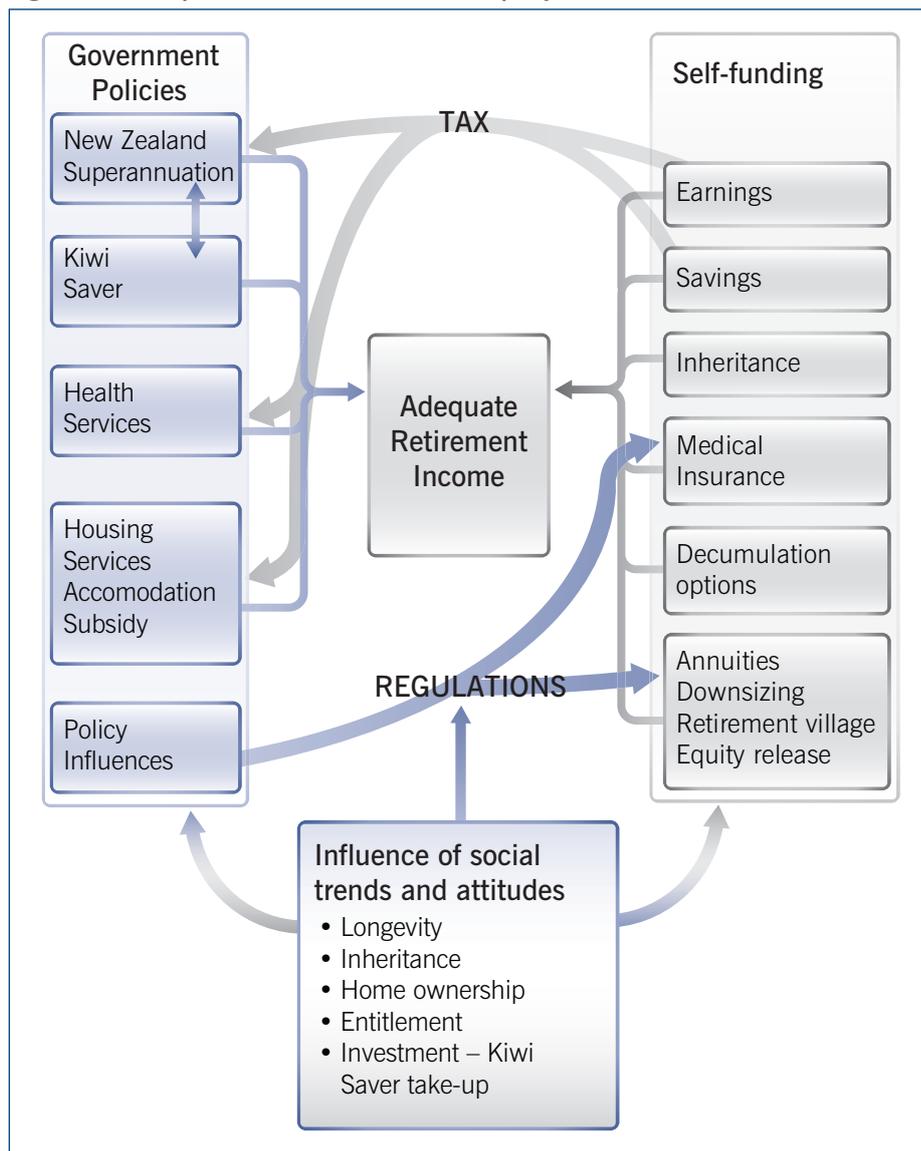
A round table discussion, under the auspices of the Institute for Governance and Policy Studies and the School of Government, held in June 2017 at Victoria University of Wellington, reached a similar conclusion. The discussion noted the relevance of the fall in homeownership; changes affecting the labour market; increasing longevity and associated health costs; and income and wealth inequalities.

This article starts by examining the sustainability of NZS, the central element in the retirement income system at present. A second important element in the framework is KiwiSaver. This has the potential to deliver substantial funds to contributors at age 65. NZS and KiwiSaver may interact more closely in the future, possibly in a two-tier system, with NZS as a ‘safety net’.

Health services and aged care – residential and home-based – also play their part in the retirement income eco-system, as do homeownership, housing support through the accommodation supplement, and government initiatives such as the Super Gold Card and the newly announced winter fuel allowance.

Decumulation of existing assets and self-funding from earnings, savings and investments have always been options for increasing the adequacy of retirement incomes. Decumulation could play a larger part in the system in future and some emerging options in the private sector are open to policy influences. Decumulation options are influenced by social trends and attitudes, listed in Figure 1, which are less

Figure 1: Interdependence of Influences on adequacy of retirement income



open to government control. It must be acknowledged that these influences, which include electoral risk, pervade the whole retirement income system and may limit the potential for change.

The sustainability of government contribution to retirement incomes

With the ageing of the population, and no change in policy settings, the gross cost of NZS will rise from the current 4.8% of GDP to 7.2% in 2045 and to 7.9% by 2060 (Treasury, 2017). However, NZS is paid net of tax, and with no change in tax rates or thresholds, the resulting net cost will only rise from 4.2% of GDP in 2016 to 6.1% in 2040 and 6.7% by 2060. Adjusting tax thresholds for inflation would offset much of the difference between the gross and net costs. These rates are not high by international standards (the overall OECD

contribution is 8.2%), but the increase in spending has given rise to concerns about the sustainability of spending on NZS as the population ages.

The New Zealand Superannuation Fund has a part to play in smoothing the fiscal cost of NZS and improving its future sustainability.² It will also contribute to intergenerational equity by reducing the future costs of NZS. The intention is to draw down the fund from 2035–36 to cover part of rising NZS costs. Offsetting that contribution is the tax paid to the government on returns from the fund. Rosenberg (2017) added in New Zealand Superannuation Fund expenditures/withdrawals, and concluded that the net fiscal costs of NZS only rise from 5.0% of GDP to 5.9% in 2060.

To assess total expenditure by the government on retirement incomes, its

contribution to KiwiSaver needs to be added. In 2012 this was estimated to be about 12% of the current cost of NZS (Dwyer, 2013). Since then, the grant of \$1,000 upon enrolment has been removed and the income-related tax relief capped at a maximum of \$521 per annum. This will reduce the fiscal cost of KiwiSaver.

Since its inception, NZS policies have been subject to change. Especially significant was the rise in the age of eligibility from 60 to 65 between 1991 and 2001, which prompted higher rates of labour force participation in this age group;

administration and compliance costs would be significant and avoidance schemes are likely to proliferate. Income testing would also discourage workforce participation beyond the age of eligibility for NZS.

- Changing the method of indexation of NZS. Options include using average earnings, median earnings or changes in consumer prices, each with different implications for the adequacy of NZS and levels of poverty among older people. Consumer price adjustments would probably lead to a two-tiered

An estimated 42% of current health spending goes on the 65 plus age group and increased numbers of older people are likely to raise health expenditure in the future, provided there is no reduction in service provision or subsidies.

and the reduction in the percentage of average earnings used to calculate net superannuation. There are a variety of options and policy proposals for the future intended to increase the sustainability of NZS. These include:

- Raising the age of eligibility. Arguments for this are not based solely on fiscal savings but also on the increased longevity of the population and the potential for extending workforce participation. Some form of income support will still be needed for older people who cannot work or find work, which will reduce the fiscal gains.
- Adjustment of residence requirements. Many OECD countries have lengthened the residence requirement for pension receipt. The issue is also relevant for migration policy, although the number of inter-country social security agreements is growing.
- Targeting NZS. Income and/or asset testing is complicated, with detailed rules as to what constitutes income and assets, and can become intrusive, especially when eligibility is based on both partners' income and assets. The

pension scheme, with means-tested supplements for those with limited income/assets.

- Raising taxes or cutting government expenditure³ are traditional responses to tight fiscal situations, along with borrowing, and these options are part of the retirement income eco-system. Possible new tax options could include a capital gains tax, a wealth tax or a financial transactions tax. However, tax increases and spending cuts clearly bring electoral risks.
- Deferring receipt of NZS for a higher pension. This policy would be administratively complex and seems not to be actively under current consideration.

The contribution of KiwiSaver⁴

The 2016 review of retirement income policy had KiwiSaver as a primary focus, with numerous recommendations, covering: compulsion for workers to join, contribution rates, transparency of fees and extending coverage.⁵

Research done for the Commission for Financial Capability (2014) shows that

most people found they needed something additional to NZS to have an adequate income in retirement. Compulsory enrolment in KiwiSaver would ensure additional retirement income for all workers. But there are arguments against compulsion (ibid.). For low-income earners, especially those with dependent children, KiwiSaver contributions could be a financial burden. An income floor before employee contributions are payable may be a solution, but, while providing current poverty relief, it would be at the expense of building up savings for retirement. Others may prefer to manage their own savings portfolio, or to adjust their savings to life-cycle flows of income and expenditure, taking into account repayment of student debt, house purchase, periods of work in other countries or offsetting the cost of dependants. In these cases income from savings will be a means of self-funding retirement income.

Other government spending on retirement incomes

In addition to direct spending on retirement incomes, other government programmes have the ability to contribute to the adequacy of retirement incomes.

An estimated 42% of current health spending goes on the 65-plus age group and increased numbers of older people are likely to raise health expenditure in the future, provided there is no reduction in service provision or subsidies. Increased health costs are also related to staff salaries and higher expectations of new medications, treatments and technology, not just ageing. Long waiting lists suggest that there may be scope for self-funding through decumulation, or medical insurance, which in the past has been encouraged through tax policies.

Already fewer people are in expensive rest home care, albeit at higher levels of dependency. But, if the policy of 'ageing in place' continues, then home care and services delivered in the community, including the provision of specialised housing for older people, become more important and are already under-resourced. Here again there is potential for self-funding, and policies, such as income-testing, could be developed to encourage this.

The accommodation supplement was designed to reduce the impact of housing costs on low incomes, so for older people it may be a useful addition to retirement income. Its adequacy has been questioned, given the rise in rents (particularly in Auckland and Wellington) – although accommodation supplement increases came into effect from 1 April 2018. The public housing stock is historically low and private landlords do not fill the gap. Poor housing has a negative effect on physical and mental health outcomes. Older renters may therefore generate higher health service costs. Unless there are increases in NZS or the accommodation supplement, greater poverty among older renters can be expected. In addition, the maturity of KiwiSaver accounts and their decumulation through annuities, or returns on occupational pensions, will affect eligibility for the accommodation supplement, which is means-tested.

In the 2008–09 financial year, 22,452 people receiving NZS also received the accommodation supplement, but this was only 9% of recipients. The percentage fell to about 8% in 2010–11 and then increased to about 10% in 2012–13. Of over 500,000 people receiving NZS in the 2008–09 financial year, only 4% received the accommodation supplement. This increased to about 5% in 2012. On this basis, around \$100 million is distributed to older people in the housing subsidy. This type of assistance to retirement incomes could probably be expanded, along with the targeted rent and rates rebates.

Fuel poverty has become an increasing concern. The Labour-led administration claims that ‘around 1600 Kiwis die each year due to cold housing in winter, and thousands more end up in hospital’ (Woods and Sepuloni, 2017). The winter energy payment was introduced in 2018, payable to beneficiaries and superannuitants for 14 weeks from 1 July (in subsequent years to be for 22 weeks from 1 May), worth \$450 for a single person and \$700 for a couple, with a direct annual cost of \$374 million in 2018 and \$1.816 billion over four years (ibid.). This cash grant should add to the well-being of retirees and result in some savings in healthcare costs. However, it has been criticised as being poorly targeted, given its universal nature.

Decumulation/self-funding

Self-funding or decumulation, both terms meaning the running down of savings and investments to increase current income, are ways of increasing retirement incomes, assuming that such assets are available. This depends on individual working and housing careers, as well as life experiences. In 2016 the Commission for Financial Capability report called for more work on decumulation tools and information on mechanisms for decumulation. A New Zealand Society of Actuaries report (2017) has guidelines about the use of such

make some drawings, often shifting money into term deposits in banks. More information is needed about the attitudes and expectations of KiwiSaver members and others, to assess the potential of this method of self-funding retirement incomes.

There are several options for decumulation, with the possibility that people will use more than one.

- Invest KiwiSaver lump sums and other savings, using the returns for current income needs, and leaving the capital for a ‘rainy day’ or bequest.
- Draw down capital and accumulated

Although KiwiSaver accumulations are as yet not high, the Commission for Financial Capability (2014) reported that about a third of members reaching 65 are withdrawing all their funds, a third are leaving them as investments, and a third make some drawings, often shifting money into term deposits in banks.

mechanisms, with the benefits and impacts of each approach.

Many people die with money in the bank. This may be because of intentional bequest motives, ‘rainy day’ contingency plans, conservatism, insufficient knowledge of decumulation options, premature death or inertia. Attitudes towards bequeathing are important. But with increased longevity, those receiving bequests may well be into their 60s – a way of funding the next generation’s retirement lump sums? The fall in homeownership will, of course, reduce the availability of funds to be passed on. Potential inheritances may be diverted into later life health and residential care costs as a means of self-funding, linked to the availability of health services.

Although KiwiSaver accumulations are as yet not high, the Commission for Financial Capability (2014) reported that about a third of members reaching 65 are withdrawing all their funds, a third are leaving them as investments, and a third

interest regularly, based on a target income, which can be altered if circumstances change. Capital access is maintained, but financial capability is required for this to operate successfully.

- Trade down to smaller/less expensive dwellings, which often have the added advantage of being more suitable for later life; or move into a retirement village where greater certainty about housing costs is offset by a significant charge on home equity and very limited options to move on to other housing (Stock, 2017).
- Commercial equity release schemes, mainly in the form of reverse mortgages with compounding interest on released capital loans, are further options and are widely used overseas (Davey and Wilton, 2006; Davey, 2010). This option also brings a much reduced ability to move to other accommodation as loans must be repaid on the client’s death or move into residential care.

- Commercial annuities. The presence of NZS as a universal and inflation-indexed quasi-annuity has impeded the development of a private sector life annuity market in New Zealand (St John, 2009). Among the barriers are uncertainties about longevity and the difficulty of obtaining adequate margins, alongside the need to set aside solvency capital. Regular annuity payments may also affect benefit eligibility (for the accommodation supplement and the residential care subsidy). New products, such as

of NZS. There is no work test for NZS and no compulsory retirement, so current settings encourage working longer (Davey, 2014). The Commission for Financial Capability included workforce ageing in its 2016 review of retirement income policies and recommended a national conversation and attitude change regarding older workers. To gain the potential economic and social benefits from extending workforce participation, investment in retraining and career transition support for older people (over 50) is a priority (this might usefully include support for entrepreneurship),

show that almost 80% of those aged 65 plus owned their own homes, usually mortgage free, resulting in relatively low housing-related expenditures and a consequential fall in income poverty after adjusting for housing costs. When all asset ownership is added, people aged 65 plus have a material deprivation level of 3%, compared to 18% for families with dependent children (Perry, 2017).

Homeownership is thus a way of pre-funding some retirement accommodation costs, although this is offset by the payment of rates, insurance, repairs and maintenance expenditures. But homeownership rates have been declining for all age groups, falling from a peak of 73.5% in 1986 to 65% in 2013, with projections of further decreases. A Department of Building and Housing report predicted that, by 2051, 21% of households where the reference person is 65 years old or older will be living in rented accommodation (Nana et al., 2008). The impact of this trend on the adequacy of NZS will need to be carefully monitored to ensure that poverty rates for older people in the future do not increase substantially.

The contribution of the accommodation supplement has already been mentioned. This potentially raises retirement income adequacy for older people who qualify, whether renters or owners. The impact of the winter energy payment has yet to be seen.

Conclusion

This analysis concludes that NZS is sufficient to provide a minimum standard of living, but any reduction of support in other areas (health, housing subsidies) will result in increases in income poverty. The decline in home ownership and higher rents are also likely to lead to an increase in material deprivation among older renters. To avoid these outcomes, consideration needs to be given to how NZS can be supplemented. As discussed in this article, government policies can bring improvements in this area, but there will be a fiscal cost, driven by population ageing.

The maturing of KiwiSaver accounts and other savings, and income flows from decumulation, have the potential to contribute significantly to an adequate standard of living in retirement. However,

Between the censuses of 2001 and 2013, the percentage of men aged 65-plus who were employed rose from 17 to 28% and of women from 7 to 16% ...

drawdowns associated with deferred and variable annuities, could be more acceptable, but are as yet relatively undeveloped.⁶ There could be a role for government in the annuities sector, although this may mainly benefit those who are already financially secure.

Given the need to achieve an adequate income in retirement by supplementing NZS, decumulation appears to be an accessible avenue for self-funding. It is worth pursuing as part of the policy mix and deserves more attention from policymakers.

Prolonging working lives

Extending working lives has resulted from better health, requirements for extra income, interest in work, and need for social contact and stimulation. It is serving a wider economic purpose by helping to ease labour and skills shortages. Between the censuses of 2001 and 2013, the percentage of men aged 65-plus who were employed rose from 17 to 28% and of women from 7 to 16% (Cameron, 2014). Earning income after the age of 65 will help to supplement NZS and increase overall retirement income.

Higher labour force participation will raise the tax base and thus the affordability

along with improved capability on the part of employers to manage an ageing workforce. Increased flexibility of employment, both part-time and part-week, would also make it easier to 'work longer'.

Adequacy of retirement incomes

The interaction of the policies examined above should ensure an adequate retirement income, as defined. NZS could be seen as the income floor below which superannuitants should not fall. At present, the level of NZS is just below the commonly used New Zealand poverty threshold of 60% of household median disposable income, suitably adjusted for family size and composition. In 2015, just over 30% of those aged 65 plus had incomes below this threshold, but they required relatively little income in addition to NZS to rise above it (Perry, 2017); hence the importance of ways to achieve this additional income, including earnings, self-employment and self-funding.

NZS settings were developed on the assumption that a high proportion of New Zealanders in retirement would be homeowners. Housing costs affect the level of income available for current expenditures, and thus material standards of living. Figures from the 2013 census

for people on low incomes, with few assets or savings, there may be insufficient avenues for decumulation, so NZS will remain the basis for their retirement income. And for people already close to retirement there may be insufficient time for principal and accumulated interest to provide an adequate KiwiSaver fund to draw on.

By OECD standards, New Zealand spends a low proportion of its GDP on pensions, mainly because of flat-rate NZS compared to earnings-related pensions overseas. In 2015 this was 5.1% of GDP as opposed to 8.2% for the OECD overall. There are many other legitimate claims on government spending, ranging from poverty relief for working-age families, to education, affordable housing, mental health services, tax cuts, etc. Easing of the 'burden' of NZS, perhaps with the maturity of KiwiSaver accounts, may open up resources for reallocation.

As well as fiscal considerations, an examination of retirement income policies, their trends and interrelationships, highlights the importance of social and

behavioural issues. These include intergenerational equity and fairness between age groups in terms of contribution and receipt of benefits (which the New Zealand Superannuation Fund was designed to address in part). Rising expectations of lifestyles and access to services are often attributed to the baby boom generation. This supports the need for savings and decumulation and probably for a higher degree of private provision. Deeply ingrained in New Zealand society is the historic preference for homeownership over renting, and feelings of entitlement to government support as against the requirement to self-fund. All these have political implications and resonate with politicians.

The debate about retirement income policies at the public level needs to be widened, with better understanding of interconnecting policies and political trade-offs. Movement towards this goal can be seen in the 2016 review of retirement income policies. As well as developing policy instruments for addressing the sustainability and adequacy of retirement

incomes, it is crucial for government to recognise the interdependencies outlined in this article and work towards a unified policy approach to ensure adequacy of retirement incomes and intergenerational equity.

- 1 For convenience this means all people aged 65 plus (the current age of eligibility for NZS). This age group is the generally accepted definition of 'older people', although there is no official or compulsory retirement age in New Zealand.
- 2 The Labour-led government elected in 2017 intends to resume contributions to the New Zealand Superannuation Fund after the National-led government ceased to add to the fund during its term of office.
- 3 Cutting government expenditure can also include stopping New Zealand Superannuation Fund contributions, as done by successive National-led administrations between 2008 and 2017. While this reduced the then government deficit, it came at the expense of the size of the fund, and thus intergenerational equity.
- 4 The purpose of the KiwiSaver Act 2006 is to encourage a long-term savings habit and asset accumulation by individuals who are not in a position to enjoy standards of living in retirement similar to previous standards. The act aims to increase individuals' well-being and financial independence, particularly in retirement. Both employees and employers contribute to individual accounts, held by registered KiwiSaver providers. Funds mature at age 65, but can be withdrawn as a deposit for a first home and there is a provision for financial hardship withdrawals or 'holidays' from contribution.
- 5 The Labour-led government has not yet indicated what action it will take on these recommendations.
- 6 A recently launched product – Lifetime Retirement Income – offers a tax-paid fortnightly income for all of the investor's life, based on returns from an initial invested sum.

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