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Resilience and future wellbeing: The start of a conversation on improving the risk management and resilience of the Living Standards Capitals

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Resilience and Future Wellbeing

The start of a conversation on improving the risk management and resilience of the Living Standards Capitals

Margreet Frieling and Ken Warren

Living Standards Series: Discussion Paper 18/05

July 2018

DISCLAIMER

This paper is one of a series of Discussion Papers on wellbeing in the Treasury's Living Standards Framework (LSF). The papers on the relationship between the LSF and the Sustainable Development Goals, Financial/Physical Capital, and the note on the role of culture in the LSF are all Discussion Papers. The Discussion Papers are not the Treasury's position on measuring intergenerational wellbeing and its sustainability in New Zealand. Our intention is to encourage discussion on these topics.

There are marked differences in perspective between the papers that reflect differences in the subject matter as well as differences in the state of knowledge. The Treasury welcomes comments on these papers to help inform our ongoing development of the Living Standards Framework.

**NZ TREASURY
DISCUSSION PAPER 18/05**

Resilience and Future Wellbeing

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Executive summary

The decentralised and siloed nature of much of New Zealand's risk management means that insufficient attention is paid to the interconnectedness and cascading nature of risk factors. A more proactive, coordinated and evidence-based approach to risk management and resilience building is required to maintain societal resilience and sustainability in the face of the complex risks we are facing domestically and globally.

Because of the cross-cutting nature of risks, cross-government coordination is key to strengthening our overall resilience. A national framework of primary risk factors for New Zealand, together with a cross-government, future-focused agenda for resilience building, can offer an integrated system for determining resilience objectives, setting targets, action and evaluation measures.

The Department of the Prime Minister and Cabinet (DPMC) has started work in this direction and is developing a National Risk Register for New Zealand. DPMC has identified at least four categories of long-term trends (environmental, societal, economic and technological) that influence the risk landscape for future wellbeing. This paper provides a first exploration of how these four overarching trends influence the risk landscapes for the four capitals in the Treasury's Living Standards Framework (LSF): natural; economic; human; and social capital.

This paper is meant as a starting point for an open conversation between risk practitioners and policy-makers across government, as well as iwi and Māori community representatives, researchers across different disciplines, think tanks, not-for-profit organisations and wider civil society representatives, on how to better incorporate risk management and resilience building into public policy. Ultimately, the identification of risk and resilience factors for each of the four capitals will help policy analysts better evaluate policy proposals against risk and resilience factors for sustainable wellbeing.

The paper is part of a series of discussion papers that the Treasury will issue this year. At this time, papers are also being released on financial/physical capital, Māori wellbeing, Pacific peoples wellbeing and the sustainable development goals in the context of the LSF. The papers start the conversation and should be seen in that light. We highly welcome feedback from readers on what is proposed, including the identified risk and resilience factors for each of the capitals as well as reflections on the proposed institutional context for better risk management and resilience building.

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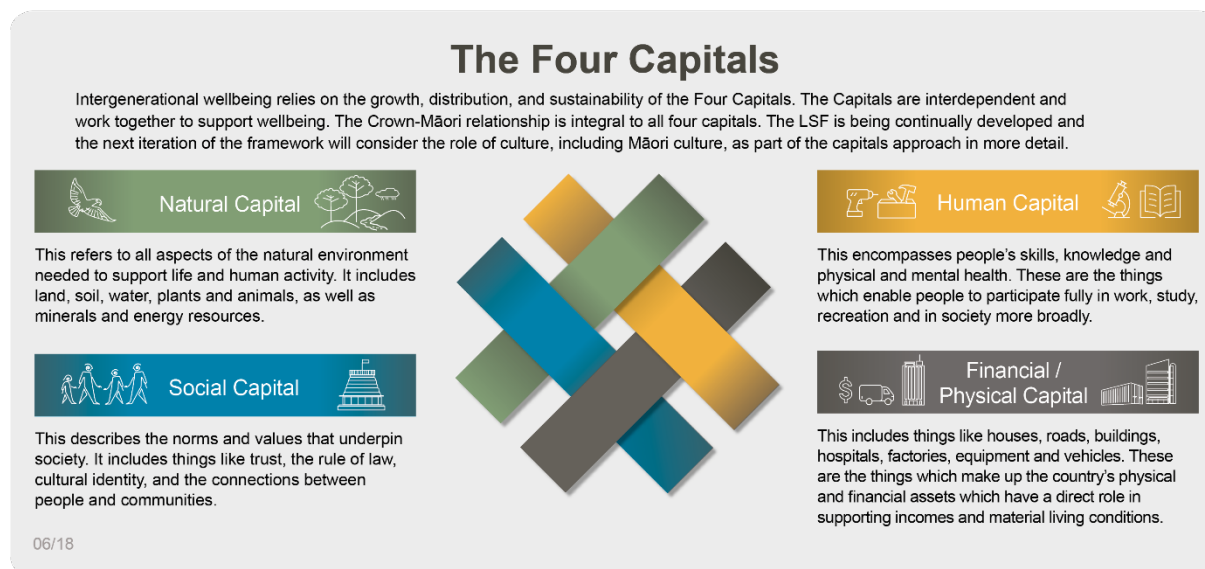
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Section 1: Background

1. Introduction

Risk is widely regarded as the impact of uncertainty on objectives. This paper explores indicators of risk and resilience in the context of the Treasury's Living Standards Framework (LSF). The overall objective of the LSF is to maximise intergenerational wellbeing. The LSF puts sustainable, or intergenerational, wellbeing at the core of policy development and evaluation. At the centre of the framework are four capitals (see Figure 1).

Figure 1 – The Treasury's Four Capitals framework¹



¹ LSF Capital models are also being developed from Te Ao Māori and Pacific perspectives.

The four capitals in the LSF help policy-makers to take into account the range of impacts that a policy option may have on the material and non-material factors that affect New Zealanders' wellbeing, now and in the future. The underlying principle of the capitals framework is that good public policy enhances the capacity of natural, social, human and financial/physical capital to improve wellbeing for New Zealanders. In order to do so in a sustainable way, good policy should contribute to risk management and resilience building for all four capital stocks that constitute future wellbeing.

Why focus on better risk management and resilience building?

The institutions that enable society to absorb shocks and stresses, and support recovery from them, are critical to wellbeing. The improved efficacy of these institutions from the start of the industrial revolution has strong explanatory power for the surge in world economic growth from then compared to previous centuries (Haldine, 2018). The stabilising role and resilience that these institutions provided have permitted the risk-taking and innovation necessary for the great advances in wellbeing that have been achieved in the past 250 years.

Today, however, risk management is increasingly challenged by the complexity of our current day societies, in which multiple systems simultaneously impact on the four Living Standards Capitals. Risk management in such complex circumstances requires a greater allowance for uncertainty and a shift from reactive to proactive risk management. To that end, decision-makers in both government and the private sector require more

comprehensive strategies that combine active management of specific risks with enhancement of generic resilience in society (Helm, 2015).

Currently, many risks of national significance are managed at a local level without institutions to provide a view on national risk tolerances and standards. Moreover, there is often little backbone to the networks whereby risk managers across agencies collaborate with each other. Therefore, there is opportunity for improving the attention that is paid to the interconnectedness and cascading nature of risk factors. For example, decisions on land use impact not only on the resilience of our natural capital (eg, the absorption capacity of our biodiversity), but also on the resilience of our physical capital (eg, the capacity of our infrastructure to absorb natural disasters such as floods) and of our human capital (eg, through exposure to natural hazards). The generic resilience in society is thus significantly impacted by these decisions.

As Jonathan Boston, Professor of Policy Studies at the Victoria University of Wellington School of Government, has noted, New Zealand “lacks a unified approach to the identification, monitoring and reduction of risk” (Deloitte, 2017, p. 29). This appears to not just be an issue in the public sector, but also in New Zealand’s private sector. The 2018 Guinness report found that reporting on global risks by New Zealand businesses is weak or missing and that Extended External Reporting (EER)¹ in New Zealand has slipped behind what would internationally be considered good practice (Guinness, 2018, p. 1).

A further opportunity for improvement of our risk management and resilience building lies in the use of scientific evidence for risk management and decision-making under uncertainty, a subject discussed in a series of papers from the Office of the Prime Minister’s Chief Science Advisor (2016a, b). In one example, the New Zealand Institute of Economic Research (NZIER, 2014) has commented that New Zealand’s water management system requires a more coordinated approach based on policy-related research: “Without performance metrics, decision makers rely on their own experience and instincts that may or may not lead to good water management policy. This ‘hit or miss’ approach to such an important issue is unlikely to lead to good outcomes” (NZIER, 2014, p. iv). Policy-makers need to understand the strengths and weaknesses of the research and be active in challenging researchers to answer the pertinent policy and/or risk treatment questions.

In short, a more proactive, coordinated and evidence-based approach to risk management and resilience building is required to maintain societal resilience and sustainability in the face of the complex risks we are facing domestically and globally. DPMC has started work in this direction. For example, the Science Policy Exchange is a new forum for early career scientists and policy professionals who are interested in better understanding the nexus between public policy and science so as to help improve the possibilities for scientifically informed public policy. Moreover, DPMC’s National Risk Unit is developing a National Risk Register (NRR) for New Zealand. They have identified a number of long-term trends (environmental, societal, economic and technological) that influence the risk landscape for future wellbeing. Four globally significant and widely accepted trends are: 1) Climate change and environmental degradation; 2) Changing demographics and income or wealth inequality; 3) Global economic growth and productivity; and 4) Digital connectivity and technological change.

¹ Extended External Reporting (EER) includes all information above and beyond what a company is required to provide under the Companies Act 1993 and the Financial Reporting Act 2013, such as information on a company’s outcomes, governance, business model, risks, prospects, strategies and its economic, environmental, social and cultural impacts.

This paper provides a first exploration of how these four trends influence risks and resilience for each of the four Living Standards Capitals. Bringing risk and resilience factors for the four capitals together in one place offers two important benefits. Firstly, it encourages a comprehensive, rather than siloed, perspective on risk and resilience, which takes into account the ways in which risk and resilience factors across the different capitals mutually reinforce each other. Secondly, it encourages a more systematic consideration of risk and resilience across the four capitals. This is important because, traditionally, risks tend to be looked at from certain capital perspectives (eg, financial and natural capital viewpoints) more than others (eg, human and social capital viewpoints).

About this paper

The remainder of this paper is organised as follows. Chapter 2 defines the concepts of risk and resilience and introduces the four overarching trends that impact on risks. Chapters 3 to 6 in Section 2 identify risk and resilience factors for each of the four capitals. Risk factors are identified based on the four overarching trends and a review of the international and domestic literature on the impacts of these trends on the capitals. Subsequently, Section 3 of this paper makes a start at exploring the requirements for an institutional environment that better supports the incorporation of risk management and resilience building strategies across the public sector. It includes three case studies about how other countries have anchored futures thinking into public policy and have encouraged inter-agency collaboration for a more coordinated approach.

It should be noted that, whilst this paper identifies risks and resilience factors, it does not comment on which are the best policies to manage these risks or achieve better resilience. The identification of opportunities to manage risks and strengthen resilience is best left to the expertise of policy-makers in the different domains. Rather, the focus of this paper is on: 1) developing a framework for risk and resilience factors for each of the four Living Standards Capitals; and 2) exploring the institutional settings that can aid or hinder policy-makers in making the best decisions for the future wellbeing of New Zealand in the face of uncertainty.

We value your feedback

To further inform our understanding of risk and resilience for the four Living Standards Capitals, this paper seeks input from people with a broad range of knowledge and experience, from within the public and private sectors as well as civil society. Therefore, this paper is written for a broad audience of risk specialists and policy-makers (across different sectors and at national as well as regional and local levels), iwi and Māori community representatives, researchers across different disciplines, think tanks, not-for-profit organisations and wider civil society representatives. This paper is intended to be a means to start the conversation, rather than a finished product, and should be seen in that light. We highly welcome feedback from readers on what is proposed, including the identified risk and resilience factors for each of the capitals as well as further reflections on the required institutional context for better risk management and resilience building. In addition, we are aware that the current literature review is based on Western sources mainly. To address this limitation, we welcome contributions from other cultural perspectives on ways to conceptualise risk and resilience factors across the four capitals for New Zealand.

2. Defining risks and resilience

Risk and uncertainty

In economic literature, the notion of Knightian uncertainty is used to distinguish true unknowns from more quantifiable risks. Knight (1921, pp. 19–20) wrote that: “It will appear that a measurable uncertainty, or ‘risk’ proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all.” Knight thus distinguished uncertainty from the concept of risk, whereby risk refers to situations where outcomes are unknown but governed by known probability distributions. Uncertainty, on the other hand, applies to situations where we cannot know all the information we need in order to understand the probability distributions in the first place. In the case of risk, decision-making rules such as maximising expected utility can be applied. Such decision-making rules are not possible with Knightian uncertainty, where outcomes are governed by an unknown probability model. Knight thus concluded that “[y]ou cannot be certain about uncertainty” (Knight, 1921, p. 84).

Yet, uncertainty plays an essential part in our modern-day society. In today’s interconnected and complex world, traditional actuarial methods for risk modelling and expected value accounting, even when supported with modern computing power and ‘big data’, prove unsatisfactory in the face of society’s level of uncertainty and complexity. Therefore, rather than confining ourselves to quantifiable risks, this paper proposes a pragmatic approach that builds on a mix of both quantitative as well as qualitative data to support proactive risk management decisions and resilience building strategies. While quantitative approaches may be preferable, qualitative scores based on expert opinion can provide invaluable indications of areas of pending risk.

This paper considers four overarching trends that impact on risks for New Zealand’s Living Standards Capitals:

- **Climate change and environmental degradation.** Climate change and environmental degradation impact on a wide range of risks owing to their effects on sea level rise, the frequency and severity of natural hazards and extreme weather, biodiversity and the availability and quality of ecosystems and their services, including provisioning, regulating and cultural ecoservices.
- **Changing demographics and income or wealth inequality.** New Zealand society is becoming older and more ethnically diverse. These trends, as well as changes in levels of income or wealth inequality, impact the risk landscape of the different capitals.
- **Global economic growth and productivity.** Global economic growth and productivity have implications for national risks, even when economic trends appear to be concentrated overseas. For example, resource scarcity in other parts of the world could encourage maritime incursions into New Zealand’s Exclusive Economic Zone. Similarly, shifting international demands are likely to impact on our economy with subsequent flow-on effects.
- **Digital connectivity and technological change.** While technological change can be a source of risk (eg, cyber-crime), it can also offer the means for managing it. For example, digital connectivity and technological change has greatly enhanced our ability to analyse complex data about risks. Moreover, tools such as cell broadcasting can improve the reach of early warning messages for natural hazards.

This paper provides a first exploration of how the above trends influence risks for each of the four Living Standards Capitals.

Resilience

Resilience is commonly defined as the capacity for “bouncing back faster after stress, enduring greater stresses, and being disturbed less by a given amount of stress” (WEF, 2013, p. 37). However, major risks are often systemic in nature, and a system – unlike an object – may show resilience not by returning exactly to its previous state, but instead by finding different ways to carry out essential functions; that is, by adapting and maintaining system function in the event of disturbance. The World Economic Forum (WEF, 2013, pp. 38–39) therefore defines a resilient country as one that has the capability to:

- adapt to changing contexts
- withstand sudden shocks, and
- recover to a desired equilibrium, either the previous one or a new one, while preserving the continuity of its operations.

This is similar to the definition of resilience in the Sendai Framework for Disaster Risk Reduction, to which New Zealand is a signatory. In the Sendai framework, resilience is defined as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (UNISDR, 2017).

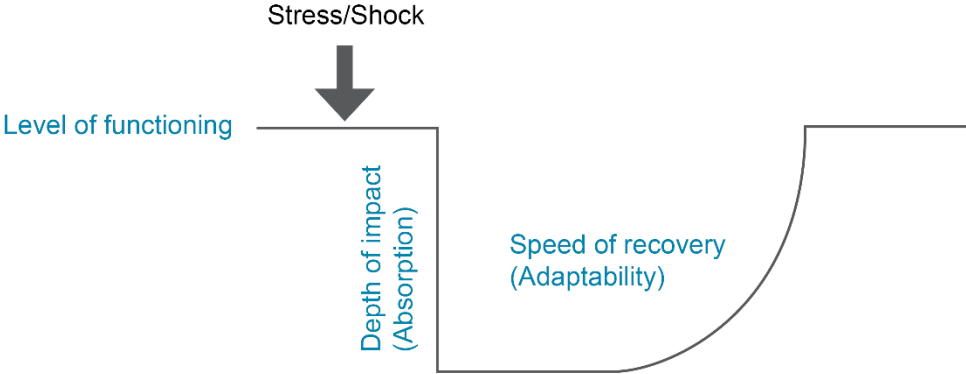
While risks tend to focus on the negative consequences from uncertainty, the concept of resilience encourages us to grasp opportunities and innovate to: 1) help protect us from vulnerability; and 2) be able to better deal with the impact from shocks and stresses as they occur. The concept of resilience enables identification of protective factors and opportunities for dealing with risks across the four Living Standards Capitals. The degree of vulnerability then depends on the nature, magnitude and duration of the shocks or stresses that are experienced as well as the level of resilience of the capital to these shocks (cf. Boston, 2014, p. 18).

Under all of the above framings, resilience has two dimensions, which are proposed to be incorporated into the Living Standards Framework:

- an *absorption capacity* dimension, which comprises resistance and buffers that can reduce the *depth of impact*, and
- an *adaptability* dimension, which focuses on elements of adaptability and innovation that maximise the *speed of recovery*.

Figure 2 below illustrates this framework. Shocks and stresses are risks that have the potential to challenge New Zealand’s intergenerational wellbeing. These risks can be single, sequential or combined in their origin and effects. A shock can be seen as a sudden, disruptive event with an important and often negative impact on (a) system(s) and its assets. Instead, a stress is a longer-term pressure with an important and often negative impact on (a) system(s) and its assets.

Figure 2 – Two dimensions of resilience: Absorption and Adaptability



When a system is subject to a stress or shock, the level of functioning declines, and can fall rapidly. The depth of the fall in functioning can be thought of as the absorption capacity of the system (see Figure 2, 'Absorption'). A system with a high absorption capacity experiences only a small loss in functioning (eg, because it has sufficient buffers to absorb the stress or shock to ensure it continues to achieve desired outcomes). The speed of recovery dimension is captured by the time lag in Figure 2 between the stress or shock and when functioning returns to a steady-state level. Systems that have high adaptability are able to recover faster than is otherwise the case. The two dimensions together acknowledge that the total impact of a shock is a function of both the depth of the impact and the time it takes to recover. This paper looks to apply both these viewpoints in its discussion of resilience.

Section 2: Risk and Resilience for the Four Capitals

The following four chapters provide a first compilation of risks and resilience factors across the four capitals, building on a literature review on how the four overarching environmental, societal, economic and technological trends impact on each of the LSF capitals. The literature review is based on the international grey and scientific literature, as well as New Zealand-based reports where available. Resilience factors are identified from both an absorption and adaptation approach, as described in the previous section. The identified factors should be seen as a starting point for a much wider conversation between policy-makers across government, as well as risk practitioners, iwi and Māori community representatives, researchers across different disciplines, think tanks, not-for-profit organisations and wider civil society representatives, about how to better incorporate risk management and resilience building into public policy.

As mentioned in the introduction to this paper, organising risks and resilience factors for each of the four Living Standards Capitals offers a comprehensive view that can help to clarify the interconnectedness and cascading nature of risks across the four domains. It also encourages a more systematic consideration of risk and resilience for each of the four capitals. At the same time, the capitals approach is likely to identify certain types of risks more than others. For example, the capitals approach is less likely to identify risks that don't have a specific relationship to a certain capital domain, but may nonetheless impact on all capitals, such as terrorism and transnational organised crime. The Capitals organising framework is therefore proposed as another lens through which to assess and understand risk and resilience, which can complement other organising frameworks such as the NRR framework developed by DPMC.

We start our discussion of risks and resilience factors with natural capital, given the large number of flow-on effects from natural capital risk and resilience factors on the other three capitals.

3. Risk and resilience for natural capital

Natural capital refers to all aspects of the natural environment. It includes individual assets such as minerals, energy resources, land, soil, water, trees, plants and wildlife. It also includes broader ecosystems and services that are critical for our wider wellbeing, including provisioning ecoservices, regulating ecoservices as well as cultural ecoservices. An additional dimension in natural capital is the joint functioning of, or interactions among, different environmental assets, as seen in forests, soil, aquatic environments and the atmosphere (Van Zyl & Au, 2018). In *The Start of a Conversation on the Value of New Zealand's Natural Capital*, Van Zyl and Au (2018) summarise different ways of measuring and evaluating the value of natural capital in New Zealand.

3.1 Risk factors²

The four environmental, societal, economic, and technological trends all influence the natural capital risk landscape:

- Climate change and environmental degradation has the most direct impact on the sustainability of our natural capital. Climate change is increasing the frequency and intensity of extreme natural events (eg, flooding, droughts and wildfires), challenging the adaptability of a wide variety of species, causing sea level rise and making our surrounding oceans more acidic. In addition, environmental pollution and pests and diseases also pose severe risks to New Zealand's biodiversity and ecosystems. The Climate Change Adaptation Technical Working Group (CCATWG, 2017, p. 29) described that "[b]oth the compounding effect and the interaction of climate change with other stressors, such as invasive species, has the potential to have a significant impact on our terrestrial, freshwater, coastal and marine ecosystems".
- Climate change and environmental degradation are heavily influenced by Global economic growth and productivity. While New Zealand's contribution to global gross greenhouse gas emissions is small (0.17%), we have the fifth-highest level of emissions per person of the 35 countries that are part of the Organisation for Economic Cooperation and Development (OECD, 2017a). New Zealand's emission profile is an outlier amongst developed countries. More than three-quarters of New Zealand's electricity generation uses renewable resources (primarily hydro generation), which has helped keep New Zealand's energy generation emissions relatively low. Yet, agriculture – which New Zealand's export-dependent economy currently relies heavily on – comprises almost half of our gross emissions (47.9%) (MfE, 2017b).
- In terms of Changes in demographics and income or wealth inequality, population growth will further increase the pressures on our natural environment (eg, by increasing waste and pollution as well as land use for human settlement). At the same time, economies of scale can make required transitions towards a low-carbon economy easier. With regard to changes in income or wealth inequality, that may induce a dividing force that will likely make it more difficult to establish shared objectives within society and to mobilise whole-of-society efforts to protect public goods such as the natural environment.

² This section focuses on factors that put the natural environment at risk. Risks stemming *from* the natural environment (eg, natural hazards such as earthquakes) will be discussed with regard to the capital stocks that they put at risk.

- Lastly, Technological change, is an essential component of climate-change mitigation and adaptation (eg, through energy efficiency improvements and the generation and application of renewable energy technology).

Based on these four trends, the primary risk to New Zealand's natural capital is 'Insufficiently timely climate-change mitigation and adaptation'.

Insufficiently timely climate-change mitigation and adaptation. The Ministry for the Environment (MfE) reports that climate change is already potentially irreversibly affecting New Zealand's natural systems. We can expect more severe effects on the environment and our human systems as the climate continues to change (MfE/Stats NZ, 2017a). The full extent of future global warming depends on emissions added from this point forward (MfE/Stats NZ, 2017a, p. 6). MfE reports that New Zealand's gross greenhouse gas emissions rose 24% from 1990 to 2015 (MfE, 2017a). Agriculture is New Zealand's largest emission sector and produced nearly half of our greenhouse gas emissions in 2015. Yet, road transport had one of the largest increases in emissions since 1990 (78%). From 1990 to 2015, our net greenhouse gas emissions rose 64%, as a result of increasing gross emissions and higher logging rates in production forests.³ MfE has expressed concern about forest harvest rates that have been increasing since 1990 and are expected to continue to increase through the 2020s, as harvest rates are one of the main drivers of New Zealand's net emissions. The increase in emissions from more harvesting is compounded by recent low rates of new forest planting (MfE, 2017b).

In its *National Communication and Biennial Report 2017 Snapshot* (MfE, 2017b), MfE summarises how New Zealand is meeting its international commitments on climate change, as part of New Zealand's obligations under the United Nations Framework Convention on Climate Change (UNFCCC). New Zealand's past target under the first Kyoto Protocol commitment period (CP1) was to reduce greenhouse gas emissions to 1990 levels between 2008 and 2012. New Zealand's current target under the UNFCCC is to reach 5% below our 1990 greenhouse gas emission levels by 2020. In 2016, New Zealand ratified the Paris Agreement and announced the target to reduce greenhouse gas emissions to 30% below 2005 levels by 2030. The Ministry concludes that "projections [of New Zealand's greenhouse gas emissions] show we need to do more to meet our targets" (MfE, 2017b, p. 3). Based on current data and policies, New Zealand's gross emissions are projected to gradually decrease to 77.2 Mt CO₂ -e by 2030. This is still 19.6% above the 1990 levels and 6.4% (rather than 30%) below 2005 levels. Nonetheless, New Zealand was confirmed to have met its past target under the Kyoto Protocol in 2016, and is considered to be on track to meet its current and future targets through a mix of reducing emissions domestically, planting forests to absorb carbon dioxide, and offsetting our emissions by buying emission reductions from overseas. However, the OECD (2017b) notes that the feasibility to deploy "negative emissions" at scale is a major uncertainty going forward, despite being an important feature of most scenarios consistent with the Paris Agreement's goals.

In addition to climate change, other risks to the natural environment include degrading environmental quality, accelerating biodiversity loss, and natural resource depletion, and their additional drivers such as land and water use, pollution and waste and introduced pests and diseases.

³ Net emissions acknowledge the role of carbon sinks, such as growing forests, in removing atmospheric greenhouse gases but also adding them when forests are harvested and land use is changed (MfE, 2017a, p. 6).

Degradation of environmental quality. Decreasing environmental quality poses risks to ecosystems, as well as lowering the use value of natural capital and the ecosystem services it provides. There are many factors that decrease the quality of New Zealand's terrestrial, freshwater, coastal and marine ecosystems and the ecosystem services they deliver. Pollution and industrial and household waste degrade the quality of natural habitats. At the same time, human land use (eg, farming, building activities, road network configurations) affects the quality and connectivity of ecosystems. While *Environment Aotearoa 2015* (MfE/Stats NZ, 2015, p. 24) notes a significant improvement in air quality overall since 2006 (mainly driven by the shift to cleaner home heating), the quality of water in New Zealand's lakes, rivers, streams and aquifers is variable, and depends on the dominant land use in the catchment (MfE/ Stats NZ, 2017b).

The quantity and quality of our soil are affected by erosion and intensification of agriculture. Of the 192 million tonnes of soil that is estimated to be lost each year, 44% comes from exotic grassland. In terms of soil quality, soil monitoring programmes in 11 regions across the country between 2014 and 2017 show that more than 48% of tested sites were outside the target range for two soil quality properties – 'phosphorus content in soil' and 'macroporosity' (which is part of the soil's physical status and for which 'too low' is an indicator of soil compaction). High soil phosphorus levels and low macroporosity can have negative impacts on water quality and production. Soils with intensive land uses, such as dairy, cropping and horticulture, and dry stock, were more frequently outside of the target range for these two soil quality indicators (MfE/Stats NZ, 2018).

Decreasing environmental quality poses risks to ecosystem services, including the provisioning ecoservices, regulating ecoservices and cultural ecoservices that natural capital provides. Provisioning ecoservices include soil productivity, gas and mineral production, timber production, wild fish harvest and water abstraction. These provisioning ecoservices are important for New Zealand's economic wellbeing. Regulating ecoservices include flood protection, storm protection, erosion protection, carbon sequestration and air pollutant absorption. These regulating services are critical for our human capital (including our health and the impact of natural disasters on human lives) as well as the sustainability of our natural and physical capital. Cultural ecoservices include outdoor recreation and amenities, taonga and symbolic values, natural heritage and access to areas that are important to cultural practices. These cultural ecoservices are important for our mental, physical and cultural health.

Accelerating biodiversity loss. Biodiversity is the variability among living organisms and the ecological systems of which they are a part. It includes the diversity within species, between species and of ecosystems. Biodiversity is important for many reasons. In addition to the intrinsic (existence) value of biodiversity, which is recognised in the Resource Management Act 1991, New Zealand's biodiversity also has global importance: 52% of New Zealand's indigenous species are found nowhere else on Earth. The benefits that we get from biodiversity (ecosystem services) include the functions that support life, such as the provision of food, materials and ingredients for medicines, water purification and regulation, erosion regulation, as well as economic, social and cultural benefits (eg, tourism and recreation) (MfE/Stats NZ, 2015, pp. 104–105).

Human land use and pollution result in biodiversity loss. For example, there is continued loss of indigenous land cover. Between 1996 and 2012 there was a net loss of 31,000 hectares of tussock grassland, 24,000 hectares of indigenous shrubland and around 16,000 hectares of indigenous forests, through clearance, conversion and development. Although these areas represent a small proportion of each land cover type, the ongoing loss continues to threaten indigenous biodiversity. These factors are further compounded by the fast pace at which

climate change affects our ecosystems, which struggle to adapt. For example, ocean warming and acidification (caused by climate change) pose risks to many ecologically important species in New Zealand's marine environment. Pests and diseases form a risk to New Zealand's indigenous as well as its wanted introduced natural capital.⁴ Lastly, certain ways to combat climate change, such as hydroelectric installations, also carry risks to biodiversity and therefore need to be carefully managed (McGlone & Walker, 2011).

New Zealand's species extinction rate is among the highest in the world (OECD, 2017a). Many of New Zealand's unique species are highly specialised (eg, tuatara), limited in number (eg, takahe) and/or have specialised habitat requirements (eg, frogs and lizards). These factors reduce their capacity to adapt to a changing climate (CCATWG, 2017, p. 29). The conservation status of seven bird species, three gecko species and one species of ground wētā is worsening. Many of these are taonga species (MfE/Stats NZ, 2018). As unstable ecosystems are more likely to lose species, losses of biodiversity tend to feedback on themselves, causing an acceleration with even more losses of species.

Natural resource depletion. Resource depletion is the consumption of a resource faster than it can be replenished. Growing populations, economic production processes and the demands and lifestyles of the developed world mean that we are using more natural resources than what is sustainable. Depletion of natural resources threatens the availability of natural capital for future use, the functioning of the food chain, ecological stability and economic productivity. An example of resource depletion is the loss of some of New Zealand's most versatile land and high class soils to urban expansion. Versatile and high class land is important to retain as it has few natural limitations to production. It has generally been classified as classes 1–2 or 1–3 in the Land Use Capability (LUC) system (Lynn et al., 2009). Land classified as LUC 1–2 covers only 5.2% of New Zealand (Rutledge et al., 2010). Studies based on changes in land cover indicate that, between 1990 and 2008, 29% of new urban areas were on some of our most versatile land. Additional examples of resource depletion include overfishing, deforestation and fresh water depletion.

3.2 Resilience factors

Absorption

For natural capital, absorption capacity refers to the ability to absorb shocks or stresses without triggering non-linear, abrupt environmental change.

Planetary boundaries. At a global level, work has developed on identifying and measuring planetary boundaries, or thresholds that go beyond absorption levels. For example, Rockström et al. (2009) suggested nine planetary boundaries for: Stratospheric ozone depletion; Loss of biosphere integrity; Chemical pollution and the release of novel entities; Climate change; Ocean acidification; Freshwater consumption and the global hydrological cycle; Land system change; Nitrogen and phosphorus flows to the biosphere and oceans; and Atmospheric aerosol loading. Natural capital absorption capacities diminish as those

⁴ As former New Zealand politician and current Parliamentary Commissioner for the Environment, Simon Upton, noted in a 1999 speech: "The indigenous ecology is still in the throes of a traumatic round of extinctions as a result of the arrival of humans around 800 years ago and a host of four-legged predators subsequently. The introduced agri-business ecology is in a fragile state but for the opposite reason: its vigour relies in no small part on the absence of predators and pathogens that were left behind in large numbers at the time of European colonisation but could arrive at any time" (Upton, 1999).

thresholds approach. *New Zealand's Environmental Reporting Series* (MfE/Stats NZ, online source) includes trend measures for these categories. For example:

- *Climate change*. New Zealand's gross greenhouse gas emissions rose 24% from 1990 to 2015.
- *Ocean acidification*. The pH of New Zealand's sub-Antarctic waters decreased 0.0015 units a year between 1998 and 2016.
- *Nitrogen and phosphorus flows to the biosphere and oceans*. From 1990 to 2012, the quantity of nitrogen leached from agriculture annually increased by an estimated 28.6% (30.4 million kilograms).
- *Loss of biosphere integrity*. In 2014, New Zealand had 71 identified rare ecosystems, with 45 of them threatened with extinction.

However, with the exception of fresh water standards, New Zealand does not currently have a generally accepted science-informed process to set the desired levels of absorption capacity, or safety margins, in each of these areas.

Adaptation

- The impact of the above risks to our natural capital on our intergenerational wellbeing is critically dependent on the adaptation activity we undertake. From an adaptation perspective, high quality and comprehensive regulations, strong biosecurity and a whole-of-society response are essential components to prevent further damage to the natural environment and to support recovery. Moreover, the Climate Change Adaptation Technical Working Group (CCATWG, 2018, p. 8) has recommended that, for adaptation to climate change to be effective, New Zealand needs the following foundational actions: a regularly updated national adaptation action plan; a regularly updated national climate change risk assessment to prioritise actions; and a monitoring and reporting function for assessing the progress of implementing the national adaptation action plan and its effectiveness in addressing changing risks and priorities.
- **High quality and comprehensive institutional regulations for sustainable use of natural capital.** New Zealand's key environmental planning legislation is the [Resource Management Act](#). In 1991, the Act was internationally lauded for making environmental impact assessment an integral part of the planning and approval process. However, since then, concerns have been raised about the processes of the Act. Fast-tracking of environmental approvals has been seen to limit scope for public participation in environmental decision-making. As Palmer (2013) has argued, the concern that the balance of the Act is not right and has tipped too far in favour of development is confirmed by the fact that almost all environmental indicators in New Zealand have become worse since we have had the Act, not better. Further concern has been raised about local governments being challenged by the important tasks that were set out for them in the Resource Management Act, and central government making limited use of its power to regulate to provide uniform standards in areas where these are needed (see Cheyne, 2013; Palmer, 2013). The OECD's Environmental Performance Review of New Zealand (2017a) has urged to strengthen national-level management of air and water pollution and hazardous waste with more guidance and support to local authorities. The above concerns suggest that considerable opportunities towards more sustainable use of natural capital lie in the improvement of environmental protection legislation and regulatory processes as well as more effective collaboration between stakeholders.

- **Strong biosecurity.** Biosecurity forms an important part of protecting New Zealand’s indigenous natural capital as well as our wanted introduced natural capital. Biosecurity helps to keep pests and diseases out of New Zealand, both to avoid additional pressures on indigenous biota and to conserve the competitive advantage of wanted introduced species.
- **Whole-of-society collaboration for environmental protection and restoration.** Effective collaboration between public, private and civil society stakeholders towards environmental protection and restoration is critical to adaptive capacity. In relation to mobilising this whole-of-society response, the New Zealand Climate Change Adaptation Technical Working Group (CCATWG, 2017) has done a stocktake of what New Zealand sectors are doing to adapt to climate change. With regard to central government, the Working Group found that “Central government has played a key role in funding research which provides the basis for building New Zealanders’ understanding of climate-related changes and the impacts this will have on different sectors of society.” At the same time, they noted that “[c]entral government’s agencies’ understanding of how climate change will impact on their responsibilities and operations is less clear. There is some misalignment in how climate change adaptation and resilience objectives are incorporated into legislation and policy. As a result, central government agencies’ response to adaptation is not currently coordinated and there is little alignment of adaptation goals or agreement on priorities” (CCATWG, 2017, p. 45).

With regard to New Zealand’s primary industries, including agriculture, the Working Group (CCATWG, 2017, pp. 80–81) notes that action undertaken by the primary sector in response to climate change varies considerably across sectors and individual farmers. A number of primary industry bodies and businesses reported that adaptation to climate change is not always considered a priority for their sectors compared to issues around financial viability, biosecurity and more immediate environmental issues (such as water quality and availability). In terms of the public understanding of environmental issues, the Lincoln University *Public Perceptions of New Zealand’s Environment 2016* (Hughey, Kerr, & Cullen, 2016, p. 52) reported that “Most respondents, consistent with previous surveys, considered the condition of New Zealand’s native plants and animals to be ‘adequate’ or ‘good’ (...). This public lack of understanding of the seriousness of the problem could ultimately hinder acceptance of additional expenditures and programmes in this area.”

4. Risk and resilience of financial/physical capital

Financial/physical capital includes things like investments in houses, roads, buildings, hospitals, factories, equipment and vehicles. These are the things that make up the country's physical and financial assets which have a direct role in supporting incomes and material living conditions. In *The Start of a Conversation on the Value of New Zealand's Financial/Physical Capital*, Janssen (2018) describes different indicators of financial and physical capital in New Zealand.

4.1 Financial capital – risk factors

The four environmental, societal, economic and technological trends all impact on risks to our financial and physical capital.

For financial capital:

- Climate change and environmental degradation challenge our current economic activities, including agriculture, horticulture, fisheries, aquaculture, forestry and tourism, which are highly dependent on our natural resources. In addition, an increased frequency of natural disasters and extreme weather events comes with high recovery costs.
- With regard to the second trend of Changing demographics and income or wealth inequality, excessive income inequality has been argued to lower economic growth and resilience.
- The third trend of Global economic growth and productivity has positive and negative effects on the financial risk landscape. International connections open up access to markets, people, capital and ideas that our smaller domestic market cannot offer. At the same time, this makes us more vulnerable to external influences, including the impact and uncertainty caused by geopolitical events and resource scarcity in other parts of the world.
- The fourth trend of Digital connectivity and technical change similarly has positive and negative effects. The digital revolution has increased international connectivity and has opened up new ways to conduct business, but – as will be discussed below – it has also brought new risks with it, such as cybercrime.

Based on an analysis of the impact of the above four trends, risk factors for financial capital include:

- **Delayed action towards a low-carbon future.** Climate change and environmental degradation challenge our current economic activities, which are heavily dependent on our natural capital. In a recent *Environmental Performance Review of New Zealand*, the OECD has urged New Zealand to come up with a long-term vision to transition to a greener, low-carbon economy, in order to ensure its global competitiveness going forward. It said accounting for pollution abatement would have reduced New Zealand's gross domestic product (GDP) growth between 2000 and 2013, whereas for three-quarters of OECD countries, doing so would increase growth (OECD, 2017a). It warned that this could impact New Zealand's global competitiveness, as investors were looking towards sustainability and strong environmental performance. The New Zealand Productivity Commission (NZPC, 2017a) and the Royal Society of New Zealand (RSNZ, 2016) have similarly expressed concern about a critical risk of New Zealand putting off

the transition to a low-carbon future for too long. They have argued that delayed action is likely to exacerbate the economic and social costs of the required transition, as it means that future emission reductions would need to be much more dramatic and abrupt to compensate for previous emissions (NZPC, 2017a; RSNZ, 2016; World Bank, 2015).

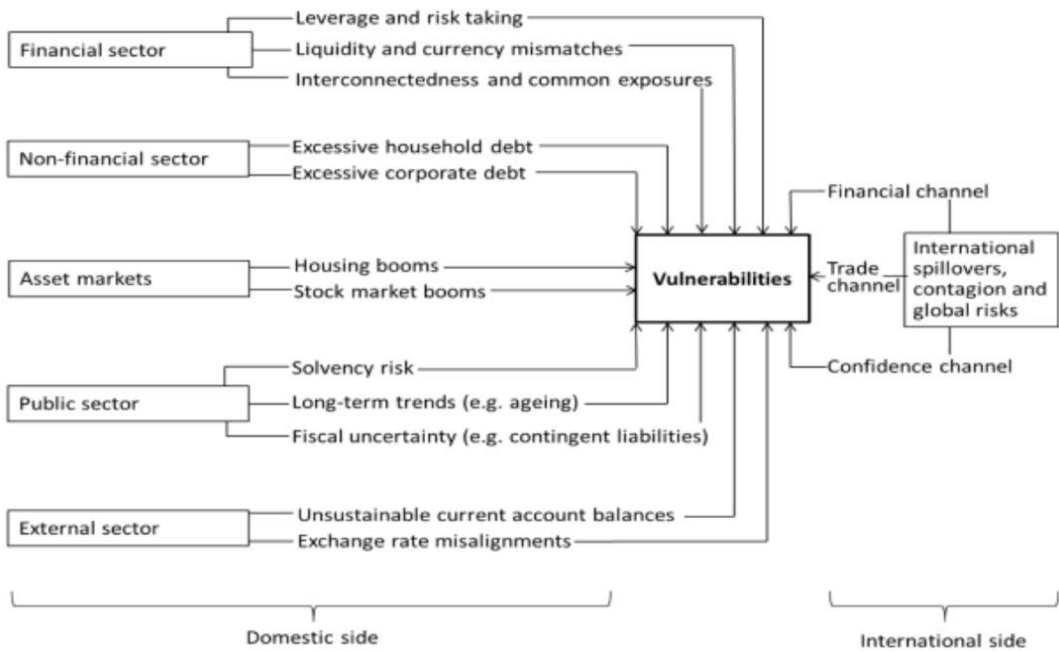
- **High income inequality.** Rising income inequality could pose further risks to our financial capital. There is growing consensus that assessments of economic performance should not focus solely on overall income growth, but also take into account income distribution. While some inequality is inevitable in a market-based economic system, excessive inequality can lower economic growth, in addition to eroding social capital and increasing political polarisation (International Monetary Fund (IMF), 2017, p. IX). Joseph Stiglitz (2015) has outlined different channels through which high levels of inequality can lower economic resilience. Firstly, inequality leads to weaker aggregate demand, as those at the bottom spend a larger fraction of their income than those at the top, with less available to build up their financial resilience. Secondly, inequality of outcomes is associated with inequality of opportunity. When those at the bottom of the income distribution are at greater risk of not living up to their potential, the economy pays a price, not only with weaker demand today, but also with lower growth in the future. Thirdly, societies with greater inequality are less likely to make public investments that enhance productivity, such as in public transportation, infrastructure, technology and education.
- **Price shocks.** Within the global market, risks to New Zealand's financial capital can also occur from price shocks. New Zealand's export-dependent economy, with important trading links to Europe, Australia, the United States and, more recently, China, makes it vulnerable to disruption from global trade and overseas economies, through effects on trade and on international travel and tourism (RSNZ, 2016, p. 7). This is compounded by the fact that New Zealand's goods export base is amongst the least diversified of the OECD member countries, and it has become less diverse over the past decade or so. New Zealand's five largest export markets accounted for 59.2% of total goods exports in 2013, relative to the OECD median of 52.0%. This represented a 3.8%-point increase from the corresponding proportion in the early 2000s, compared with a decrease in the OECD median over the same period (The Treasury, 2014). This lack of diversity increases dependence and therefore threatens economic resilience, as a downturn in a key sector can have a big impact across the economy.
- **Cyber risk.** The digital revolution has enhanced the ability to conduct business but has also brought new types of risk with it. The World Economic Forum (WEF) 2018 *Global Risks Report* notes that, globally, cyber attacks are increasing, both in prevalence and disruptive potential and that the cost of cyber crime is rising (WEF, 2018, p. 14). The *Cyber Threat Report 2016/2017* by New Zealand's National Cyber Security Centre (NCSC, 2017) estimated that advanced cyber threats have the potential to cause \$640 million harm annually to New Zealand's organisations of national significance and that the operation of the NCSC's cyber defense capabilities reduced harm by \$39.47million in the 2016–17 year. The NCSC recorded 396 incidents for the 2016–17 year, an increase of 58 over the previous year. The increase reflects the evolving threat landscape as well as the NCSC's increased capacity to detect and respond to threats.

4.2 Resilience of financial capital

The OECD has recently released a set of more than 70 vulnerability indicators for OECD countries to assess their economic resilience. The indicators are grouped into five domestic areas: 1) financial sector imbalances; 2) non-financial sector imbalances; 3) asset market

imbalances; 4) public sector imbalances; and 5) external sector imbalances (see Figure 3). An additional international “spillovers, contagion and global risks” category aims at capturing vulnerabilities that could transmit from one country to another through financial, trade or confidence channels. Evidence in a companion paper (Hermansen & Röhn, 2015) shows that the majority of the proposed indicators for which sufficiently long time series exist was helpful in predicting severe recessions and crises in OECD countries between 1970 and 2014.

Figure 3 – Conceptual Model of Vulnerabilities



Source: Röhn, Caldera Sánchez, Hermansen, and Rasmussen (2015, p. 6)

New Zealand has good statistics and information on each of these measures. The six-monthly fiscal stability reports produced by the Reserve Bank assess the soundness of the New Zealand financial system, and in particular its vulnerability to housing booms. In the public sector, not only is good information provided, but targeted levels of prudent public debt also articulate a desired level of resilience to enable the Government to assist New Zealanders to absorb financial shocks.

Absorption

Specific absorption-related resilience factors that have been emphasised by other publications include:

- **Adequate steps towards a climate resilient economy.** The 2017 New Zealand Productivity Commission paper *Low-emissions Economy*⁵ (NZPC, 2017a) describes a wide range of opportunities to reduce New Zealand’s domestic greenhouse gas emissions (excluding international carbon trading arrangements). It argues that moving to a low-emissions New Zealand economy will require: 1) getting emissions pricing right, to send the right signals for investment; 2) harnessing the full potential of innovation and supporting investment in low-emissions activities and technologies; 3) creating laws and institutions that endure over time and act as a commitment device for future

⁵ A final Productivity Commission report to the Government on the move to a low-emissions economy is due by 30 June 2018.

governments (see also Chapter 7 of this paper); and 4) ensuring other supportive regulations and policies are in place (including to encourage an inclusive transition).

- **Inclusive growth.** The October 2017 IMF *Fiscal Monitor* focused on tackling inequality and noted that rising inequality and slow economic growth in many countries have focused attention on policies to support inclusive growth. For example, the 2017 WEF *Report on Inclusive Growth and Development* presents an Inclusive Development Index (IDI), to provide a richer and more nuanced assessment of countries' level of economic development than the conventional one based on GDP per capita alone. It also provides a policy framework showing the many factors that can drive a more inclusive growth process.
- **Strong cyber security.** The free flow of information is a crucial driver behind economic value. As the WEF (2012, p. 4) describes, a locked down economy is a frozen economy. They note that it is vital to our economic resilience that we think beyond information security to overall network resilience (see also, Roeger et al., 2017). As the primary cyber vulnerability of many organisations is human (ie, awareness, leadership and execution), a collaborative, multi-stakeholder approach must be taken and even competitors in a given industry must become partners in the effort to ensure a stable and trusted environment (Dobrygowski, 2016). The WEF (2012) identifies four basic principles to guide the move to cyber resilience:
 - 1) Organisations must recognise the interdependent nature of our hyperconnected world and their role in contributing to a safe shared digital environment. The WEF poses an open, secure and resilient online space as a public good which can only be as strong as its weakest link.
 - 2) Executive management teams must recognise their leadership role in setting the tone and structure for cyber resilience.
 - 3) Organisations must recognise the importance of integrating cyber risk management within broader risk practice.
 - 4) Organisations should encourage their suppliers to adopt cyber resilience principles and guidelines.

DPMC's New Zealand Cyber Security Strategy and Action Plan (DPMC, 2015) aims to raise the cyber security awareness and understanding of individuals and small businesses; improve the level of cyber security across government; and build strategic relationships to improve cyber security for critical national infrastructure and other businesses. However, the Cyber-security Strategy does not currently provide a basis for an ongoing assessment of the resilience of our critical information systems.

Adaptation

From an adaptation perspective, **diversification of trade in goods and services** can help to recover from a large downturn in a key sector. Nonetheless, Lederman and Maloney (2012) argue that increasing diversification is not clear-cut. While they agree that diversification, to a point, does appear important for reducing the negative externality posed by terms-of-trade volatility, they argue that steering for diversification is difficult and that providing a fertile business environment where new industries can establish roots is likely to be the best bet.

In addition, **well-functioning insurance markets** are critical for enabling New Zealanders to adapt to financial shocks. Insurance promotes stability by protecting those who suffer harm,

thereby helping to stabilise their financial situation. Moreover, it encourages individuals and firms to invest and create wealth knowing they can limit their losses. Private insurance can also relieve pressure on the social insurance system, preserving resources for essential social security. Lastly, it facilitates trade and commerce as many products and services will only be produced and sold if adequate liability insurance is available to cover negligence and other claims.

4.3 Physical capital – risk factors

Nowadays, societies are highly reliant on the functioning of their physical infrastructure, such as telecommunication, electricity, water and transportation networks. New Zealand's infrastructure has been bolstered by significant expenditure in recent years to address historic underinvestment. Notwithstanding that recent investment, New Zealand's physical capital faces two big risks:

- **Affordability constraints for maintenance and renewing of infrastructure.** Financial constraints challenge the affordability of required renewals and maintenance of ageing infrastructure and building stock, which in turn puts the quality of this physical capital at risk.
- **Natural disasters and extreme weather events** put our physical capital further at risk. New Zealand's climate is naturally variable because of its location in the South Pacific Ocean and our small but mountainous land area. These factors contribute to the extreme weather, such as heavy rainfall, storms and droughts. Climate change increases the frequency and severity of these events. The recent storm in Auckland (April 2018) left more than 79,000 Auckland homes without power, with some being cut off for days. Floods are one of the most frequent and costly natural disasters in New Zealand. Between 1968 and 2017, New Zealand has experienced over 80 damaging floods. The Insurance Council of New Zealand calculated that industry payments for flood damage between 1976 and 2004 averaged \$17 million per year in 2004 dollars, and this covers only just part of the actual cost⁶ (McSaveney, 2018).

The trends of Climate change and environmental degradation as well Changing demographics and income or wealth inequality may increase these risks:

- More frequent severe weather events and natural hazards, owing to climate change, are likely to increase recovery costs for serious disruption of critical infrastructure and building stock (including those on our coastal margins). Such recovery costs would put further pressure on affordability constraints for infrastructure maintenance and renewal.
- At the household level, insurers warn that an increase in natural disasters and extreme weather events will increase policy prices and will make some properties uninsurable.
- With regard to Changing demographics, our growing population adds to the development of infrastructure pinch-points, especially because population growth is concentrated in certain regions more than others. For example, Auckland is forecast to grow by another 716,000 people from 2015 to 2045 (The Treasury, 2015).
- An ageing population will also place different demands on private assets and public infrastructure. This challenges cities to think about intergenerational living spaces,

⁶ For example, government expenditure on civil defence responses during flood emergencies alone averages about \$15 million per year over the same period (McSaveney, 2018).

downsized housing and public spaces that cater for elderly populations, while rural communities need to adapt to both decreasing and ageing populations.

- No specific influences on the physical capital risk landscape have been identified based on the two trends of Global economic growth and productivity and Digital connectivity and technological change.

4.4 Resilience of built capital

Having resilient infrastructure is critical to prevent follow-on complications when a disaster happens. Sajoudi, Wilkinson, Costello, and Sapeciay (online source) describe key characteristics of resilience from a physical engineering perspective:

Absorption

- **Robustness of existing and developing physical capital.** Robustness is one of the main features of resilient physical capital that can absorb shocks and stresses. It refers to “the ability (...) to withstand a given level of stress (...) without suffering degradation or loss of function” (McDaniels, Chang, Cole, Mikawoz, & Longstaff, 2008, p. 312). New Zealand’s building standards generally ensure the earthquake safety of most dwellings. Yet, the effects of recent earthquakes have raised questions about the unexpected number of new-builds that incurred severe damage. The damage has partly been attributed to land use problems. A background document by the Ministry of Business, Innovation and Employment (MBIE), focusing on identified lessons on resilience after the Christchurch earthquakes, noted that “land-use planning legislation needs to better recognise natural hazards”, that “decision-making frameworks need to give adequate weight to the risks of natural hazards, particularly in areas of existing development” and that “improving the review and consenting processes associated with the design of buildings is urgent” (MBIE, 2015, p. 6). Similarly, a 2007 National Institute of Water and Atmospheric Research (NIWA) report noted that ongoing coastal development in New Zealand, including in Northland and the Bay of Plenty, was very likely to exacerbate the future risk to lives and property from sea-level rise and storms.
- **Redundancy and flexibility of critical physical capital.** Redundancy is a form of resilience that ensures system availability in the event of component failure, by ensuring that key components always have at least one independent back-up component. This includes redundancy in main infrastructure, through the existence of alternative transport routes, as well as back-up options for other critical physical capital, such as water networks and power supply networks. Similarly, the concept of flexibility can be defined as a system’s ability to restructure itself in response to external changes or pressures (Woods, 2006).

Adaptation

- **The capacity and level of collaboration within New Zealand’s construction industry.** When dealing with the impact of a big shock or stress to our physical capital, such as the building and infrastructure damage after the Christchurch and Kaikoura earthquakes, the speed of recovery to a large extent depends on the capacity of New Zealand’s construction industry, including its access to the financial, physical and human capital required to rebuild. Moreover, the importance of inter-agency collaboration is emphasised in both the overview work by Sajoudi et al. (online source) and the 2015 MBIE report on lessons from the Christchurch earthquakes. Inter-agency collaboration refers to the level of collaboration and formal agreements between key physical capital agencies on how to optimally support each other in case of an emergency.

5. Risk and resilience of human capital

Human capital refers to individuals' skills, knowledge, mental and physical health that enable them to participate fully in work, study, recreation and in society more broadly (Morrissey, 2018). *The Start of a Conversation on the Value of New Zealand's Human Capital* by Morrissey (2018) explores the current state of our human capital and proposes indicators for measurement of its value.

5.1 Health – risk factors

The four environmental, societal, economic and technological trends all impact on the risk landscape for health outcomes:

- Population growth, global economic growth (and accompanying lifestyles), environmental pollution and severe droughts around the world mean that the planet's water quality and aquifers are rapidly being depleted and increase the risk of water scarcity and irregular water supply.
- Climate change also increases the risks of natural hazards and extreme weather events, which pose direct risks to human life as well as indirect risks by increasing food insecurity (in conjunction with population growth).
- Moreover, climate change brings changes to disease vectors worldwide, which can affect incidences of existing and new diseases. Other indirect risks of climate change may include growing stress and mental health issues; for example, as a consequence of extreme weather events, sea-level rise or loss of livelihoods (Woodward, Hales & de Wet, 2001).
- In terms of Changing demographics, an ageing population causes greater demand pressure on the health system.
- Higher income or wealth inequality results in a larger proportion of the population lacking sufficient buffers to be resilient to a wide range of risks, such as the impact of natural disasters and changes in the labour market, which can in turn negatively affect their wellbeing outcomes.
- The impacts of Digital connectivity and technological change can be seen as positive and negative. Technological developments are critical for finding better ways to deal with risks to health and lives, such as issues of water scarcity and food insecurity, predicting risks of natural hazards and extreme weather events, and improving health prevention and treatment opportunities. At the same time, concerns have been expressed about the use of digital technology by children and teenagers and the impacts on their mental and physical health.

Based on the above analysis, the following risk factors have been identified for health.

Water scarcity. “When the well is dry, we know the worth of water” (Franklin, 1746). Water shortage (the lack of fresh water to meet water demand) affects every continent and was listed in 2015 as the largest global risk in terms of potential impact over the next decade by the World Economic Forum (WEF, 2015), directly affecting humans' ability to survive. The 2016 World Bank report *High and Dry: Climate Change, Water and the Economy* estimates that reduced freshwater availability and competition from other uses – such as energy and agriculture – could reduce water availability in cities by as much as two-thirds by 2050,

compared to 2015 levels. Yet, despite the considerable risks of water shortage and irregular water supply for all four capitals, Water New Zealand reports in its 2016/17 *National Performance Review* that an estimated 90 million cubic metres of water was lost in 2016/17, owing to leakage in water infrastructure. This amount is roughly equivalent to the amount of water Tauranga residents would use over a period of nine years (Water New Zealand, 2017).

The NZIER (2014, p. i) describes the complexity of the challenges facing water management in New Zealand. There is significant variation of water quantity issues by catchments. Scarcity and quality are not an issue across all of New Zealand all of the time, but most regions have at least one river (surface water) or aquifer (groundwater) that is either fully over-allocated, or likely to become so in the next five years. The full impacts of past and present water usage on water quality have yet to fully materialise. Currently, 39% of groundwater sites and 44% of lakes have nutrient levels above natural levels. The growth of agriculture (mainly dairying) and urbanisation are the main sources of water quantity and quality problems, and they are expected to continue. The NZIER notes that New Zealand has had little consistent water policy over time. Since 1991, the Resource Management Act (RMA) has given regional councils the responsibility of managing the complex trade-offs associated with water management. The NZIER (2014, p. ii) argues that the weaknesses of the current RMA system have become clearer as water scarcity and quality issues have become more prevalent: the first-in, first-served mechanism is inefficient for allocating water; the lack of flexibility restricts improvements to water allocation; and there are large gaps in information and data. They have emphasised the importance of water management principles and frameworks at the central government level. “Without performance metrics, decision makers rely on their own experience and instincts that may or may not lead to good water management policy. This ‘hit or miss’ approach to such an important issue is unlikely to lead to good outcomes” (NZIER, 2014, p. iv).

Natural hazards and extreme weather events. New Zealand’s geology and location on the Pacific Ring of Fire bring several natural hazards with it, such as earthquakes, volcanic activity and tsunamis which pose risks to people’s lives. Moreover, climate change will lead to more frequent extreme weather events, such as droughts and floods (MfE, 2017a).

Decreasing food security. Our changing climate and growing population are challenging New Zealand farmers to keep growing enough food to feed the country and produce enough crops to meet export demands. More frequent extreme weather events, such as droughts, floods and cyclones, devastate crops, thereby driving up food prices. The increasing price of fresh food, in part owing to unfavourable weather, has been well-publicised in recent years. For example, Stats NZ (2017a) reported that vegetables prices increased 18% in the year ended June 2017. High and volatile food prices decrease food security, particularly for low-income households who have no buffer to protect themselves from unpredictable price spikes of fresh produce. Health practitioners are concerned that if fresh food is too expensive, people will replace it with cheap but unhealthy food (Amoah, Cairncross, & Rush, 2017), thereby impacting on New Zealand’s health outcomes. One of the major risk factors for non-communicable diseases (such as cancer, cardiovascular diseases and diabetes), causing 88% of health loss in New Zealand, is an unhealthy diet, low in fruit and vegetables and high in salt and saturated fats (MoH, 2016).

Expanding morbidity (ill health) and increasing demand pressure on the health system. Recent societal gains in life expectancy and quality stand in contrast with the increasing burden of illness and long-term costs of treatment. Findings from the Ministry of Health’s *New Zealand Burden of Diseases, Injuries and Risk Factors Study* (MoH, 2016) describe that only 70% to 80% of the years of life gained over the past quarter century have

been years lived in good health. The 2016 report noted that neuropsychiatric disorders are the leading cause of health loss (accounting for 20% of health loss) and that providing better care for people living with mental illness, addiction and dementia is a growing challenge for the health and social sectors. Health loss from musculoskeletal disorders (already accounting for 13% of all health loss), including neck and lower back disorders and arthritis, is increasing partly because of rising rates of obesity. At the same time, addressing cardiovascular disorders is an unfinished agenda and accounted for 8% of all health loss. An ageing population will further increase demand pressure on the health system. Moreover, as there is a steeply increasing prevalence of multiple long-term conditions with old age, a health system oriented to managing single diseases individually will struggle to cope.

Inequalities in wellbeing outcomes. Risks are unevenly distributed and are generally greater for disadvantaged people and communities (IPCC, 2014; RSNZ, 2016). Inequalities in wellbeing outcomes, such as the inequalities in health, education and housing outcomes between ethnic and socio-economic groups in New Zealand decrease overall levels of resilience across the population and increase people's vulnerability to a wide range of risks, such as the impact of natural disasters and changes in the labour market. The International Risk Governance Council (IRGC) therefore argues that sound risk management practices minimise the inequitable distribution of risks and benefits between social groups (IRGC, 2017, p. 5).

5.2 Resilience of health

Absorption

From an absorption perspective, the following factors can help to minimise our vulnerability to the above risks.

- **Public, institutional and political support for water management reform** is a key resilience factor to ensure future wellbeing. The 2014 NZIER report on *Water Management in New Zealand* noted that the main problem with New Zealand water policy is uncertainty (NZIER, 2014, p. i). The uncertainty is driven by increased competition for water, a lack of understanding of society's preferences about how we use and value water, a lack of scientific information about water and inertia on the part of users and institutions. They noted that there is a broad consensus that the current approach under the RMA is flawed, but that durable solutions require broad public, institutional and political support. Their key recommendations included: 1) reforming allocation and reallocation mechanisms; 2) imposing environmental externality limits based on case-specific evaluation; 3) investing in coordinated research; and 4) centralising key water management decisions, with central government and its agencies providing the overarching water management principles and frameworks.
- **Investment in new agricultural technologies and increasing national food stocks and emergency reserves** can help to build resilience against food spikes. A recent article in *National Geographic* (Viviano, 2017) describes how a small country like the Netherlands has become the second largest global exporter of food by dollar value after the United States, with only a fraction of the land available to other countries, by using new agricultural technologies that help to increase output. These technologies have simultaneously reduced crop dependence on water by as much as 90%, have almost eliminated the use of chemical pesticides on plants in greenhouses and have cut the use of antibiotics by poultry and livestock producers by as much as 60%. Other ways to strengthen resilience to food spikes may include increasing national stocks and emergency reserves. For example, the Association of Southeast Asian Nations plus

Three (China, Japan and South Korea) officially launched its Emergency Rice Reserve in 2013 as a permanent mechanism to keep its rice markets flexible during times of natural and man-made shocks (Fan & Brzeska, 2014).

- **Strong health prevention.** Strengthening health prevention can bring major population health benefits (MoH, 2016). Prevention can stem from changing poor health behaviours as well as developments in health research and innovation. For example, the 2016 MoH report notes that following the ‘tobacco end game’, even greater challenges are to address diet, physical inactivity and the obesity epidemic – challenges that go well beyond the health system and will require not only a whole-of-government but also a whole-of-society response. In addition, new research developments and innovations can help to prevent poor health outcomes as well as improve treatment opportunities. The Ministry of Health has estimated that, potentially, over one-third of all health loss is preventable (MoH, 2016). Beyond the benefits to health, a strong focus on prevention can also help the health system become more sustainable clinically, fiscally and economically (by reducing demand pressure), depending on the affordability and effectiveness of relevant interventions.

Adaptation

From an adaptation perspective, emergency preparedness and resourcefulness are key resilience characteristics that help individuals and communities to re-establish their wellbeing following severe stresses or shocks that have occurred.

- **Emergency preparedness and resourcefulness.** Resourcefulness refers to people’s ability to knowledgeably react to and manage a disaster or disturbance as it occurs. Resourcefulness helps individuals and communities to move more easily from the impact of a stress or disaster to finding a new balance (Petit, Eaton, Fisher, McAraw, & Collins III, 2012). Resourcefulness is a key element of efforts to raise public emergency preparedness; however, the concept is applicable beyond emergency preparedness alone. For example, (rediscovered) resourcefulness is also a key skill in the adaptation towards a low-carbon society. Two common attributes of resourcefulness include the capacity for self-organisation and creativity (WEF, 2013). These attributes have strong links to social, human and cultural capital. Collaborative networks and creative skills are critical in circumstances such as failures of government institutions when communities need to self-organise and continue to deliver essential public services (see also, Boston, 2014, p. 19).

5.3 Knowledge and skills – risk factors

The four overarching trends will have the following impacts on the knowledge and skills risk landscape.

- Technological developments will change the type of skills required within jobs and change the types of jobs available. For example, current jobs may in the future be replaced by automation. Technological developments will thus cause a shift in the skills and capabilities required in the labour market.
- Climate change and environmental degradation mean that changes need to be made towards a low-carbon economy. This is likely to cause further structural change to the skills and capabilities required in the labour market.

- In terms of Changing demographics and income inequality, New Zealand's population will become more ethnically diverse. This further increases the importance of addressing issues of inequality in educational outcomes between different ethnic groups in New Zealand.
- The main impact of Global economic growth and productivity lies in the need for New Zealand to maintain its competitiveness with other countries by continuing to increase our skills levels so that we do not fall behind.

Based on this analysis, the following risk factors have been identified for knowledge and skills.

- **Large changes in skills requirements.** A nation's prosperity relies heavily on its education system to give the workforce the skills needed to compete. Future trends in the labour market (including globalisation, technological change, the transition to a low-carbon economy and demographic changes) pose challenges to the resilience of the skills system. OECD evidence suggests that, on average, across 21 OECD countries, 9% of jobs are at high risk of automation, and another 25% will likely experience significant retooling because of automation (Arntz, Gregory, & Zierahn, 2016). The majority of jobs at risk of automation are lower-skilled jobs, with 75% of labouring jobs under threat compared to just 12% of professional roles (CAANZ, 2015). While the extent and distributional impacts of these trends are uncertain, it is clear that there will be structural changes in the labour market, with increased demand for some jobs and decreases for others, and the creation of entirely new jobs. A successful transition will rely on workers being able to adapt and transfer their skills from areas of decreasing employment to new industries that are expected to grow and to adapt to changes in skills required within jobs.
- **Inequality in educational outcomes.** Demographic change means that improving the educational outcomes of Māori and Pasifika is even more important, as they are projected to make up an increasing proportion of the labour force. The proportion identifying as Māori is projected to grow from 16% in 2013 to nearly 20% in 2038. Those identifying with a Pacific ethnicity will grow from 8% in 2013 to 11% in 2038. The "European" ethnic group will decrease its share of New Zealand's population over the projection period, while those identifying with an Asian ethnicity have been projected to grow from 12% in 2013 to 21% in 2038 (Stats NZ, 2017b).

5.4 Resilience of knowledge and skills

The skills system supports the sustainability of human capital by equipping people to cope with a changing labour market and by increasing our skills levels. Moreover, the skills system can help address issues of inequality by providing everyone with the opportunity to improve their skills and life chances through education regardless of their background. Equitable educational opportunities can help individuals reach their full potential and overcome disadvantage, thereby improving their long-term wellbeing outcomes (OECD, 2017c).

The McKinsey Global Institute (2017) has specified a range of resilience factors that affect the adaptation capacity of human capital.

- **Strong foundational skills (literacy, numeracy, social and emotional skills).** Successful adaptation to and recovery from changes in the labour market relies on workers being able to adapt and transfer their skills from areas of decreasing employment to new industries that are upcoming, and to adapt to changes in skills

required within jobs. Strong foundational skills are critical to support resilience in the face of these changes.

- **Higher skills, including more tertiary-level skills.** Technological change and globalisation are expected to shift the capabilities within and across jobs towards more personal interactions and more advanced levels of cognitive capabilities. There is expected to be an increased demand for jobs that require a tertiary degree or advanced training. More advanced cognitive skills (eg, high-level logical reasoning) are expected to be required as automation replaces routine tasks. In particular, mathematics is becoming an increasingly critical skill in a technology rich environment. Social and emotional skills are also expected to become increasingly important as rote aspects of jobs become automated and workers focus more on people-centred elements of roles (eg, supporting collaboration for work that is non-routine and non-linear).
- **Responsive educational institutions.** To assist people with the changes in the skills required over time, educational institutions need to be responsive to changes in the labour market. A recent report by the New Zealand Productivity Commission (2017b) suggests that there is scope to improve the responsiveness of our skills system to the labour market: “The Commission finds that the tertiary education system is not well-placed to respond to uncertain future trends and the demands of more diverse learners. The system is not good at trying and adopting new ways of delivering education, and does not have the features that will allow it to respond flexibly to changing circumstances. The system does a good job of supporting and protecting providers that are considered important, but it is not student-centred. Neither does it reach out, as much as it could, to extend the benefits of education to groups that have traditionally missed out on tertiary education” (NZPC, 2017b, pp. 1–2).
- **Flexible labour market.** Flexible labour market settings, including relatively low employment protection legislation, have supported high labour force participation and relatively low unemployment. New Zealand has a high labour force participation rate, relatively low unemployment and a high rate of re-engagement for displaced workers. Future trends in the labour market point to ensuring labour market regulation continues to provide sufficient flexibility whilst adapting to the changing labour market and improving the employment outcomes for Māori and Pasifika.

6. Risk and resilience of social capital

Social capital refers to the social connections, attitudes and norms that contribute to societal wellbeing by promoting coordination and collaboration between people and groups in society. This includes levels of generalised trust and pro-social norms, civic behaviours as well as institutional trust (Frieling, 2018). In *The Start of a Conversation on the Value of New Zealand's Social Capital*, Frieling (2018) provides a conceptual framework for social capital, including its components, determinants and outcomes, and suggest ways to measure New Zealand's social capital stock.

6.1 Risk factors

The four environmental, societal, economic and technological trends have the following impacts on the risk landscape for social capital:

- Higher income or wealth inequality may corrode levels of generalised and institutional trust.
- Increasing ethnic diversity may also challenge social capital in society, although the evidence for this is less clear-cut.
- Climate change and resulting sea-level rise can cause migration issues as certain low-lying micro-states in the South Pacific region will become uninhabitable, and their entire people will need to be relocated. Sudden large-scale migration flows into New Zealand may challenge levels of cohesiveness and generalised trust in society.
- Digital connectivity and technological change are seen to have both positive and negative effects on social capital. On the one hand, they generate new opportunities to connect. On the other hand, the fast pace and ways in which new media operate also pose new challenges to institutional trust.
- In terms of Global economic growth and productivity, the distribution of this growth is particularly important to social capital. According to the IMF (2017), over the past three decades, 53% of countries have seen an increase in income inequality, with this trend particularly pronounced in advanced economies. Global increases in income inequality can increase the risk of conflict in those societies with potential flow-on effects for New Zealand.

Based on an analysis of the four trends above, the following risk factors have been identified for social capital.

- **Poverty and income inequality.** Income inequality is one of the most robust cross-country determinants of generalised trust in societies (Knack & Keefer, 1997; Knack & Zak, 2001; Uslaner, 2002; Zak & Knack, 2001). Growing income inequality is seen to lower social capital and argued to increase the risk of anti-social behaviours like corruption (Transparency International, 2013). The 2014 OECD report *Focus on Inequality and Growth* reports that the Gini coefficient – a commonly used measure of income inequality – increased in the majority of OECD countries between the mid-1980s and 2014, but shows a particularly large increase (more than 5 points) for New Zealand, as well as Sweden and the United States, for this time period. The 2017 Report on Household incomes in New Zealand (MSD, 2017) noted that, in 2016, the equivalised disposable income (before housing costs) of a household at the 80th percentile was 2.6 times larger than that of a household at the 20th percentile. It notes rapid rises in inequality occurred from around 1988 to 1994. There was a further net rise in the decade

from 1994 to 2004 but the rate of increase was slower. From 2004 to 2010, the 80:20 ratio fell, indicating decreasing inequality on this measure in the period, mainly as a result of the Working for Families package (2004 to 2007) and improving employment prior to the GFC. The impact on incomes of the GFC and the associated downturn and recovery has led to some volatility in the index between the 2009 and 2016. For incomes before housing costs, there is no evidence of any net rise in inequality from the mid-2000s to 2016. However, for incomes after housing costs, there is evidence of a rise in the 80:20 measure from the mid 2000s to 2016, heading towards the previous high point in the early 2000s.

- **Migration and diversity.** A quarter of New Zealand's population is foreign born and New Zealand's ethnic diversity is projected to further increase up to 2038 (Stats NZ, 2017b). Population diversity can generate important socio-economic benefits, such as productivity growth, trade facilitation and more informed decision-making. Nonetheless, it can also challenge and undermine a society's overall sense of unity and generalised trust. Empirical evidence for the effect of diversity on generalised trust is mixed. Some studies, mostly from the United States, suggest that ethnic, cultural and political diversity tend to lower generalised trust and the development of bridging networks (Alesina & Ferrara, 2000, 2002; Costa & Kahn, 2003). Other studies conclude that there is no strong evidence for an eroding effect of diversity on social capital once the association between diversity and economic deprivation is taken into account (Gesthuizen, Van der Meer, & Scheepers, 2009; Laurence, 2011). Moreover, cross-national studies suggest that the relationship between diversity and cohesion at the country level may be moderated by good governance and economic development. For example, Delhey and Newton (2005) report that the relationship between ethnic fractionalisation and generalised trust is significantly weakened in the presence of good governance and national wealth.

Migration flows into New Zealand, including from New Zealand's surrounding Island populations, are estimated to increase over the next decades owing to environmental pressures such as sea-level rise, food and water scarcity and their economic and social spin-off effects. As Boston (2014, p. 11) has noted, a notable migration issue over the longer term will be the inundation of certain low-lying micro-states in the South Pacific region, such as Kiribati and Tuvalu, as a result of sea-level rise, and the need to relocate entire peoples.

- **Low institutional trust.** Sensationalism in the media and the fast pace with which social media respond to media releases pose challenges for the maintenance of institutional trust. As Sir Michael Cullen (2014, p. 73) has described, politicians and public officials' future-focused strategies are challenged by a media "whose interest barely extends beyond the immediate news cycle, which is roughly one hour". Cullen argues that, nowadays, media comment is seldom around the inherent value of policies and their future benefits, but focuses instead on how the policy is going to be received by the public today and its short-term consequences, "in a world of instant comments and pervasive cynicism" (p. 74).

6.2 Resilience of social capital

As Reisinger et al. (2014, p. 1376) note, resilience factors for social capital have received only limited attention and are rarely included in vulnerability assessments, and frameworks that integrate social, psychological and cultural dimensions of vulnerability with biophysical impacts and economic losses are lacking.

Absorption

From an absorption perspective, resilience factors for social capital include the following:

- **Low inequality.** As mentioned above, income inequality is one of the most robust cross-country determinants of generalised trust, a core element of social capital. As income inequality so strongly affects trust, Knack and Zak (2001) conclude that “[e]ven if the cost to redistribute one dollar is high, e.g., it may cost administratively up to two dollars to transfer a single dollar, our analysis shows that this policy is an efficient way to raise trust” (p. 14). The efficacy of raising trust with redistributive transfers offers part of the explanation for the high degree of trust in Scandinavian countries.
- **High trust in public institutions.** High trust in public institutions is the building block that underpins generalised trust in others as well as civic behaviour (Berman, 1997; Encarnación, 2006; Kumlin & Rothstein, 2005). Trust in institutions underpins the development of social capital in several ways. Firstly, implementation-focused institutions include what Rothstein and Stolle (2008) label “order institutions”, such as the courts, the police and the other legal institutions of the state that are tasked to detect and punish people who cannot be trusted. By doing so, order institutions help create a stable and safe environment for public interaction and reduce the amount of uncertainty in the interactions between relative strangers (Zak & Knack, 2001). Analysis of cross-country data from over 50 countries confirms the importance of a country’s legal structures and security of property rights for the formation of generalised trust (Berggren & Jordahl, 2006). Secondly, perceptions of procedural fairness and efficiency positively influence people’s willingness to comply with the outcome of a given process (Lind & Tyler, 1998; Murphy, 2004). Therefore, an erosion of trust in legal and administrative institutions erodes the degree of cooperation the individual is willing to give to the state, such as through tax compliance (Orviska & Hudson, 2003; Scholz & Lubell, 1998), voting (Jones & Hudson, 2000) and other civic behaviours. Analysing data from 38 countries, Letki (2006) found that trust in political institutions and their objective quality are the strongest predictors of civic morality, including obedience to formal rules, and honest and responsible behaviour. The Kiwis Count Survey (2017) conducted by the State Services Commission measures trust in public services in two ways: trust of New Zealanders based on personal experience of using public services and trust in the public sector brand (perception) The 2017 Survey reported that by both measures, trust (the percentage of people who answered a 4 or a 5 on a five point scale) has increased markedly since 2007. In 2017 trust in public services based on personal experience was high at 79%, 12 percentage points higher than when first measured in 2007.

Adaptation

From an adaptation perspective, collaboration and conflict resolution skills are key to restore damages to generalised and institutional trust if and when they occur.

- **Collaboration and conflict resolution skills.** In today's interconnected world, the importance of social and conflict resolution skills continues to grow. Population growth and more diverse societies increase the importance of people's collaborative and social skills. Every three years, the *Programme for International Student Assessment* (PISA) measures students' ability to apply their knowledge in three core subjects – science, reading and mathematics – to familiar settings. Recognising the growing importance of collaborative skills, PISA 2015 has measured students' ability to solve problems collaboratively in 52 education systems around the world. The results show that 15-year-olds in New Zealand have an overall performance on collaborative problem solving above the OECD average. Yet, some interesting nuances appear. Of all OECD countries, New Zealand showed the largest gender difference in performance on collaborative problem solving (after accounting for performance in science, reading and mathematics), with girls scoring over 40 points higher on collaborative problem solving than boys (see OECD, 2017d, Figures V.4.3 and V.4.6). In addition, migrant students in New Zealand perform below their expected level in collaborative problem solving (OECD, 2017d, Figure V.4.11).

Figure 4 provides a summary of the risk and resilience factors across all four capitals.

Figure 4 – Overview of risk and resilience factors across the four LSF capitals

NATURAL CAPITAL		FINANCIAL/PHYSICAL CAPITAL	
RISKS		RISKS	
<ul style="list-style-type: none"> Insufficiently timely climate-change mitigation and adaptation Degradation of environmental quality Accelerating biodiversity loss Natural resource depletion 		Financial capital <ul style="list-style-type: none"> Delayed action towards a low-carbon future High income and wealth inequality Price shocks Cyber risk 	Physical capital <ul style="list-style-type: none"> Affordability constraints for maintenance and renewing of infrastructure Natural disasters and extreme weather events leading to infrastructure failure
RESILIENCE		RESILIENCE	
Absorption <ul style="list-style-type: none"> Safety margins in environmental thresholds (planetary boundaries) Adaptation <ul style="list-style-type: none"> High-quality and comprehensive institutional regulations for sustainable use of natural capital Strong biosecurity response capability Whole-of-society collaboration for environmental protection and restoration 		Financial capital <ul style="list-style-type: none"> Absorption <ul style="list-style-type: none"> Adequate steps towards a climate resilient economy Inclusive growth Strong cyber security Adaptation <ul style="list-style-type: none"> Trade diversification Well-functioning insurance markets 	Physical capital <ul style="list-style-type: none"> Absorption <ul style="list-style-type: none"> Robustness of physical capital Redundancy and flexibility of critical physical capital Adaptation <ul style="list-style-type: none"> Capacity and level of collaboration within New Zealand's construction industry.
HUMAN CAPITAL		SOCIAL CAPITAL	
RISKS		RISKS	
Health <ul style="list-style-type: none"> Water scarcity Natural hazards and extreme weather events Decreasing food security Expanding morbidity and demand pressure on the health system Inequality 	Knowledge and skills <ul style="list-style-type: none"> Large changes in skills requirements Inequality in educational outcomes 	<ul style="list-style-type: none"> Poverty and income inequality Migration and diversity Low institutional trust 	
RESILIENCE		RESILIENCE	
Health <ul style="list-style-type: none"> Absorption <ul style="list-style-type: none"> Public, institutional and political support for water management reform Investment in new agricultural technologies and increasing national food stocks and emergency reserves to deal with decreasing food security Strong health prevention Adaptation <ul style="list-style-type: none"> Emergency preparedness and resourcefulness 	Knowledge and skills <ul style="list-style-type: none"> Absorption <ul style="list-style-type: none"> Strong foundational skills Higher skills Adaptation <ul style="list-style-type: none"> Responsive educational institutions Flexible labour market 	<ul style="list-style-type: none"> Absorption <ul style="list-style-type: none"> Low inequality High trust in public institutions Adaptation <ul style="list-style-type: none"> Collaboration and conflict resolution skills 	

Interconnections between risk and resilience factors across the four capitals

Given the interconnectedness between many of the risk and resilience factors in Figure 4, risks to one type of capital are likely to influence risks to another capital. For example:

- Low resilience of financial capital increases the risk of affordability constraints to invest in the maintenance of physical capital, which can in turn pose increased risks to financial as well as human capital.
- Low resilience of social capital (eg, low trust in public institutions) is likely to negatively impact on the collaboration between government and civil society in environmental protection and restoration, thereby lowering natural capital resilience.
- Water scarcity and food insecurity (Risk – human capital) can inflame latent conflicts in society (Risk – social capital), which are fuelled by levels of poverty and income and wealth inequality.
- Increasing extreme weather events owing to climate change (Risk – natural capital), can lead to food price spikes, which can in turn worsen health outcomes, as it leads people to choose cheaper but unhealthier diets (Risk – human capital). Moreover, remaining consistent and reliable food production is key to the global trade of New Zealand produce (financial capital).

Yet, on the upside, resilience factors can also work together to strengthen each other's potential. For example:

- Responsive educational institutions (resilient human capital) can help to contribute to the necessary research and innovation that can help facilitate the transition to a low-carbon economy (resilient natural and financial capital).
- Low inequality (resilient social capital) strengthens people's willingness to contribute to the public good, including collaboration for the restoration and protection of public goods, such as the natural environment (resilient natural capital).
- Strong health prevention (resilient human capital) will lower demand pressure on the health system, thereby freeing up resources to invest in the resilience of the other capitals.
- Resilient public finances mean that the Government is better placed to assist the public through the recovery process of significant adverse events (eg, natural disasters, economic crises or the loss of essential infrastructure).

Section 3: Incorporating Risk and Resilience in Public Policy-making

This paper has started its discussion of risk and resilience with the statement that “a more joined-up and proactive approach to risk management and resilience building is required to maintain societal resilience and sustainability in the face of the complex risks we are facing domestically and globally”. In this final section of this paper, we make a start at identifying some of the key requirements for an institutional environment that facilitates a more proactive and coordinated approach to risk management and resilience building. We also start to explore what we can learn from other countries about ways to anchor futures thinking into public policy and to encourage inter-agency collaboration for a more joined-up approach.

7. Institutional settings for better risk management and resilience building

An institutional context that enables better coordination of national risk management and resilience building needs to be supported by all three levels in the hierarchy of economic institutions (see Williamson, 2000):

- Institutional Environment – the formal rules of the game, including objectives, standards and criteria.
- Governance – the play of the game, focusing on getting the governance structures right.
- Operational Strategies and Resource Allocation – the strategies and resource transactions that help to achieve goals.

All three levels of institutions can be observed in the determination of fiscal resilience. The Public Finance Act 1989 sets out the formal rules of the game, including the use of Generally Accepted Accounting Practice in the measurement of fiscal performance, and the expectation for the Government to be fiscally responsible. The Public Finance Act, however, recognises that governance (the second layer in the hierarchy of institutions) is a matter for the government of the day and thus requires that Government to express its fiscal strategy and desired level of fiscal resilience in the light of current economic conditions. That strategy must set out how resilient the Government wants the public finances to be with an expression of prudent net debt that becomes a target for the government of the day. At the third level, the budget process allocates resources in accordance with the Government’s fiscal strategy.

First tier: Institutional Environment

Unless the players in the game have a common set of objectives, standards and measures to work towards, they will not be able to interact and coordinate well. A critical element of the institutional environment for better resilience building is therefore a generally agreed resilience objectives and measurement framework. In turn, such a resilience objectives and measurement framework should be informed by the identification and prioritisation of key risks. DPMC has started work on the development of a National Risk Register (NRR) for New Zealand. From a Living Standards Perspective, it is important that the identified risks equally consider all four capitals. Moreover, the identified risk and resilience factors and measures must be open to progressing insights and developments if they are to retain legitimacy over the medium and long term.

Shared resilience objectives are important to make resilience an explicit objective of policy across the public sector and to move from a reactive approach, based primarily on risk response, towards proactively setting performance targets for resilience building and articulating long-term visions for more sustainable development across the capitals. As Deloitte (2017, p. 29) has argued: “Unless resilience is made an explicit objective of policy and decision-making, we are likely to undervalue resilience when we choose what to invest in.”

Improving governance of risk and resilience requires institutions that go beyond the proclivities of the government of the day. Jonathan Boston (2014) has argued that “the incentives in democratic political systems are for decision-makers to focus on contemporary ills rather than future threats and opportunities” (p. 6) and that “the long-term economic, fiscal, social and environmental consequences of such political myopia are potentially serious, both in scope and in scale” (p. 17). Strengthening resilience building across the four capitals therefore requires creating laws and institutions that act as a commitment device for future governments (see also: New Zealand Productivity Commission, 2017a). Only with legislative support can high-level resilience principles provide an ongoing base for long-term thinking and action, and a basis for the coordination of the myriad of entities that affect New Zealand’s opportunities risks and resilience.

New Zealand has in the past been able to get government commitment for stable monetary conditions and responsible fiscal management. Similarly, it should be possible to achieve cross-party support for the proposition that governments on an ongoing basis must express their desired resilience targets for New Zealand using legitimised measures, and ensure reporting occurs against them. Currently, the Civil Defence Emergency Management Act 2002 already requires a national civil defence emergency management strategy to be prepared once each decade. Based on a consultation process, the strategy states the Crown’s goals in relation to civil defence emergency management in New Zealand, the objectives to be pursued to achieve those goals and the measurable targets to be met to achieve those objectives. Reinvigorating this process, expanding it to cover both absorption and adaptation capacities for the four Living Standards Capitals and making it a three-yearly requirement to align with the electoral and political processes would significantly strengthen the governance of resilience of the Living Standard Capitals. The Sendai Principles, to which New Zealand is a signatory, could form the basis of principles that can be developed and agreed at the highest levels.

A final aspect of the institutional environment is clarity about the rights and obligations of all the parties that impact on resilience settings. Optimal decision-making is unlikely where there is debate or uncertainty about who wears the risks, and in particular the extent that risks are socialised. For example, inconsistent expectations about the management of retreat from coastal properties in danger of inundation are likely to lead to inconsistent decision-making and surprises when and if inundation does occur.

Second tier: Governance

Having established such high-level principles using generally agreed measures and a commitment that resilience objectives should be set, it then becomes the task of the government of the day to articulate how it intends to bring those principles and commitments into effect. At the end of the day, governance of risk comprises more than the identification of the combination of likelihood and effect. It is also driven by risk appetite; that is, the total amount and type of risk a government is willing to pursue, maintain or adopt. In turn, the Government’s risk appetite and the measures it takes to align its resilience investments with

that appetite are affected by risk perceptions, risk tolerance and risk attitudes of other stakeholders in society.

There are challenges at the governance level. Setting appropriate objectives is hard. Too few objectives will likely be distortionary; too many objectives can result in a lack of focus. Moreover, the objectives themselves need to be both challenging and achievable. Too challenging and the target will not be credible; too achievable and the opportunity for improvement is wasted. Objectives must be amenable to change in order to deal with unforeseen developments, but not so amenable that they lose their power altogether or change so frequently that they create confusion for public servants and other players in making medium- or longer-term plans. Lastly, governments alone cannot build resilient societies. Appropriate objective setting for resilience levels requires collaboration and coordination between leaders within public, private and civil society sectors, as well as between local and central government. These collaboration and coordination processes will need to take appropriate account of the behavioural biases that bedevil risk management (eg, myopia, optimism bias and inertia) (Meyer & Kunreuther, 2017).

Third tier: Operational Strategies and Resource Allocations

For the resilience targets to be achieved, strategies must be developed and implemented to achieve them. The targets and the measures (see 'First tier: Institutional Environment'), provide the overarching framework to develop and coordinate such strategies. The requirement is for evidence-based strategies aimed towards better resilience outcomes, as well as clarification of ways in which agencies work together to achieve better resilience, such as ways to involve wider public, private and civil sector stakeholders.

A key question remains as to how to best assess how much to invest in resilience in absolute terms and how to compare competing investment proposals for resilience in the face of budget constraints. Several techniques have been developed to apply cost-benefit analysis when risk distributions are well-characterised (eg, options analysis) and new techniques are emerging. For example:

- The Resilience Dividend Valuation Model (RDVM) (Bond et al., 2017), developed by a partnership between RAND and the Rockefeller Foundation, compares the impact of a (proposed) resilience project to a business-as-usual scenario, with the net difference being described as the resilience dividend. The RDVM uses a wellbeing framework, based on the theory of inclusive wealth, to create a model for valuing and monetising the impacts of a (potential) resilience project. The resilience dividend describes the net benefits associated with the absorption of shocks and stressors, the recovery path following a shock and any co-benefits that accrue from a project. For any given project, the estimated dividend may be positive or negative.
- In the natural capital domain, Mace, Halls, Cryle, Harlow, and Clarke (2015) have developed an approach to estimate asset-benefit relationships across different types of natural capital in the UK. They estimate the status and trends of benefits relative to societal targets using existing regulatory limits and policy commitments and allocate scores of high, medium or low risk to prioritise the asset-benefit relationships that are of highest concern.
- Modelling techniques that acknowledge the multivariate nature of systemic risk are also developing. Martin and Pindyck (2015) recognised that, while a policy to avert one catastrophe considered in isolation can be evaluated in cost-benefit terms, such an approach fails because society faces multiple catastrophes. Even if the benefit of

averting each one exceeds the cost, we should not necessarily try to avert them all. They argue that cost-benefit analysis can be applied directly to “marginal” projects (ie, projects whose costs and benefits have no significant impact on the overall economy), but that policies or projects to avert major catastrophes are not marginal. Instead, their costs and benefits can alter society’s aggregate consumption, and therefore they cannot be studied in isolation. The benefits of multiple projects to reduce risk or increase resilience are subject to diminishing returns but the costs of each marginal project do not diminish. Using willingness-to-pay to measure benefits and a permanent tax on consumption as the measure of cost (both a percentage of consumption), they have derived a decision rule to determine the optimal set of catastrophes that should be averted. Given that the complete elimination of some catastrophes will be impossible or prohibitively expensive, the framework also handles the more realistic alternative to reduce the likelihood that the catastrophe will occur or the consequences of a catastrophe. It should be noted that there are important challenges when applying such a model as a tool for government policy, including identifying all of the relevant potential catastrophes, estimating the mean arrival rate and the probability distribution for the impact and estimating the cost of averting or alleviating the catastrophe, which the model expresses as a permanent tax on consumption.

- Other academics have built on the work by Martin and Pindyck. For example, Besley and Dixit (2017) constructed a model that incorporated three important features in the context of major environmental catastrophes: 1) the distribution of possible damage has a fat tail; 2) the probability of the catastrophic event increases as greenhouse gases accumulate; and 3) a technological solution may emerge making conservation efforts unnecessary. They solved the model numerically for plausible values of the parameters and evaluated the trade-offs between alternative policies such as prevention, mitigation and technological fixes.
- The last few years have also witnessed an increasing research literature on systemic risk in the financial sector with the aim of identifying the most contagious financial institutions and their transmission channels (eg, Acharya, Pedersen, Philippon, & Richardson, 2010). Specific measures of systemic risk have been proposed for the banking sector. On the basis of market prices, the estimated loss probability distribution of a bank, conditional on the occurrence of an extreme event in the financial market, can be calculated. Giudici, Sarlin, and Spelta (2016) have approached the issue of how risks are transmitted between different financial institutions in a multivariate framework. It may be possible to extend this research into the networks that exist in other capitals.

7.1 Three international case studies

Three international case studies below describe different ways in which other countries have tried to:

- increase the incentives for governments to consider important long-term policy issues
- create a space for experimentation and innovation
- connect public, private and civil society stakeholders in futures thinking and strategy development.

Western Australian Department of Treasury – environmental scanning

The Western Australian Department of Treasury (WA Treasury) introduced an environmental scanning process in the aftermath of the 2008 global financial crisis. As Eastough (2014, p. 135) describes, a new strategic policy unit was created to “make space” to provide advice on longer-term and cross-cutting policy issues. Part of its remit was to start producing regular environmental scans. Eastough (p. 136) describes environmental scanning as “a formal and systematic exploration of the external environment to identify potential opportunities, challenges and likely relevant future developments that could or should inform government policy deliberations”. She draws the following lessons from the Western Australian experience:

- Comprehensive scans need input from people with a broad range of knowledge and experience, from within the agency as well as the public sector more broadly. In addition, it is important to test “public sector thinking” against the views of others, including industry bodies and/or community stakeholders and representative bodies, academia, employee representative groups and think tanks. The WA Treasury organised internal and external workshops as one way to invite broad stakeholder feedback.
- Given the potential breadth of scope, environmental scans need tight project management, covering their scope, approaches, time frames, consultation mechanisms, format, team resourcing and the communication strategy. In the WA Treasury, dedicated resources for the project consisted of three staff, with additional input and advice from other areas within the department and from other agencies. At the simplest level, an environmental scan can be limited to identifying a list of issues and trends of relevance to the agency. Some environmental scanners may also undertake a simple risk-assessment exercise to indicate the relative risk of each issue.
- The WA Treasury chose to adopt “STEEP” as an instrument to identify issues and trends. STEEP seeks to identify changes in society, technology, the economy, environmental change and political change. However, from the WA Treasury’s perspective, the particular choice of technique is largely arbitrary, as the success of the technique in identifying relevant issues and trends is firstly contingent on access to and engagement with a diverse pool of people who are willing to share relevant ideas and expertise.
- Lastly, the WA Treasury found that environmental scans, as high-level, broad documents, are not an ideal vehicle for delivering formal conclusions and policy recommendations. They cannot provide government with immediate solutions to the complex, interdependent policy problems they describe. Rather, environmental scans should encourage thinking, discussion and further policy work. They should allow frank and balanced sharing of a broad range of issues within the public sector.

Finland – The Committee for the Future

Finland’s institutional arrangements to facilitate long-term planning are unique, particularly with regard to incentivising the political system to give more weight to long-term outcomes (Schieb, 2014, p. 37). In Finland, every new prime minister coming into power has to deliver a speech to Parliament about his or her 15-year vision for Finland, and also serves on a permanent Committee for the Future in the Parliament. According to the UK Foundation for Democracy and Sustainable Development,⁷ the Committee for the Future in Finland is a Standing Permanent Committee of 17 parliamentarians representing all parties and is

⁷ See: <http://www.fdsd.org/ideas/the-committee-for-the-future-finnish-parliament/>

underpinned by the Constitution. They deliberate about matters affecting future development, research and the impacts of technological development. They are not involved in legislative proposals or scrutiny. Rather their role is to:

- prepare parliamentary documents such as Parliament's response to the Government's Report on the Future
- issue statements to other committees on future matters when requested
- discuss future trends and related issues
- analyse research and methodology looking at the future
- serve as the parliamentary body responsible for assessing technological development and societal consequences.

The Committee has the power to decide their own agenda and take initiatives, preparing studies on futures, thereby, in a sense, serving as Parliament's think tank. They also provide information to support decision-making and assessing the long-term effect of decisions. Moreover, Bourgon (2014) has argued that, through the public process and by engaging civil society in its conversations about the future, the Committee for the Future is also critical in developing a higher level of public understanding of the challenges Finland faces and the consequences of various choices and trade-offs. This increased public awareness improves the capacity to align leaders from the public, private and civil sectors, and improves the likelihood of success for an ambitious collective agenda.

Singapore's Centre for Strategic Futures

Singapore has a vast tradition of long-term strategic planning. Singapore began its future planning efforts as an experiment within the Ministry of Defense in the late 1980s. They developed the Risk Assessment and Horizon Scanning programme and set up the Centre for Strategic Futures (CSF), both in 2009. These anticipatory ventures enable Singapore to combine the strength of scanning and scenario planning with a strong focus on experimentation and innovation. They encourage experiments with new computer-based tools and sense-making methods to improve horizon scanning. Although a small organisation, the CSF is a catalyst for strategic change in the Government and its agencies. Its current focus is on whole-of-government strategic planning and prioritisation, whole-of-government coordination and development and on incubating and catalysing new capabilities in the Singapore Public Service. CSF's mission is to position the Singapore Government to navigate emerging strategic challenges and harness potential opportunities by:

1. building capacities, mindsets, expertise and tools for strategic anticipation and risk management
2. developing insights into future trends, discontinuities and strategic surprises
3. communicating insights to decision-makers for informed policy planning.

Following the establishment of the CSF, various government agencies in Singapore have recognised the value of foresight work and begun to set up their own foresight teams which conduct more domain-specific horizon scanning and futures research.⁸

⁸ See: <https://www.csf.gov.sg>

8. Discussion and conclusion

The Identification of Risk and Resilience factors in this paper in Chapters 3 to 6, albeit only a starting point, can inform a long-term policy agenda that supports intergenerational wellbeing. Subsequent steps may include the classification of risks by likelihood and impact, to avoid excessive focus on high-profile risks, to the neglect of higher probability but lower profile risks (IRGC, 2017). The aim of the identified factors is to encourage further thinking and discussion about how to strengthen risk management and resilience building through public policy. Chapter 7 has formed the start of an exploration of possible institutional arrangements that can support a more proactive, coordinated and evidence-based approach to risk management and resilience building. More work is required to formulate more specific proposals for such an institutional environment.

Several overarching themes have come through in the discussion of risk and resilience.

- **The dynamic nature of the capitals requires an agile and inclusive approach to risk management.** Risks and resilience are dynamic in nature. Therefore, risk management strategies need to focus on the intended future of these capitals rather than their current state, bearing in mind that they are not homogeneous or fully substitutable. Strategies must be agile, able to adapt to the development of “new normals” and make use of well-debated foresight. This in itself creates a mini paradox: if risks are to be mitigated, adaption is necessary. If adaptation is to occur, innovation is necessary. For innovation to occur, risks must be taken. Thus, risks must be taken, if risks are to be mitigated. In addition, this paper has noted that risks are often unevenly distributed and generally greater for disadvantaged people and communities. An inclusive approach to risk management and resilience building is therefore an essential element of success.
- **Interdependencies between risk and resilience of capital stocks.** There are many interdependencies between risks and resilience factors for the different capital stocks. At the end of Chapter 6, this paper has provided examples of some of the interconnections between risk and resilience factors across the four capitals. As the International Risk Governance Council (IRGC, 2017) describes, sound risk management adequately considers risk trade-offs and an understanding of secondary effects and linkages between issues.
- **The growing importance of a whole-of-government and whole-of-society response.** The importance of a multi-stakeholder coordinated approach to risk management and resilience building comes through in the discussions across all four capitals. We started this paper by arguing that cross-government coordination is key to strengthen our overall resilience. In addition, a strong relationship between the public, private and civil society sectors is pivotal to enhance society’s capacity to cope with current and future shocks and stresses. In a similar vein, the International Risk Governance Council (IRGC, 2017) has emphasised the importance of risk management that takes appropriate account of public perceptions of risk and resilience.

Feedback on these observations, as well as all other aspects of this paper, are highly welcomed to help further develop the Treasury’s conceptual framework for Risk and Resilience.

References

- Acharya, V., Pedersen, L., Philippon, T., & Richardson, M.P. (2010). *Measuring systemic risk*. No. 8824, CEPR Discussion Papers. London: Centre for Economic Policy Research.
- Alesina, A., & Ferrara, E.L. (2000). Participation in heterogeneous communities. *Quarterly Journal of Economics*, 115(3), 847–904.
- Alesina, A., & Ferrara, E.L. (2002). Who trusts others? *Journal of Public Economics*, 85(2), 207–234.
- Amoah, I., Cairncross, C., & Rush, E. (2017). The battle for better nutrition: The role of the escalating fruit and vegetable prices. *New Zealand Medical Journal*, 130(1465), 107–108.
- Arntz, M., Gregory, T., & Zierahn, U. (2016). *The risk of automation for jobs in OECD countries: A comparative analysis*. OECD Social, Employment and Migration Working Papers, No. 189. Paris: OECD Publishing.
- Berggren, N., & Jordahl, H. (2006). Free to trust? Economic freedom and social capital. *Kyklos*, 59(2), 141–169.
- Berman, S. (1997). Civil society and political institutionalisation. *American Behavioural Scientist*, 40(5), 562–574.
- Besley, T., & Dixit, A. (2017). *Comparing alternative policies against environmental catastrophes*. London: Centre for Economic Policy Research. Accessed on 23/06/2018 from https://www.cepr.org/active/publications/discussion_papers/dp.php?dpno=11802
- Bond, C.A., Strong, A., Burger, N., Weiland, S., Saya, U., & Chandra, A. (2017). *Resilience dividend valuation model. Framework development and initial case studies*. Santa Monica, CA: RAND Corporation. Accessed on 27/05/2018 from https://www.rand.org/pubs/research_reports/RR2129.html
- Boston, J. (2014). Governing for the future while meeting the challenges of today. In J. Boston, J. Wanna, V. Lipski, & J. Pritchard (Eds.), *Future-proofing the state. Managing risks, responding to crises and building resilience* (Chapter 1). Canberra: Australian National University Press. Accessed on 02/05/2018 from <http://press-files.anu.edu.au/downloads/press/p283571/pdf/book.pdf?referer=222>
- Bourgon, J. (2014). Governments fit for the future: Lessons in building resilience. In J. Boston, J. Wanna, V. Lipski, & J. Pritchard (Eds.), *Future-proofing the state. Managing risks, responding to crises and building resilience* (Chapter 4). Canberra: Australian National University Press. Accessed on 02/05/2018 from <http://press-files.anu.edu.au/downloads/press/p283571/pdf/book.pdf?referer=222>
- Chartered Accountants of Australia and New Zealand (CAANZ). (2015). *Disruptive technologies, risks, opportunities – can New Zealand make the most of them?* Sydney: Author. Accessed on 08/05/2018 from www.charteredaccountantsanz.com/news-and-analysis/insights/future-inc/disruptive-technologies

- Cheyne, C. (2013). New Zealand's environmental approvals: Best in the world? *The Conversation*. Accessed on 27/04/2018 from <http://theconversation.com/new-zealands-environmental-approvals-best-in-the-world-19434>
- Climate Change Adaptation Technical Working Group (CCATWG). (2017). *Adapting to climate change in New Zealand. Stocktake report from the Climate Change Adaptation Technical Working Group*. Wellington: Author. Accessed on 01/06/2018 from <http://www.mfe.govt.nz/sites/default/files/media/adapting-to-climate-change-stocktake-tag-report-final.pdf>
- Climate Change Adaptation Technical Working Group (CCATWG). (2018). *Adapting to climate change in New Zealand*. Wellington: Author. Accessed on 01/06/2018 from <http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/ccatwg-report-web.pdf>
- Costa, D.L., & Kahn, M.E. (2003). Civic engagement and community heterogeneity: An economist's perspective. *Perspectives on Politics*, 1, 103–111.
- Cullen, M. (2014). Do governments suffer from political myopia: What is the problem and what can be done about it? In J. Boston, J. Wanna, V. Lipski, & J. Pritchard (Eds.), *Future-proofing the state. Managing risks, responding to crises and building resilience* (Chapter 6). Canberra: Australian National University Press. Accessed on 02/05/2018 from <http://press-files.anu.edu.au/downloads/press/p283571/pdf/book.pdf?referer=222>
- Delhey, J., & Newton, K. (2005). Predicting cross-national levels of social trust: Global pattern or Nordic exceptionalism? *European Sociological Review*, 21(4), 311–327.
- Deloitte. (2017). *State of the state 2017 Resilience in New Zealand*. Wellington: Author. Accessed on 27/04/2018 from <https://www2.deloitte.com/content/dam/Deloitte/nz/Documents/public-sector/resilience-in-New-Zealand-sots-2017.pdf>
- Department of the Prime Minister and Cabinet (DPMC). (2015). *New Zealand's cyber security strategy*. Wellington: Author.
- Dobrygowski, D. (2016). *Cyber resilience: Everything you (really) need to know*. Geneva: World Economic Forum. Accessed on 29/04/2018 from <https://www.weforum.org/agenda/2016/07/cyber-resilience-what-to-know/>
- Eastough, N. (2014). Improving resilience through environmental scanning in Western Australia. In J. Boston, J. Wanna, V. Lipski, & J. Pritchard (Eds.), *Future-proofing the state. Managing risks, responding to crises and building resilience* (Chapter 12). Canberra: Australian National University Press. Accessed on 02/05/2018 from <http://press-files.anu.edu.au/downloads/press/p283571/pdf/book.pdf?referer=222>
- Encarnacion, O. (2006). Civil society reconsidered. *Comparative Politics*, 38 (3): 357-376.
- Fan, S., & Brzeska, J. (2014). *Building a resilient global food system by lowering food price spikes and volatility. 2020 Conference Brief 16*. Washington: International Food Policy Research Institute. Accessed on 01/05/2018 from <https://reliefweb.int/sites/reliefweb.int/files/resources/2020resilienceconfbr16.pdf>
- Franklin, B. (1746). *Poor Richard's almanac*. Philadelphia: Author.

- Frieling, M.A. (2018). *The start of a conversation on the value of New Zealand's social capital*. Office of the Chief Economic Adviser Living Standards Series: Discussion Paper 18/04. Wellington: The Treasury.
- Gesthuizen, M., Van der Meer, T., & Scheepers, P. (2009). Ethnic diversity and social capital in Europe: Tests of Putnam's thesis in European countries. *Scandinavian Political Studies*, 32, 121–142.
- Giudici, P., Sarlin, P., & Spelta A. (2016). *The multivariate nature of systemic risk: Direct and common exposures*. Univerita di Pavia, Department of Economics and Management Working Paper Series No. 118. Accessed on 23/06/2018 from <http://d.repec.org/n?u=RePEc:pav:demwpp:demwp0118&r=net>
- Haldine, A.G. (2018). *Ideas and institutions – a growth story*. Speech given by the Chief Economist, Bank of England to the Guild Society, University of Oxford on 28 May 2018. Accessed on 22/06/2018 from <https://www.bankofengland.co.uk/-/media/boe/files/speech/2018/ideas-and-institutions-a-growth-story-speech-by-andy-haldane.pdf?la=en&hash=BDF87B794BCE9110D264BF955E43C1D7A533E593>
- Helm, P. (2015). Risk and resilience: Strategies for security. *Civil Engineering and Environmental Systems*, 32(1–2), 100–118. Accessed on 13/06/2018 from <https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F10286608.2015.1023793>
- Hermansen, M., & Röhn, O. (2015). *Economic resilience: The usefulness of early warning indicators in OECD countries*. Economics Department Working Papers No. 1250. Paris: OECD Publishing. Accessed on 29/04/2018 from [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP\(2015\)68&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP(2015)68&docLanguage=En)
- Hughey, K.F.D., Kerr, G.N., & Cullen, R. (2016). *Public perceptions of New Zealand's environment: 2016*. Christchurch: EOS Ecology. Accessed on 01/04/2018 from http://www.lincoln.ac.nz/Documents/LEaP/perceptions2016_feb17_LowRes.pdf
- Intergovernmental Panel on Climate Change (IPCC). (2014). Summary for policy makers. In *Climate change 2014: Impact, adaptation, and vulnerability. Part A: Global and sectoral aspects: Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1–32). New York: Cambridge University Press.
- International Monetary Fund (IMF). (2017). *Fiscal monitor: Tackling inequality*. Washington: Author.
- International Risk Governance Council (IRGC). (2017). *An introduction to the IRGC risk management framework*. Lausanne: EPFL International Risk Governance Center. Accessed on 20/03/2018 from https://www.irgc.org/IMG/pdf/An_introduction_to_the_IRGC_Risk_Governance_Framework.pdf
- Janssen, J. (2018). *The Start of a Conversation on the Value of New Zealand's Financial/Physical Capital*. Office of the Chief Economic Adviser Living Standards Series: Discussion Paper 18/07 Wellington: The Treasury.

- Jones, P., & Hudson, J. (2000). Civic duty and expressive voting: Is virtue its own reward? *Kyklos*, 53, 3–16.
- Knack, S., & Keefer, P. (1997). Does social capital have an economic payoff? A cross-country investigation. *The Quarterly Journal of Economics*, 112(4), 1251–1288.
- Knack, S., & Zak, P.J. (2001). *Building trust: Public policy, interpersonal trust and economic development*. World Bank MPRA Paper No. 25055. Accessed on 13/02/2018 from mpra.ub.uni-muenchen.de/25055/1/MPRA_paper_25055.pdf
- Knight, F.H. (1921). *Risk, uncertainty, and profit*. Boston, MA: Hart, Schaffner & Marx; Houghton Mifflin Company.
- Kumlin, S., & Rothstein, B. (2005). Making and breaking social capital. The impact of welfare state institutions. *Comparative Political Studies*, 38(4), 339–365.
- Laurence, J. (2011). The effect of ethnic diversity and community disadvantage on social cohesion: A multi-level analysis of social capital and interethnic relations in UK communities. *European Sociological Review*, 27, 70–89.
- Lederman, D., & Maloney, W.F. (2012). *Does what you export matter. In search of empirical guidance for industrial policies*. Washington, DC: The World Bank.
- Letki, N. (2006). Investigating the roots of civic morality: Trust, social capital, and institutional performance. *Political Behaviour*, 28, 305–325.
- Lind, E.A., & Tyler, T.R. (1998). *The social psychology of procedural justice*. New York: Plenum Press.
- Lynn, I.H., Manderson, A.K., Page, M.J., Harmsworth, G.R., Eyles, G.O., Douglas, G.B., Mackay, A.D., & Newsome, P.J. (2009). *Land use capability survey handbook – a New Zealand handbook for the classification of land*. Hamilton, Lincoln, Lower Hutt: AgResearch, Landcare Research, GNS Science.
- Mace, G.M., Halls, R.S., Cryle, P., Harlow, J., & Clarke, S.J. (2015). Toward a risk register for natural capital. *Journal of Applied Ecology*, 52, 641–653.
- Martin, I.R., & Pindyck, R.S. (2015). Averting catastrophes: The strange economics of Scylla and Charybdis. *American Economic Review*, 105(10), 2947–2985.
- McDaniels, T., Chang, S., Cole, D., Mikawoz, J., & Longstaff, H. (2008). Fostering resilience to extreme events within infrastructure systems: Characterizing decision contexts for mitigation and adaptation. *Global Environmental Change – Human and Policy Dimensions*, 18(2), 310–318.
- McGlone, M., & Walker, S. (2011). *Potential effects of climate change on New Zealand's terrestrial biodiversity and policy recommendations for mitigation, adaptation and research*. *Science for conservation* 312. Wellington: Department of Conservation.
- McGuinness Institute/Te Hononga Waka. (2018). *Reporting NZ 2018 worksheet: An analysis of the state of play of extended external reporting*. Wellington: Author.
- McKinsey Global Institute. (2017). *Jobs lost, jobs gained: Workforce transitions in a time of automation*. New York: Author.

- McSaveney, E. (2018). Floods – New Zealand’s number one hazard. In *Te ara – the encyclopedia of New Zealand*. Accessed on 19/03/2018 from <https://teara.govt.nz/en/floods/page-1>
- Meyer, R., & Kunreuther, H. (2017). *The ostrich paradox: Why we underprepare for disasters*. Philadelphia: Wharton Digital Press.
- Ministry for Social Development (MSD). (2017). *Household incomes in New Zealand: Trends in indicators of inequality and hardship 1982 to 2016* Accessed on 16 July 2018 from <https://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/monitoring/household-income-report/2017/2017-incomes-report-wed-19-july-2017.pdf>
- Ministry for Social Development (MSD). (2016). *The social report*. Wellington: Author. Accessed on 27/04/2018 from socialreport.msd.govt.nz/economic-standard-of-living/income-inequality.html
- Ministry for the Environment (MfE). (2017a). *New Zealand’s greenhouse gas inventory 1990–2015*. Wellington: Author. Accessed on 12/03/2018 from www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory
- Ministry for the Environment (MfE). (2017b). *National communication and biennial report 2017 snapshot*. Wellington: Author. Accessed on 13/03/2018 from www.mfe.govt.nz/node/23935
- Ministry for the Environment (MfE)/Stats NZ. (2015). *Environment Aotearoa 2015*. Wellington: Author.
- Ministry for the Environment (MfE)/Stats NZ. (2017a). *Our atmosphere and climate 2017*. Wellington: Author.
- Ministry for the Environment (MfE)/Stats NZ (2017b). *Our fresh water 2017*. Wellington: Author.
- Ministry for the Environment (MfE)/Stats NZ. (2018). *Our land 2018*. Wellington: Author.
- MfE/Stats NZ. (online source). *New Zealand’s environmental reporting series. Environmental indicators*. Accessed on 02/06/2018 from http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/Atmosphere-and-climate.aspx
- Ministry of Business, Innovation and Employment (MBIE). (2015). *What are the lessons for New Zealand’s built environment? A background document to inform discussion at the Built Environment Leaders Forum 2015*. Wellington: Author. Accessed on 01/04/2018 from <http://www.mbie.govt.nz/info-services/building-construction/safety-quality/documents-and-images-library/built-environment-leaders-forum/built-environment-lessons-report-final.pdf>
- Ministry of Health (MoH). (2016). *New Zealand burden of diseases, injuries and risk factors study*. Wellington: Author. Accessed on 02/04/2018 from <https://www.health.govt.nz/nz-health-statistics/health-statistics-and-data-sets/new-zealand-burden-diseases-injuries-and-risk-factors-study>

- Morrissey, S. (2018). *The start of a conversation on the value of New Zealand's human capital*. Office of the Chief Economic Adviser Living Standards Series: Discussion Paper 18/02. Wellington: The Treasury.
- Murphy, K. (2004). The role of trust in nurturing compliance: A study of accused tax avoiders. *Law and Human Behaviour*, 28, 187–209.
- National Cyber Security Centre. (2017). *Cyber threat report 2016/2017*. Accessed on 06/03/2018 from <https://www.ncsc.govt.nz/assets/NCSC-Documents/NCSC-2016-17-Unclassified-Cyber-Threat-Report.pdf>
- NZIER. (2014). *Water management in New Zealand. A road map for understanding water value*. NZIER Working Paper 2014/01. Wellington: Author. Accessed on 08/05/2018 from https://nzier.org.nz/static/media/filer_public/d2/ce/d2cef6fa-3b58-4f11-bb0b-7b2a684ac181/nzier_public_discussion_paper_2014-01_-_water_management_in_nz.pdf
- New Zealand Productivity Commission (NZPC). (2017a). *Low-emissions economy: Issues paper*. Accessed on 19/03/2018 from www.productivity.govt.nz/sites/default/files/Low%20emissions%20economy%20issues%20paper%20FINAL%20WEB.pdf
- New Zealand Productivity Commission (NZPC). (2017b). *New models of tertiary education: Final report*. Wellington: Author. Accessed on 24/05/2018 from www.productivity.govt.nz/inquiry-content/tertiary-education
- NIWA. (2007). *IPCC fourth assessment report*. Wellington: Author. Accessed on 06/04/2018 from https://www.niwa.co.nz/sites/niwa.co.nz/files/ipcc_report_03_0.pdf
- OECD. (2014). *Focus on inequality and growth*. Accessed on 27/04/2018 from <http://www.oecd.org/els/soc/Focus-Inequality-and-Growth-2014.pdf>
- OECD. (2017a). *OECD environmental performance reviews: New Zealand 2017*. Paris: OECD Publishing. Accessed on 07/05/2018 from <http://www.oecd.org/env/country-reviews/oecd-environmental-performance-reviews-new-zealand-2017-9789264268203-en.htm>
- OECD. (2017b). *Investing in climate, investing in growth*. Paris: OECD Publishing. Accessed on 29/04/2018 from <https://www.oecd-ilibrary.org/docserver/9789264273528-en.pdf?expires=1524999564&id=id&accname=guest&checksum=BEEBD27E16E1348AD1E8A989BCC752BC>
- OECD. (2017c). *Educational opportunity for all. Overcoming inequality throughout the life course*. Paris: OECD Publishing.
- OECD. (2017d). *PISA 2015 results (Volume V): Collaborative problem solving, PISA*. Paris: OECD Publishing. Accessed on 28/04/2018 from <https://www.oecd-ilibrary.org/docserver/9789264285521-en.pdf?expires=1524898348&id=id&accname=guest&checksum=BA2E2F360C49E7AB089CD808A41619B7>
- Office of the Prime Minister's Chief Science Advisor. (2016a). *Making decisions in the face of uncertainty: Part 1. Understanding risk*. Wellington: Author. Accessed on 13/06/2018 from <http://www.pmcsa.org.nz/publications/>

- Office of the Prime Minister's Chief Science Advisor. (2016b). *Making decisions in the face of uncertainty: Part 2: Risk perception, communication and management*. Wellington: Author. Accessed on 13/06/2018 from <http://www.pmcsa.org.nz/publications/>
- Orviska, M., & Hudson, J. (2003). Tax evasion, civic duty and the law abiding citizen. *European Journal of Political Economy*, 19, 83–102.
- Palmer, G. (2013). *The Resource Management Act. How we got it and what changes are being made to it*. Address to Resource Management Law Association, Devon Hotel, New Plymouth, 27 September 2013. Accessed on 27/04/2018 from http://www.rmla.org.nz/wp-content/uploads/2016/09/sir_gp_speech_2013_conf.pdf
- Petit, F.D., Eaton, L.K., Fisher, R.E., McArar, S.F., & Collins III, M.J. (2012). Developing an index to assess the resilience of critical infrastructure. *International Journal of Risk Assessment and Management*, 16(1), 28–47.
- Reisinger, A., Kitching, R.L., Chiew, F., Hughes, L., Newton, P.C.D., Schuster, S.S., Tait, A., & Whetton, P. (2014). Australasia. In V.R. Barros, C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estranda, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, & L.L. White (Eds.), *Climate change 2014: Impact, adaptation, and vulnerability. Part B: Regional aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press. Available at: http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap25_FINAL.pdf
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, III, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C. A., Hughes, T., Van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., & Foley, J. (2009). Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society* 14(2), 32.
- Roeger, P.E., Collier, Z.A., Chevardin, V., Chouinard, P., Florin, M-V., Lambert, J.H., Nielsen, K., Nogal, M., & Todorovic, B. (2017). Bridging the gap from cyber security to resilience. In I. Linkov, & J.M. Palma-Oliveira (Eds.), *Resilience and risk, NATO Science for Peace and Security Series C: Environmental security* (Chapter 14). Dordrecht: Springer. Accessed on 29/04/2018 from https://www.researchgate.net/profile/Marina_Filipovic2/publication/318854788_Contribution_to_Enhancement_of_Critical_Infrastructure_Resilience_in_Serbia/links/59a86e44a6fdcc2398387982/Contribution-to-Enhancement-of-Critical-Infrastructure-Resilience-in-Serbia.pdf#page=383
- Röhn, O., Caldera Sánchez, A., Hermansen, M., & Rasmussen, M. (2015). *Economic resilience: A new set of vulnerability indicators for OECD countries*. Economics Department Working Papers No. 1249. Paris: OECD Publishing. Accessed on 08/05/2018 from [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP\(2015\)67&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ECO/WKP(2015)67&docLanguage=En)
- Rothstein, B., & Stolle, D. (2008). The state and social capital: An institutional theory of generalised trust. *Comparative Politics*, 40, 441–467.

- Royal Society of New Zealand (RSNZ). (2016). *Transition to a low-carbon economy for New Zealand*. Wellington: Author.
- Rutledge, D.T., Price, R., Ross, C., Hewitt, A., Webb, T., & Briggs, C. (2010). Thought for food: Impacts of urbanisation trends on soil resource availability in New Zealand. *Proceedings of the New Zealand Grasslands Association*, 72, 241–246.
- Sajoudi, M.N., Wilkinson, S., Costello, S.B., & Sapeciay, Z. (online source). *Resilient infrastructure principal features: A review*. Auckland: University of Auckland. Accessed on 01/06/2018 from <https://www.library.auckland.ac.nz/external/finalproceeding/Files/Papers/46530final00154.pdf>
- Schieb, P-A. (2014). Foreseeable shocks and the critical challenges facing humanity in the twenty-first century. In J. Boston, J. Wanna, V. Lipski, & J. Pritchard (Eds.), *Future-proofing the state. Managing risks, responding to crises and building resilience* (Chapter 12). Canberra: Australian National University Press. Accessed on 02/05/2018 from <http://press-files.anu.edu.au/downloads/press/p283571/pdf/book.pdf?referer=222>
- Scholz, J.T., & Lubell, M. (1998). Trust and taxpaying: Testing the heuristic approach to collective action. *American Journal of Political Science*, 42, 398–417.
- State Services Commission (2017). *Kiwis Count Survey*. Accessed on 16/07/2018 from <http://www.ssc.govt.nz/kiwis-count>
- Stats NZ. (2017a). *Avocado prices near record levels and kumara hits new high*. Accessed on 06/04/2018 from <https://www.stats.govt.nz/news/avocado-prices-near-record-levels-and-kumara-hits-new-high>
- Stats NZ. (2017b). *National ethnic population projections: 2013 (base) – 2038 (update)*. Wellington: Author. Accessed on 28/05/2018 from http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalEthnicPopulationProjections_HOTP2013-2038.aspx
- Stiglitz, J.E. (2015). Inequality and economic growth. *The Political Quarterly*, 86(S1), 134–155.
- The Treasury. (2014). *Monthly economic indicators*. Wellington: Author. Accessed on 02/06/2018 from <https://treasury.govt.nz/sites/default/files/2014-03/mei-mar14.pdf>
- The Treasury. (2015). *The thirty year New Zealand infrastructure plan*. Wellington: Author. Accessed on 02/06/2018 from <https://treasury.govt.nz/sites/default/files/2018-03/nip-aug15.pdf>
- Transparency International. (2013). *New Zealand national integrity system assessment*. Accessed on 11/12/2017 from <https://www.transparency.org.nz/integrity-plus-2013-new-zealand-national-integrity-system-assessment/>
- United Nations Office for Disaster Risk Reduction (UNISDR). (2017). *Terminology on disaster risk reduction*. Accessed on 28/05/2018 from <https://www.unisdr.org/we/inform/terminology>
- Upton, S. (1999). Speech – Managing environmental risks, delivered 6 September 1999. Accessed on 29/05/2018 from <http://www.scoop.co.nz/stories/PA9909/S00121.htm>

- Uslaner, E.M. (2002). *The moral foundations of trust*. Cambridge, UK: Cambridge University Press.
- Van Zyl, S., & Au, J. (2018). The start of a conversation on the value of New Zealand's natural capital. Office of the Chief Economic Adviser Living Standards Series: Discussion Paper 18/03. Wellington: The Treasury.
- Viviano, F. (2017). This tiny country feeds the world. *National Geographic*. Accessed online on 01/05/2018 from <https://www.nationalgeographic.com/magazine/2017/09/holland-agriculture-sustainable-farming/>
- Water New Zealand. (2017). *National performance review. Volume 1: National overview*. Wellington: Author.
- Williamson, O.E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature*, 38(3), 595–613.
- Woods, D.D. (2006). Essential characteristics of resilience. In E. Hollnagel, D. Woods, & N. Leveson (Eds.), *Resilience engineering: Concepts and precepts* (pp. 21–34). Aldershot: Ashgate.
- Woodward, A., Hales, S. & de Wet, N. (2001). *Climate Change: Potential Effects on Human Health in New Zealand*. Wellington: Ministry for the Environment.
- World Bank (2015). *Decarbonising development: Three steps to a zero-carbon future*. Washington, DC: World Bank Group.
- World Bank. (2016). *High and dry: Climate change, water and the economy*. Washington, DC: World Bank Group. Accessed on 13/03/2018 from <https://openknowledge.worldbank.org/handle/10986/23665>
- World Economic Forum (WEF). (2012). *Partnering for cyber resilience. Risk and responsibility in a hyperconnected world – principles and guidelines*. Geneva: Author. Accessed on 29/04/218 from http://www3.weforum.org/docs/WEF_IT_PartneringCyberResilience_Guidelines_2012.pdf
- World Economic Forum (WEF). (2013). *Global risks 2013*. Geneva: Author. Accessed on 20/03/2018 from <http://reports.weforum.org/global-risks-2013/>
- World Economic Forum (WEF). (2015). *Global risks 2015*. Geneva: Author. Accessed on 13/03/2018 from <http://reports.weforum.org/global-risks-2015/>
- World Economic Forum (WEF). (2017). *The inclusive growth and development report*. Geneva: Author. Accessed on 01/06/2018 from http://www3.weforum.org/docs/WEF_Forum_IncGrwth_2017.pdf
- World Economic Forum (WEF). (2018). *Global risks report*. Geneva: Author. Accessed on 06/03/2018 from <https://www.weforum.org/reports/the-global-risks-report-2018>
- Zak, P.J., & Knack, S. (2001). Trust and growth. *The Economic Journal*, 111, 295–321.