



---

# Resilience – definitions, concepts and measurement

A literature review

---

CEU Working Paper 23/02

June 2023





## Authors

Chief Economist Unit

Sharon Pells, [Sharon.pells@mbie.govt.nz](mailto:Sharon.pells@mbie.govt.nz)

## Acknowledgements

Thanks to Michelle Hill for her help with the literature search, and to George Mason at MBIE and Ken Warren at the Treasury for their valuable suggestions. This paper also reflects helpful feedback from other colleagues in MBIE and the Productivity Commission.

CEU Working Paper 23/02

June 2023

Ministry of Business, Innovation & Employment

PO Box 1473

Wellington 6140

New Zealand

[www.mbie.govt.nz](http://www.mbie.govt.nz)

0800 20 90 20

Media enquiries: [media@mbie.govt.nz](mailto:media@mbie.govt.nz)

## Disclaimer

The views, opinions, findings, and conclusions or recommendations expressed in this paper are strictly those of the author(s). They do not necessarily reflect the views of the Ministry of Business, Innovation & Employment or the New Zealand Government. The Ministry of Business, Innovation & Employment and the New Zealand Government take no responsibility for any errors or omissions in, or for the correctness of, the information contained here. The paper is presented not as policy, but with a view to inform and stimulate wider debate.

ISBN (online) 978-1-991092-34-2

© Crown copyright June 2023

The material contained in this report is subject to Crown copyright protection unless otherwise indicated. The Crown copyright protected material may be reproduced free of charge in any format or medium without requiring specific permission. This is subject to the material being produced accurately and not being used in a derogatory manner or in a misleading context. Where the material is published or issued to others, the source and copyright status should be acknowledged. The permission to reproduce Crown copyright protected material does not extend to any material in this report that is identified as being the copyright of a third party. Authorisation to reproduce such material should be obtained from the copyright holder(s).

## **Abstract**

Resilience is about dealing with shocks, disturbances and (some argue) long-term trends. However, definitions and concepts about resilience are not yet settled, the study of resilience is highly context-specific, and resilience concepts seem hard to operationalise and measure in practice. Despite these challenges, there are some useful insights from resilience concepts. In particular, the evolutionary perspective of resilience is seen as valuable in an economic context. This perspective emphasises the capacity of a system to adapt and fundamentally change over time in the face of numerous disturbances and shocks. This perspective seems helpful when dealing with long-term challenges like climate change and with unexpected shocks and areas of deep uncertainty.

## **JEL classification**

O10, O18, O43

## **Keywords**

Economic development, regions, institutions

## Executive summary

- **There is growing interest in ‘resilience’.** Recent events such as the COVID-19 pandemic, the Russian-Ukrainian war, and Cyclone Gabrielle, in combination with trends like climate change, have led to a heightened interest in the notion of resilience. This paper examines key definitions, concepts and measurement approaches as a backgrounder for policymakers and others interested in the topic.
- **Definitions and concepts about resilience vary with context.** The study of resilience is highly context-specific and spans multiple fields and disciplines like engineering, ecology and psychology. This paper is mainly concerned with resilience in an *economic* context.
- **Resilience is about dealing with ‘shocks’ (unexpected large-scale events) and other disturbances, but definitions and concepts are not yet settled.** Definitions of resilience can include elements such as ‘bouncing back’, ‘absorbing shocks’, ‘positive adaptability/bouncing forward’ and ‘system transformation’. However, definitions are contested and there are tensions across different definitions.
- **While some question the usefulness of resilience, this paper argues that it *is* a useful concept.** Ambiguity around definitions and concepts, and overlap with related concepts, have led some to question the value-add of resilience. However, the utility of studying resilience includes that it makes us think carefully about the nature of disruptions or shocks and how they affect the relevant system, how the system responds to these disruptions or shocks, and the essence of a system that needs to be maintained through time.
- **Despite variation in concepts, there are two broad perspectives on resilience – the equilibrium perspective and the evolutionary one (see Table 1).** The equilibrium perspective emphasises the return to a previous state or equilibrium following a shock and is useful in situations where maintaining consistent performance is important. The evolutionary perspective emphasises the capacity of a system to adapt and fundamentally change over time in the face of numerous disturbances and shocks. This perspective tends to be seen as the more valuable in an economic context, as it focuses on the ability of a system to cope with multiple challenges and change over the long term.
- **These distinctions have important implications for the interpretation of resilience studies.** One key distinction is that the equilibrium perspective sees the retention of a system’s function and structure as a goal of resilience, whereas the evolutionary perspective is more concerned with the long-run health or performance of the system. Therefore, a change in the structure of the economy may be seen as a ‘bad thing’ under the former and potentially a ‘good thing’ under the latter. In the context of regional or community resilience, it is often argued that communities themselves should determine the ultimate goal of resilience, or what is important in terms of the long-run performance of the region per the evolutionary perspective, based on community values.

- **There are many different concepts about the determinants of, and/or strategies or actions to improve, resilience.** For example:
  - when resilience is seen as a *process*, pre-disruption strategies include planning and prevention, strategies during the disruption include mitigating and absorbing the disruption's effects, and post-disruption strategies include recovering and learning in preparation for future disruptions
  - other resilience strategies which span different contexts include variety (eg diversified economic structure), dispersity (eg distribution of key components/functions across space/time), redundancy (eg duplication of key components/functions) and optionality (eg keeping options open)
  - concepts about regional resilience often emphasise the effective use of the region's assets or resources, and the role of governance and institutions.
- **While valuable, the evolutionary perspective of resilience tends to be hard to measure.** Equilibrium-based methods include indicators of time to recovery and of avoidance of losses following a shock. Evolutionary-based approaches involve a long-term, systemic view of performance and can be hard to operationalise. However, arguably, this view of resilience is a more useful gauge of economic performance than many standard indicators like economic growth, as it relates to the long-term viability of an economic system – the ultimate test of that system.
- **Researchers in Aotearoa New Zealand have used methods based on the evolutionary perspective.** Encouragingly, studies of rural resilience and other aspects of resilience in New Zealand have tended to use mixed methods approaches and to take a long-term view. These methods are broadly in line with the evolutionary perspective of resilience. Other New Zealand studies, while not labelled as resilience ones, have examined the nature and effects of specific shocks.
- **Kaupapa Māori offers unique insights into resilience.** Māori hold wide-ranging perspectives on the topic of resilience, often motivated by a wider agenda to advance social justice for Māori. One study about Māori conceptions of resilience during the Christchurch earthquakes found that Māori risk management initiatives were collaborative and shaped by kaupapa (cultural values), specifically the value 'aroha nui ki te tangata' (extend love to all people). These community-based approaches tended to be seen as more effective in enhancing resilience than individually-focused mainstream ones. More generally, concepts from te ao Māori like kaitiakitanga (guardianship and protection) seem to broadly align with the evolutionary perspective of resilience.
- **While this paper only considers concepts and theories about resilience, it does offer some tentative policy implications.** In particular, the evolutionary perspective of resilience implies that, rather than aspiring to control change in systems assumed to be stable, policy should aim to manage the capacity of systems to adapt to change. The findings in this paper could be built upon by examining existing evidence of the resilience of the New Zealand economy, and about the effectiveness of policies to enhance resilience.

**Table 1: Equilibrium and evolutionary perspectives of resilience**

		<b>Equilibrium perspective</b>	<b>Evolutionary perspective</b>
<b>Basic concept</b>		Emphasises the return to a single previous state or equilibrium following a shock or the shift to alternative multiple equilibria	Emphasises the capacity of a system to adapt and fundamentally change in the face of numerous shocks and disturbances
<b>Definitional elements</b>		Bouncing back Absorbing shocks	Positive adaptability/bouncing forward System transformation
<b>Main fields of use</b>		Engineering, ecology (re absorbing shocks), economics (mainstream)	Psychology, socio-ecological systems, economics (evolutionary, ecological)
<b>The resilience of what?</b> (Entity or system that needs to be resilient)		Resilience studies cover a broad range of disciplines and levels. In economic systems, the unit of analysis can be people, firms, communities, regions, countries	
		Tends to take a fairly narrow view eg regional employment	Tends to take a systems view eg ecological systems, regional economic systems
<b>To what?</b> (Nature of shock or disturbance)		Resilience studies cover a broad range of different shocks, disturbances and perturbations	
		Examines a single shock eg recession Tends to view shocks in a negative light	Examines multiple shocks, disturbances and long-term trends eg climate change Tends to view shocks as a learning opportunity
<b>By what means?</b> (Resilience strategies)		Resilience strategies tend to be context-specific, although some cover a range of contexts – variety, dispersity, redundancy and optionality	
		Risk mitigation, impact absorption, recovery	Resilience is a long-term <i>process</i> including ongoing adaptation and learning
<b>With what outcome?</b> (Outcomes from resilience)		Return to the original pre-shock state – the system structure and function are unchanged Avoiding the shock altogether	Long-run performance or health of the system (which needs to be defined) – the system structure and even function may change The survival of the system
<b>Relation-ship with other concepts</b>	Closely-related concepts	Risk management Robustness	Antifragility Complex adaptive systems
	Sustainability	Not much to say on this	Generally seen as positively related
	Productivity	Short-term trade-off, via mechanisms like redundancy, variety and dispersity	In the long term, the relationship is more complex via mechanisms like innovation
	Inclusion	Greater equity and social connections may increase community resilience	
<b>Measurement approaches</b>		Approaches that focus on single shocks Indicators of time to recovery and avoidance of losses, and models of how long it takes for a shock to dissipate, or where a system would have been in the absence of a shock	Approaches that take a long-term, systemic view System dynamic models, case studies, mixed methods, indicator frameworks, and other methods to gain a broad picture of system performance in the long term

Source: Author, based on studies covered in this paper

# Contents

<b>1</b>	<b>Introduction</b> .....	<b>1</b>
1.1	Background and motivation.....	1
1.2	Research questions and purpose .....	1
1.3	Approach and scope .....	1
<b>2</b>	<b>Definitions</b> .....	<b>3</b>
2.1	Elements of definitions .....	3
2.2	Specific definitions .....	5
<b>3</b>	<b>Resilience concepts</b> .....	<b>7</b>
3.1	Equilibrium and evolutionary perspectives .....	7
3.2	Resilience of what? .....	9
3.3	Resilience to what? .....	9
3.4	Resilience by what means? .....	11
3.5	Resilience with what outcome? .....	18
<b>4</b>	<b>Links to other concepts</b> .....	<b>19</b>
4.1	Risk management .....	19
4.2	Robustness .....	19
4.3	Antifragility.....	20
4.4	Complex adaptive systems.....	20
4.5	Transition theories .....	22
4.6	Sustainability.....	23
4.7	Productivity.....	24
4.8	Inclusion.....	25
<b>5</b>	<b>Measurement</b> .....	<b>27</b>
5.1	Broad approaches and considerations.....	27
5.2	Illustrative examples .....	31
<b>6</b>	<b>New Zealand</b> .....	<b>34</b>
6.1	Definitions.....	34
6.2	Concepts .....	34
6.3	Measurement .....	37
<b>7</b>	<b>Discussion</b> .....	<b>39</b>
7.1	What have we learnt about the resilience literature? .....	39
7.2	About which types of shock might we be most worried? .....	40
7.3	How can we deal with these shocks? .....	40
<b>8</b>	<b>Conclusions</b> .....	<b>42</b>
	<b>References</b> .....	<b>43</b>

## List of Tables

Table 1: Equilibrium and evolutionary perspectives of resilience.....	iv
Table 2: Broad elements of definitions of resilience.....	5
Table 3: Broad methods for measuring regional resilience.....	27
Table 4: Example indicators of adaptive capacity .....	32

## List of Figures

Figure 1: Nature of regional shocks .....	10
Figure 2: Strategies to manage the resilience of a system.....	12
Figure 3: Resilience management steps over time .....	13
Figure 4: A conceptual framework of economic resilience.....	13
Figure 5: Some determinants of regional economic resilience.....	16
Figure 6: Adaptive cycle model and resilience.....	21
Figure 7: Multi-level perspective model .....	22
Figure 8: A conceptual framework for Māori resilience.....	35

# 1 Introduction

## 1.1 Background and motivation

Policymakers worldwide have long asked what makes one country or economy more resilient than another, or one region more resilient than another. ‘Resilience’ has been a topic of enduring interest to policymakers and academics. Resilience seems particularly relevant to a small, open economy like Aotearoa New Zealand, with limited influence on the world stage, and prone to earthquakes and other natural hazards.

Recent events such as the COVID-19 pandemic, the Russian-Ukrainian war, and Cyclone Gabrielle have brought resilience to the fore, as these shocks have disrupted supply chains, food security and other activities, and affected the lives and wellbeing of many New Zealanders. These shocks, in combination with trends like climate change, have led to a heightened interest in resilience. A recent example of this interest is the Productivity Commission’s (2023) inquiry into the resilience of New Zealand’s economy and living standards to supply chain disruptions.

If policy work aimed at improving resilience is to be effective, policymakers need to be clear about what they mean by, and how they understand, ‘resilience’.

## 1.2 Research questions and purpose

This literature review examines the following questions:

1. What do we mean by ‘resilience’? (Definitions)
2. How do we understand resilience? (Concepts and theories)
3. How can we analyse or measure resilience? (Measurement)

The ultimate purpose is to contribute to understandings of resilience, and to provide background information to policymakers and others interested in the topic.

## 1.3 Approach and scope

Our literature search was based on the three questions above.

As discussed later in this paper, the study of resilience spans a number of fields or disciplines such as engineering, ecology and psychology. Our main focus was on resilience in an *economic* context – the resilience of economic systems.<sup>1</sup> By economic system we generally mean a system of production, resource allocation and distribution of goods and services within a society or a given geographic area. An economic system is a means to an end. For example, an economic system provides job opportunities and wages to its residents, and thus contributes to residents’ material living standards and

---

<sup>1</sup> The term ‘system’ is discussed further in section 3.2.

ultimately their wellbeing. As well as material living standards, an economic system affects outcomes like environmental sustainability (through the types of goods and services produced and the ways in which they are produced for example) and inclusion (through the distribution of access to resources and job opportunities for example).

Despite the focus on economic systems, we took a fairly wide view and looked across a range of other disciplines to identify relevant insights. This wide view reflects that an economic system is intrinsically linked with environmental, social and other systems – a point picked up later in this paper. It also reflects that, if nothing else, the last few years have shown that previously-considered ‘wild cards’ like global pandemics can and do occur.

Given the focus on concepts and theories, the review mainly covered highly-cited international studies. To provide some New Zealand context, we also considered insights from te ao Māori and relevant New Zealand studies on the topic.

## 2 Definitions

**‘Resilience’ is about dealing with disturbances and shocks. But resilience is a contested term. Definitions matter, and there are tensions across definitions. For example, some definitions emphasise the retention of the structure and function of an (economic) system, while others do not.**

### 2.1 Elements of definitions

#### 2.1.1 ‘Bouncing back’ emphasises efficiency, constancy and predictability in the face of a disruption or shock

While perspectives about the genealogy of resilience differ (Bourbeau 2018), the term resilience is often seen as originating from the Latin word ‘resiliere’, which means to ‘bounce back’. This narrow view of resilience, with its focus on a system’s speed of recovery or return to its pre-shock position, was termed ‘engineering resilience’ by the ecologist Holling (1973) in his seminal paper on resilience. Holling argued that an engineer designs a device to perform specific tasks under a narrow range of predictable external conditions, and so is concerned with consistent non-variable performance in which slight departures from the performance goal are immediately counteracted. This view of resilience therefore emphasises efficiency, constancy and predictability.

In economics, this idea of resilience as ‘bounce back’ bears a close affinity with the idea of ‘self-restoring equilibrium dynamics’ found in mainstream economics – a point which Holling himself made (Martin and Sunley 2015). The assumption is that the normal condition of an economy is one of equilibrium (a steady state or a balanced growth path). If the economy is pushed away from this assumed position or path by a shock, such as a major recession, automatic, ‘self-correcting’ market mechanisms are activated which operate to restore the equilibrium.

#### 2.1.2 ‘Absorbing shocks’ is about how much disturbance a system can take and remain within critical thresholds

A second definition of resilience, found especially in the ecological literature, is a system’s ‘ability to absorb’ a shock (Martin and Sunley 2015). Holling (1973) defined ‘ecological resilience’ as “a measure of the ability of systems to absorb changes of state variables, driving variables, and parameters, and still persist”. For Holling, resilience was essentially about how much disturbance a system can take and remain within critical thresholds. Implicit in this conception of resilience is the assumption that systems can be pushed into alternative equilibria. Holling (1973) provided an example of this shift – if a population of fish moves location due to fishing pressure, the new location can be seen as a new equilibrium.

There are parallels in economics in terms of the idea of multiple equilibria (Martin and Sunley 2015). If a shock to an economy is too severe, it can so change economic structures, behaviours and expectations that the economy does not return to its pre-shock state or path, but is pushed to a new equilibrium. However, as in ecology, there is some ambiguity about how much reorganisation is permitted for the economic system to be regarded as having ‘absorbed’ the shock and still retained its core identity.

### **2.1.3 ‘Positive adaptability’/‘bouncing forward’ emphasises learning, adaptation, and preparation for future shocks**

More recently, the notion of ‘positive adaptive resilience’ has emerged (Martin and Sunley 2015). This idea is found in behavioural psychology to describe the adaptive coping skills of individuals to maintain or quickly regain wellbeing following personal stress or trauma. Resilient individuals are thought to adjust to life stressors.

Adaptive resilience resonates with ideas in complex adaptive systems theory (see section 4) and evolutionary theory more generally (Martin and Sunley 2015), including evolutionary economics. These theories are concerned with the interplay between continuity and change in self-organising systems subject to internal or external perturbations, and the capacity of systems to adapt to such pressures. Adaptive resilience emphasises processes like learning, adaptation, and preparation for future shocks. This might involve the retention of the function of the system, but not necessarily its structure. By ‘function’ we mean what a system does and/or its purpose.

### **2.1.4 ‘System transformation’ is about fundamental reorientation**

The most radical definition sees resilience as system transformation (Martin and Sunley 2020). Here the idea is that the scale or nature of a shock, expected or experienced, is such that the very viability or sustainability of a system is brought into question, and requires nothing short of a wholesale transformation of the system’s structure and function. Therefore, this form of resilience involves much more than adaptability. Instead, it has to do with the redeployment of resources and the reorientation of system dynamics to achieve a more sustainable and viable state of the relevant system.

Resilience as system transformation therefore raises questions about what *is* actually retained over time if the system’s fundamental function changes. Some definitions of resilience use the notion of system performance, but even here clarity is required about what is meant by ‘performance’. In Holling’s (1973) ecological view of resilience, the thing that is preserved across time is the existence of a system eg survival of a species.

There seem to be parallels with the calls of some economists to shift the focus of the economic system away from economic growth towards sustainability, in response to existential threats from climate change and biodiversity loss etc (see for example: Stiglitz, Sen and Fitoussi 2009, Raworth 2012). In particular, Raworth’s (2012) ‘doughnut economics’ argued that humanity should aim to meet the needs of all people within social and planetary boundaries. Doing this requires a radical change in the economic system, as many environmental ceilings have been, or are likely to be, breached. Raworth’s view emphasises the inter-dependence of economic and natural systems, per the evolutionary perspective of resilience (see section 3).

**Table 2: Broad elements of definitions of resilience**

Definition/type	Interpretation	Main fields of use
Resilience as ‘bounce back’ from shocks	System returns, ‘rebounds’, to pre-shock state or path: emphasizes speed and extent of recovery.	So-called ‘engineering resilience’, found in physical sciences, some versions of ecology; akin to ‘self-restoring equilibrium dynamics’ in mainstream economics?
Resilience as ‘ability to absorb’ shocks	Emphasizes stability of system structure, function and identity in the face of shocks. The size of shock that can be tolerated before system moved to new state/form.	So-called ‘extended ecological resilience’, found in ecology and social ecology; akin to multiple equilibrium economics?
Resilience as ‘positive adaptability’ in anticipation of, or in response to, shocks	Capacity of a system to maintain core performances despite shocks by adapting its structure, functions and organization. Idea of ‘bounce forward’.	Found in psychological sciences and organizational theory; akin to ‘robustness’ in complex systems theory; can be linked with evolutionary economics?
Resilience as ‘system transformation’ in anticipation of, or in response to shocks	The capacity of a system to create a fundamentally new reconfiguration and set of structures and functions, when conditions make the existing system untenable or unsustainable.	Found, for example, in studies of sustainability of socio-ecological systems, where radical, systemic shifts in values, beliefs, patterns of social behaviour and governance and management regimes are required.

Source: Martin and Sunley (2020)

## 2.2 Specific definitions

### 2.2.1 Definitional ambiguity has led some to question the usefulness of ‘resilience’

The discussion above shows that definitions of resilience are not yet settled. Different definitions emphasise different – and sometimes conflicting – ideas. These distinctions can have important implications for the ways in which resilience is interpreted and measured. One distinction is the degree of change a system can undergo for it to be deemed ‘resilient’. This distinction implies that a crucial step in studying resilience is determining system success or failure including what, if anything, needs to be maintained across time.

Another definitional distinction is the stage at which resilience applies. For example, Rose (2007) conceived resilience as only operative in the response/recovery/reconstruction stages, often referred to as post-disaster or post-shock stages. This view of resilience therefore excludes the idea of ‘vulnerability’ (the susceptibility of a system to shocks), as the inherent vulnerability of a system to shocks is primarily a pre-disaster condition. However, many other definitions and frameworks include the pre-shock stage, and therefore see vulnerability as a key component of this stage. Other definitions like ‘positive adaptability’ and ‘system transformation’ apply an even longer-term view, as they consider more than one shock. This longer-term view is covered in the evolutionary perspective of resilience (see section 3).

Partly because of the lack of agreement around definitions, some question the usefulness of resilience as a concept. As Rose (2007) put it: “resilience is in danger of

becoming a vacuous buzzword from overuse and ambiguity”. Concerns include that: there is no agreement around definitions, measurement, and theories (Martin and Sunley 2015); some definitions are so broad as to render the term meaningless (Rose 2007); resilience overlaps with other concepts like robustness, stability, sustainability, adaptation,<sup>2</sup> mitigation, and may not add much value (Rose 2007); and resilience lacks any sort of formal theoretical underpinning in economics (Stanley 2011).

An alternative view is that resilience *is* a valuable concept, as it can aid understanding about the ability of systems to cope with challenges and change. Resilience makes us think carefully about the nature of disruptions and how they affect the relevant system, and about the essence of a system that needs to be maintained through time, reflecting factors such as what societies value now and in the future (Early and Chapman 2013).

Arguably, resilience is a more important indicator of economic performance than traditional indicators like economic growth, as one of the most basic functions of an economic system is its survival, and the ultimate test of that system is its long-term viability (Aligica 2013). For example, the global financial crisis – as well as concerns around climate change – reopened debates about the viability of capitalism.

### **2.2.2 A number of alternative definitions are available**

A few specific highly-cited definitions of resilience are identified below. Note that these definitions capture the definitional elements in Table 2 to varying degrees.

“The capability of a system to maintain its functions and structure in the face of internal and external change and to degrade gracefully when it must” (Allenby and Fink 2000).

“The ability of an entity or system to maintain function (eg continue producing) when shocked” (Rose 2007).

“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” (United Nations Office for Disaster Risk Reduction 2009).

“A resilient country is one that has the capability to 1) adapt to changing contexts, 2) withstand sudden shocks and 3) recover to a desired equilibrium, either the previous one or a new one, while preserving the continuity of its operations” (World Economic Forum 2013).

“The long-term capacity of a system to deal with change and continue to develop” (Stockholm Resilience Centre 2011).

---

<sup>2</sup> For example, in the context of climate change, the IPCC (2018) defined adaptation as: “in human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities”.

## 3 Resilience concepts

Resilience concepts can broadly be grouped into the equilibrium perspective and the evolutionary one. The evolutionary perspective is generally seen as more valuable for studying the resilience of economic systems, as it emphasises the ability to cope with multiple challenges and change over the long term. Otherwise, the study of resilience tends to be context-specific.

### 3.1 Equilibrium and evolutionary perspectives

#### 3.1.1 There are wide-ranging concepts and ideas about resilience

As discussed in section 2, resilience has been studied across many fields and disciplines. Resilience can relate to ecological systems, the built environment, the economy, communities, individuals etc. While important insights can be drawn by looking across disciplines, care needs to be taken in drawing direct analogies from one discipline to another (Martin and Sunley 2015). Looked at another way, resilience can help bridge different disciplines (Aligica 2013). In this sense, resilience brings together diversity and polycentrism.

The study of resilience is therefore highly context-specific and begs a four-part question: *resilience of what, to what, by what means, and with what outcome?* (Martin and Sunley 2020). This question is considered further in the remainder of this section.

#### 3.1.2 Despite their variety, resilience concepts can be grouped into two perspectives

In broad terms, resilience concepts can be grouped into two schools of thought or perspectives – equilibrium and evolutionary (Simmie and Martin 2009).

Equilibrium-based theories of resilience emphasise the return to a single previous state or equilibrium following a shock ('bouncing back'), or the shift to alternative multiple equilibria ('absorbing shocks') (Simmie and Martin 2009).

In contrast, evolutionary-based theories emphasise the capacity of a system to adapt ('positive adaptability'/'bouncing forward') and fundamentally change ('system transformation') over time in the face of numerous shocks and disturbances. This view sees resilience as a dynamic process, not just a characteristic or property, and resonates closely with the Schumpeterian (1942) notion of 'creative destruction' (Martin 2012).

The grouping of resilience concepts into these two broad perspectives seems to be a key insight from the resilience literature. Therefore, in the remainder of this paper we draw this distinction fairly sharply where we consider it useful for explaining key ideas and concepts. In practice, however, there is likely to be considerable overlap (see section 4).

### **3.1.3 The equilibrium perspective is valuable for situations which involve narrow performance considerations**

The equilibrium view of resilience, with its focus on a system's speed of recovery or return to its pre-shock position, is valuable in contexts like engineering which is concerned with consistent non-variable performance in which slight departures from the performance goal are immediately counteracted. Maintaining consistent performance seems important when considering the resilience of things like bridges, aircraft, nuclear reactors and so on.

The resilience of buildings and infrastructure in the face of earthquakes is another example where the equilibrium perspective is valuable, and one which is highly relevant to New Zealand. These structures need to be robust and withstand a given level of stress without suffering degradation or loss of function (Bruneau, et al. 2003).

### **3.1.4 The evolutionary perspective tends to be seen as the more useful in an economic context**

Evolutionary thinking challenges the prominent notion in many traditional economic theories that economies exhibit linear dynamics and return to a static equilibrium (Bristow and Healy 2014). Despite these challenges to conventional wisdom, many authors contend that evolutionary-based theories are more useful than equilibrium-based ones for studying the resilience of economic systems, especially regional economic systems (see for example: Simmie and Martin 2009, Linkov, Trump and Hynes 2019, Davoudi 2012, Pendall, Foster and Cowell 2010, Bristow and Healy 2014).

For example, Christopherson, Michie and Tyler (2010) argued that the equilibrium perspective of resilience has significant limitations in the context of regional resilience as it is unrealistic. Instead, the evolutionary perspective tends to be seen as more relevant, as regional economies are likely to resemble complex adaptive systems comprising collections of agents (principally businesses and institutions) who interact with each other in complex ways (Bristow and Healy 2014).

The evolutionary perspective also emphasises adaptation and learning which are seen as critical to maintaining regional resilience over time. The likelihood of economic success being sustained over the long term crucially depends on a region's ability to adapt to changing circumstances and adjust to external shocks as and when these occur (Christopherson, Michie and Tyler 2010). This does not necessarily happen by itself; maintaining the resilience of regional economies and other complex social systems requires (self-)monitoring, deliberation, choice, and learning (Aligica 2013). These ideas are picked up further in the discussion below about regional governance and agency in decision-making, and about complex adaptive systems in section 4.

## 3.2 Resilience of what?

### 3.2.1 In an economic context, resilience can relate to people, firms, communities, regions and countries

The first thing to clarify in the study of resilience is what it is that needs to be resilient. 'System' is often used as a generic term for this entity, especially in relation to evolutionary-based theories of resilience. System generally means a set of things working together as parts of a mechanism or an interconnecting network; a complex whole. A system is surrounded and influenced by its environment, described by its boundaries, structure and purpose and expressed in its functioning. Systems can range in size and complexity from an individual IT system to the transport system.

Regarding *economic* systems, Rose (2007) distinguished three levels at which resilience takes place:

- Microeconomic – individual behaviour of firms, households, or organisations.
- Meso-economic – economic sector, individual market, or cooperative group.
- Macroeconomic – all units and markets combined, including interactive effects.

Therefore, the unit of analysis in studies about the resilience of economic systems can be people, firms, communities, regions, countries etc. Typically, the smaller units are likely to be more adaptable, and their experiences can provide information up the 'hierarchy' to slower moving larger groups who in turn provide stability. Beyond the unit of analysis, clarity is also needed about what specific variable or attribute of system performance or health needs to be resilient (see section 5).

## 3.3 Resilience to what?

### 3.3.1 Resilience is about dealing with unexpected 'shocks' and disruptions, and (some argue) long-term trends

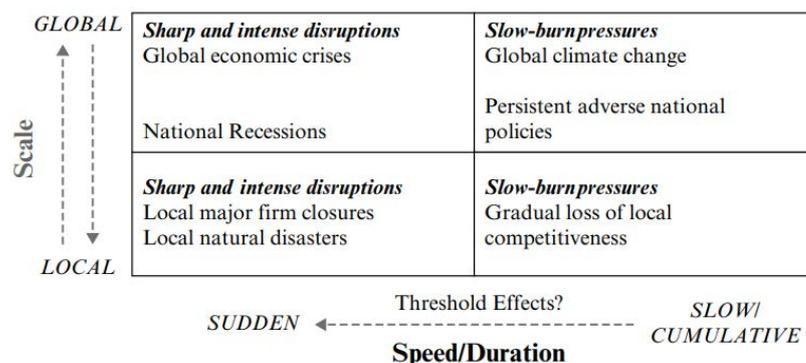
Resilience is concerned with the effects of 'shocks' (unexpected events that have a large-scale impact), perturbations and disturbances etc. Much of the focus is on sudden, 'out-of-the-ordinary' events like recessions and natural disasters.

Some authors also include 'slow-burn' pressures that cumulate over long periods of time, such as climate change. Long-term trends such as technological, social and economic change are often highlighted in the context of the resilience of rural communities facing decline (see for example Canadian Centre for Community Renewal 2000). However, some authors disagree with the inclusion of long-term trends, arguing that the inclusion extends resilience ideas too far (see for example Rose 2009).

Figure 1 provides some examples of both unexpected shocks and disruptions, and also slow-burn pressures and long-term trends. The matrix relates to regional shocks categorised across two dimensions – scale and duration. The OECD (2021) developed a somewhat similar matrix which categorised shocks as either chronic/acute (similar to

the speed/duration dimension in Figure 1), and exogenous/endogenous (the degree to which shocks are natural events or are due to human actions). For example, biodiversity loss was categorised by the OECD as chronic/endogenous.

**Figure 1: Nature of regional shocks**



Source: Martin and Sunley (2020)

Understanding the nature and causes of shocks is central to studying resilience (Christopherson, Michie and Tyler 2010). Tierney (2014) contended that disasters of all types – be they natural, technological, or economic – are rooted in common social and institutional sources. Put another way, risks and disasters are produced by the social order itself. This view of disasters therefore challenges the notion that such occurrences are singular exogenous events, driven by forces beyond our control.

### 3.3.2 The evolutionary perspective of resilience involves considering various pressures in combination over the longer term

While matrices like Figure 1 provide useful simple depictions, they can understate the complexity of change that different systems face. Threats may arise from hard-to-predict low probability, high consequence events recently described as ‘black swans’ (Linkov, Trump and Hynes 2019). But a range of other shocks, disturbances, and ongoing trends can create pressure on systems. Linkov, Trump and Hynes (2019) argued that, ideally, the study of resilience involves considering these various pressures in combination and over the longer-term, per the evolutionary perspective.

In fact, an evolutionary perspective tends to see shocks and disturbances as a learning opportunity and as a means of improving resilience (Davoudi 2012). Linkov, Trump and Hynes (2019) argued that biological, cognitive, or infrastructural, systems that have previously been exposed to shocks and stresses are more likely to have the experience and memory to adapt in the face of new and emerging challenges. For example, the human body is better able to more quickly absorb and/or recover from certain illnesses if it was exposed to similar diseases in the past through the creation of antibodies. This idea of embracing shocks is taken to the extreme in Taleb’s (2012) concept of ‘antifragility’ (see section 4).

## 3.4 Resilience by what means?

### 3.4.1 Resilience strategies tend to be context-specific

Often concepts about strategies to enhance resilience tend to reflect the particular context under consideration. Put another way, there is no generalisable explanation of what causes resilience, but only case-specific explanations (Rose 2009). Important contextual factors include both the type of system or entity that needs to be resilient, and the nature of the shock or disturbance.

For example, Rahman, et al. (2022) developed a framework for examining strategies for improving the resilience of economies to supply chain disruptions. The framework classified strategies into three categories – preparedness strategies, response strategies, and recovery strategies – to mitigate macro-level, supply, demand, manufacturing, information, transportation, and financial disruptions of supply chains. For example, supply-based preparedness strategies included strategic reserves, storage, and internal stock, per the ‘redundancy’ strategy discussed below. Information-based response strategies included having a detailed view of supply chain inventories and other supply chain parameters and sharing information. Manufacturing-based response strategies included re-shoring, back-shoring, near-shoring, and localising.

In another example, Bruneau, et al. (2003) developed a highly-cited framework about seismic resilience – the ability of both physical and social systems to withstand earthquake-generated forces and to cope with earthquake impacts. Under this framework, seismic resilience is seen as consisting of the following properties:

- **Robustness:** strength, or the ability of elements, systems etc to withstand a given level of stress or demand without suffering degradation or loss of function.
- **Redundancy:** the extent to which elements, systems etc exist that are substitutable and are capable of satisfying functional requirements in the event of disruption, degradation, or loss of functionality.
- **Resourcefulness:** the capacity to identify problems, establish priorities, and mobilise resources when conditions exist that threaten to disrupt some element or systems, and the ability to apply material and human resources to meet established priorities and achieve goals.
- **Rapidity:** the capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruption.

In the context of the resilience of rural communities facing long-term decline, the Canadian Centre for Community Renewal (2000) developed a conceptual model of community resilience comprising:

- **People in the community:** attitudes and behaviours which create community norms that either promote or hinder resilience.
- **Organisations in the community:** public and private organisations which provide the leadership and resources to get things done, engage the public, and collaborate effectively.

- Resources in the community: the awareness and use of resources both within the community and outside it, including building on local strengths while seeking appropriate external resources.
- Community process: strategic thinking and planning, including a widely shared vision for the future.

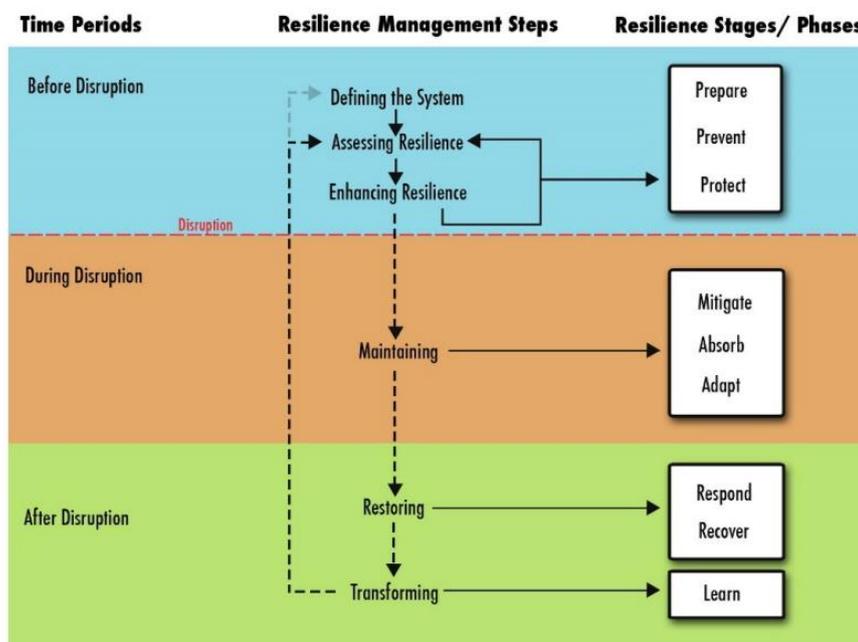
### 3.4.2 Resilience strategies are often grouped into ones before, during and after a disruption, reflecting the view of resilience as a process

In the remainder of this sub-section we attempt to draw out common threads in concepts about strategies to achieve resilience.

Many conceptual frameworks about resilience strategies distinguish between actions taken before, during and after a shock(s). This view tends to see resilience as a *process* (Martin and Sunley 2015, Linkov, Trump and Hynes 2019). But resilience can also be seen as a property, (desirable) attribute (Linkov, Trump and Hynes 2019), or outcome (Munoz, Billsberry and Ambrosini 2022).

For example, Linkov, Trump and Hynes (2019) developed a framework regarding strategies to manage the resilience of a system – see Figure 2. The framework essentially takes the evolutionary view of resilience, as the strategies include ‘adapt’ and ‘learn’, and the framework covers more than one shock via the feedback loop.

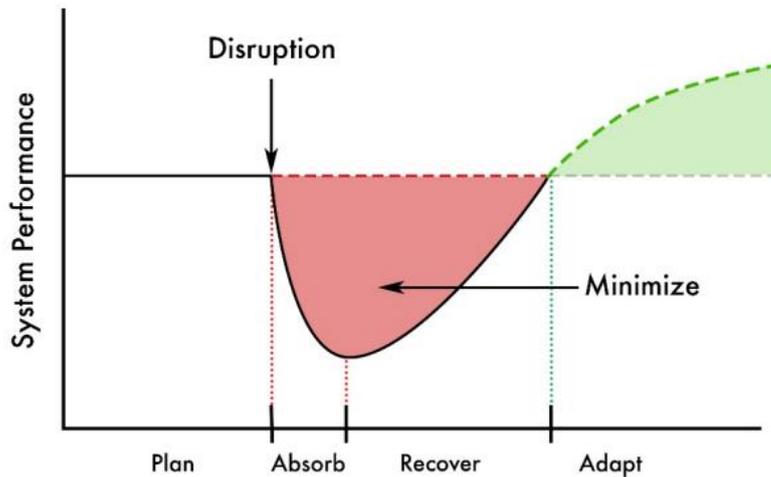
Figure 2: Strategies to manage the resilience of a system



Source: Linkov, Trump and Hynes (2019)

The resilience process above is often depicted as a timeline – see for example Figure 3. Note that here, rather than returning to the pre-disruption state or equilibrium, system performance is assumed to be enhanced following the adaptation phase.

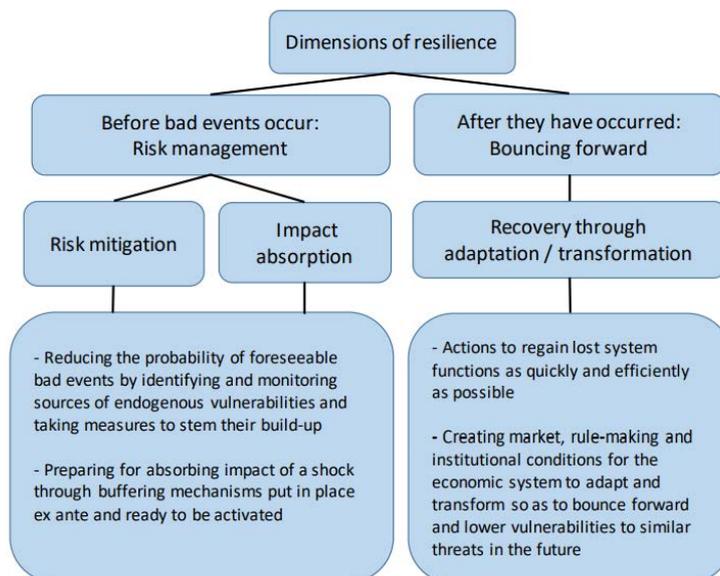
Figure 3: Resilience management steps over time



Source: Linkov, Trump and Hynes (2019)

Somewhat similarly, the OECD (2021) developed a policy framework that distinguished between policy actions before and after a ‘bad event’ occurs – see Figure 5.

Figure 4: A conceptual framework of economic resilience



Source: OECD (2021)

The OECD (2021) provided some examples of how the framework could be applied to specific events or shocks. For example, regarding threats to digital security, policy actions *before* such an event include sharing of strategic intelligence on global threats and actors, and stronger international policy and regulatory frameworks related to digital security; policy actions *after* the event include the development of a culture of security across key sectors, the development of digital security skills, and innovation in digital security.

### **3.4.3 Resilience strategies involve some common considerations**

While not a framework of resilience strategies as such, Linkov, Trump and Hynes (2019) identified some common ‘domains’ when considering resilience strategies:

- Physical: sensors, facilities, equipment, system states and capabilities.
- Information: creation, manipulation, and storage of data.
- Cognitive: understanding, mental models, preconceptions, biases, and values.
- Social: interaction, collaboration etc between individuals and entities.

Importantly, Linkov, Trump and Hynes (2019) argued that, while the physical and cognitive domains attract a lot of attention in resilience work, the information domain is of great importance and has a large impact on citizen response. Not all individuals understand and interpret information the same way. This leads to a need for attention to be paid on how to get information out effectively and in a timely fashion during a crisis. Also important is adequate information in real time for authorities to make informed and appropriate decisions. Information needs to flow from local organisations to the centre, and vice versa.

### **3.4.4 Various ‘capitals’ are often seen as sources of resilience**

Many conceptual frameworks about resilience strategies, especially in the context of regional and community resilience, include various ‘capitals’ or assets which are seen as sources of resilience. For example, the OECD (2014) developed a conceptual framework which sees the resilience of a community depending on the community’s access to financial, human, natural, physical, political, and social capital (OECD 2014). The Australian Productivity Commission (2017) used the same five capitals as a way of framing its work on regional resilience. In New Zealand, these types of ideas are picked up in Treasury’s Living Standards Framework (see section 6).

Resilience based on capitals essentially revolves around the idea that the more resources from which a community is able to draw, the greater its resilience (Australian Productivity Commission 2017). This idea seems intuitive. But it does raise questions about the added value of a resilience lens over other economic development lenses (see section 5). Presumably, access to different capitals or resources improves a range of outcomes, not just resilience. For example, Treasury’s Living Standards Framework is a *wellbeing* framework, and is predicated around the concept that New Zealand’s wealth (capitals) can be used to improve current and future wellbeing.

However, the idea that more resilient communities have more resources from which to draw does have some potentially useful insights. In particular, from an equity perspective, policy effort should probably focus more on less resilient/resource-rich communities rather than more resilient/resource-rich ones. Also, community resilience is not just a matter of the amount and type of resources that communities have at their disposal, but also the awareness of and effective use of those resources (Canadian Centre for Community Renewal 2000).

### **3.4.5 Strong governance and institutions are prominent in regional resilience**

The role of governance and institutions features prominently in many theories about resilience, especially the resilience of regions, as well as more generally in the economic development literature. For example, ‘deep roots’ institutions like the rule of law, the role of property rights etc, are thought to shape a country’s areas of economic strengths and economic trajectory (Ketels 2016).

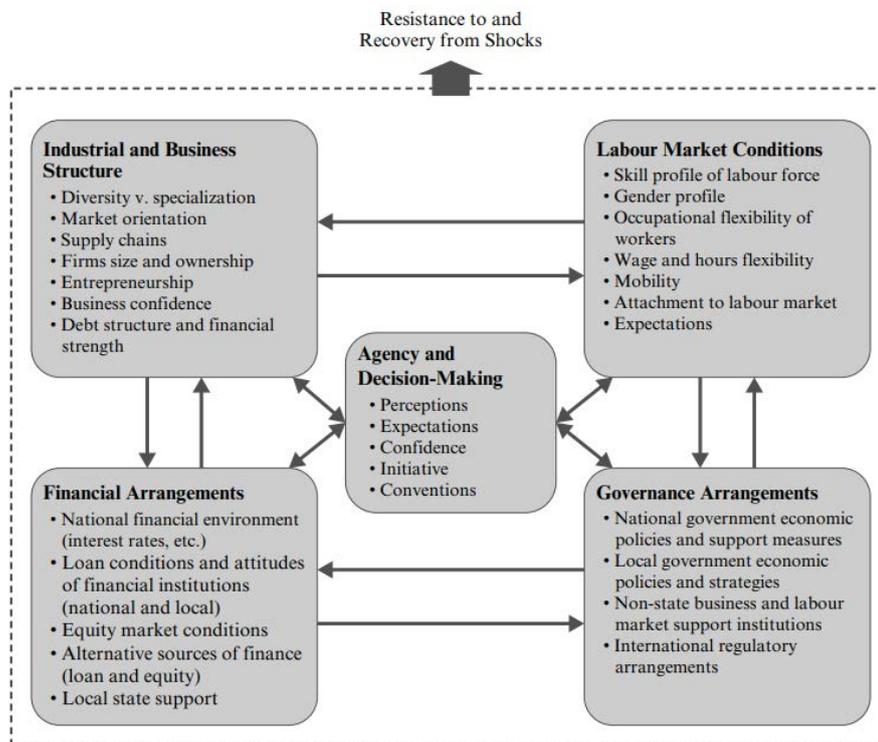
The prominence of governance and institutions in the literature about the resilience of economic systems partly reflects the role of human agency and decision-making in social systems (see for example Bristow and Healy 2014, Martin and Sunley 2015 and 2020, Noy and Yonson 2018, Sensier and Uyarra 2020). It also reflects the link between social and natural systems. As Aligica (2013) put it, “institutions emerge at the boundary between the realm of the natural and the realm of the social to mediate and structure the relationship between humans and their environment”.

Local economic governance arrangements can exercise considerable influence over the resilience of regions (Martin and Sunley 2020). These authors argued that a region with an activist policy authority committed to constantly enhancing and fostering local economic investment, entrepreneurship, the attraction of skilled labour, and infrastructural improvement, is not only likely to contribute to that region’s long-run growth rate but also to its capability to recover from unexpected shocks and perturbations. Similarly, the existence of local business associations, labour training institutions, private–public networks, and other such components of a region’s economic governance architecture may also be expected to shape its resilience.

At the extreme of this focus on local governance and institutions is ‘economic localism’, the belief that the main responsibility for local economic growth and vitality rests with local people themselves, not with central governments (Martin and Sunley 2015). Yet, if local businesses, workers and institutions lack the necessary resources and capabilities, full recovery from a major disruption may not occur without external support, including from central government. Central government policies, such as spending on infrastructure, technology, skills, business promotion and public services can shape not only geographical patterns of long-run growth, but also regional differences in economic resistance to and recoverability from shocks. Central government therefore plays a key role in working with local actors and supporting the resilience of regions.

Martin and Sunley (2020) developed a conceptual framework about the determinants of regional resilience which included governance considerations – see Figure 5. Note that the framework also picks up some of the other ideas in this sub-section.

**Figure 5: Some determinants of regional economic resilience**



Source: Martin and Sunley (2020)

The role of governance and agency in decision-making for resilient regional economies tends to relate to the evolutionary perspective of resilience (Bristow and Healy 2014, Martin and Sunley 2020). For example, Sensier and Uyarra (2020) argued that resilient regions are more likely to have dynamic and adaptable institutional structures that have learnt from previous crises. Similarly, Aligica (2013) argued that institutional design processes that ensure high levels of adaptability are likely to allow systems to incorporate new pieces of information quickly when conditions change.

Innovation is needed to be adaptable, per the evolutionary perspective. For a region to adapt to a particular challenge, institutions need to elicit adaptive learning, coordination, and innovation from its members (Aligica 2013). Importantly, innovation can help counter diminishing returns from labour, capital assets and other physical resources. This reflects that (intangible) ideas are not used up in the same way as (tangible) physical resources – the same idea can be used by one person or 1,000 people. The role of innovation relates to the point above – that resilience depends not only on access to resources, but also making the best use of those resources.

The evolutionary perspective emphasises regional economies determining for themselves the ultimate goal of resilience, or what is important in terms of the long-run performance of a regional economy. Doing so might involve local policy and governance institutions developing a collective and forward-looking strategic position on their economy including how to survive disruptive shocks (Martin and Sunley 2020).

### 3.4.6 Variety, dispersity, redundancy and optionality are resilience strategies which span a number of contexts

Ensuring *variety* within a system is a strategy to build resilience which is frequently mentioned in many different contexts. This strategy is based on the evolutionary perspective of resilience and draws on Darwinian theory which stresses the role of variety in species in enabling them to adapt to changing environments. Thus, in nature, variety is key to the resilience of ecosystems (Stanley 2011).

Regarding regional economic resilience, variety can come in the form of structural (sectoral) variety and variation in firm behaviour and might be expected to influence regional economic resilience in several ways (Simmie and Martin 2009). Firstly, the degree of sectoral variety is thought to influence the vulnerability of a regional economy to shocks, with regions having a more diversified economic structure being less prone to shocks, or at least more able to recover from them, than if they are economically specialised. Secondly, sectoral variety may influence innovative activity among firms, though opinion is divided on whether a diversified industrial structure is more conducive to innovation than a specialised structure. Along a somewhat similar line, Aligica (2013) argued that the resilience of a region is related to its institutional diversity.

While variety encompasses variances in type, *dispersity* refers to the distribution of important system components and functions over space, scale, and time (Stanley 2011). When system parts are concentrated or centralised they may be highly vulnerable to disruption. Increasing the geographic, temporal or hierarchal separation between components (decentralisation) can reduce the chance they will be affected by a shock hitting a particular place, time or scale. For example, dispersity in decision-making and problem solving, especially in disaster situations, may best be done at more decentralised local scales that involve as many system actors as possible (Stanley 2011).

Building *redundancy* – intentionally duplicating critical components or functions of a system – is another frequently-mentioned strategy to build resilience (Stanley 2011). This strategy is undertaken before a disruption occurs, such as in the ‘plan’ and ‘prepare’ phases in Figure 2 and Figure 3. One example of system redundancy is that the human body has two kidneys rather than the one it needs to remove waste (Taleb 2012). In economic systems, building redundancy could include stockpiling a readily accessible reserve supply of a particular resource, part or skill (Stanley 2011).

Relatedly, *optionality* is another resilience strategy which can be applied in a range of contexts. An early example of this strategy is a financial option which gives an investor the right, but not the obligation, to acquire a financial asset in the future, allowing him/her to see how market conditions play out before deciding whether to exercise the option. The same insights have been used for investment in infrastructure and physical assets in cases where there is risk/uncertainty attached to future values and the option for delay – Real Options Analysis (Watkiss, et al. 2014). More generally, trial and error (Taleb 2012) and learning and experimentation (Quinlan, et al. 2016) are important strategies for keeping options open and building resilience.

## **3.5 Resilience with what outcome?**

### **3.5.1 Returning to ‘normal’, and avoiding a shock altogether, are the desired outcomes of resilience based on the equilibrium perspective**

The desired outcome in equilibrium-based views of resilience is a return to the pre-disruption state following a shock. This includes the retention of the structure and function of the system, as discussed in section 2.

However, critics of the equilibrium view argue that the desire for a return to ‘normal’ risks a lack of questioning of what normality entails. One oft-cited example is the 2005 Hurricane Katrina. The hurricane not only destroyed the physical fabric of New Orleans, but also revealed social processes which residents did not find acceptable, and a pre-disaster normal to which they did not want to return (Davoudi 2012, Pendall, Foster and Cowell 2010). More recently, the recovery from COVID-19 has been seen as an opportunity to ‘bounce forward’ and help address challenges like climate change.

Equilibrium-based views of resilience also emphasise avoiding shocks altogether as a desirable outcome. This line of argument includes that a system that is hardly affected by a shock is more likely to recover, and more quickly, than a system that is severely weakened by the shock (Simmie and Martin 2009). An alternative (evolutionary-based) view is that exposure to shocks is vital in experiential learning and adaptation.

### **3.5.2 Maintaining the long-run performance of a system is the desired outcome of resilience based on the evolutionary perspective**

The evolutionary perspective of resilience sees the long-run performance, health or integrity of the system as the desired outcome of resilience (Simmie and Martin 2009). Importantly, ‘performance’ and ‘health’ need to be defined for resilience work to be useful.

In the context of regional resilience, many argue that local communities themselves should determine the goal of resilience and what constitutes the long-run health or performance of the region. For example, Bristow and Healy (2014) argued that communities should collectively decide what matters for the development of their region, based on these communities’ normative values and worldviews.

The survival of the system is also generally seen as a desirable outcome based on the evolutionary perspective. Otherwise, little else is assumed – or deemed as desirable – to remain the same.

## 4 Links to other concepts

Resilience has many ‘conceptual cousins’, such as robustness, anti-fragility, and complex adaptive systems, as well as links with outcomes such as sustainability, productivity and inclusion. This section briefly touches on some of the main theoretical links; there are many more.

### 4.1 Risk management

#### 4.1.1 Risk management is about the prevention of known risks before a shock, and so is a narrower concept than resilience

Different authors view the link between risk and resilience in different ways. Linkov, Trump and Hynes (2019) argued that risk management is concerned with efforts to prevent or absorb threats *before* they occur, while resilience is focused on recovery from losses *after* a shock has occurred (although note that others do not make this distinction – see section 2).

In addition, risk management includes the quantification of the likelihood and consequences of an event (per Knightian risk – see Knight 1921), whereas resilience is also concerned with unpredictable events for which the probability of occurrence cannot be quantified (per Knightian uncertainty). Note that this distinction between risk and uncertainty is quite stark. Possibly a more useful distinction is that between ‘black swans’ (unmeasurable) and ‘grey rhinos’ (measurable).

Resilience therefore tends to be seen as a wider concept than risk. As well as known risks, resilience involves dealing with the inherently unknown. Therefore, one way of thinking about the connection between risk management and resilience is that the former is part of the wider process of resilience (see section 3.4).

### 4.2 Robustness

#### 4.2.1 Robustness is about preserving stability, and is a narrower concept than resilience

Robustness emphasises preserving stability, maintaining, coping, and withstanding (Munoz, Billsberry and Ambrosini 2022). These ideas are picked up in some equilibrium-based views of resilience like ‘bouncing back’ which see the goal of resilience as returning to the previous state. For example, in an earthquake, buildings and infrastructure need to be robust and withstand a given level of stress or demand without suffering degradation or loss of function (Bruneau, et al. 2003).

Robustness and resilience are therefore related concepts, but the latter is generally seen as broader.

## 4.3 Antifragility

### 4.3.1 Antifragility is about a performance gain when exposed to adversity, and so relates to the evolutionary perspective of resilience

Antifragility is a concept developed by Taleb (2012). The idea is that systems characterised as antifragile will benefit, thrive, and grow when exposed to volatility, randomness, disorder, and uncertainty (Taleb 2012). While resilience is often about recovery after performance degradation, antifragility is defined as a performance *gain* when exposed to adversity (Munoz, Billsberry and Ambrosini 2022). Antifragility therefore seems to relate to, and be an extreme expression of, the evolutionary view of resilience, as it involves learning and adaptation in the face of a shock.

In particular, antifragility embraces volatility as information and a means of learning (Taleb 2012). A key argument is that it is hard to predict the next shock or disruption, so it is better to build antifragility into a system via strategies like redundancy and variety (see section 3).

## 4.4 Complex adaptive systems

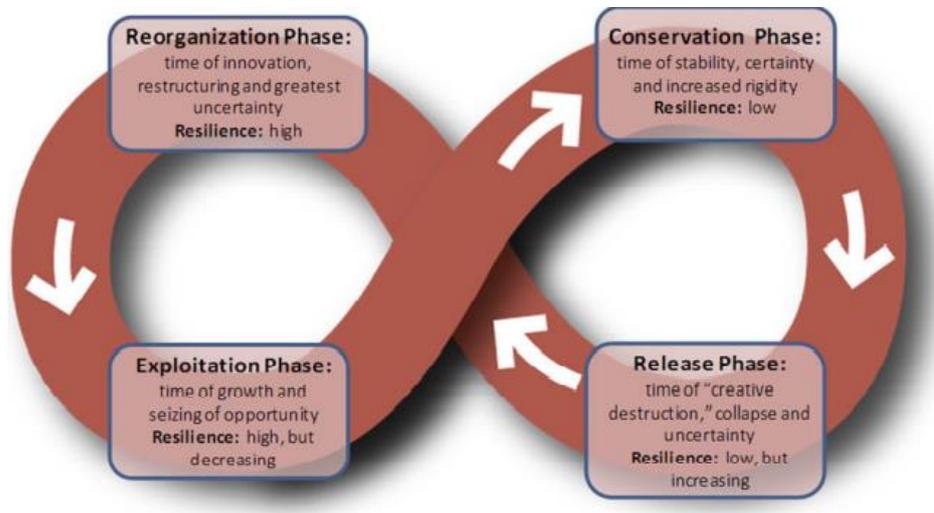
### 4.4.1 Complex adaptive systems theory is about interactive and dynamic systems that change over time

Complex adaptive systems theory is a broad body of work rather than a single theory, and sees all kinds of system as characterised by complex non-linear dynamics and perpetual uncertainty and change (Bristow and Healy 2014).

The ‘adaptive cycle’ model, developed by Holling and Gunderson (2002), is a prominent model in complex adaptive systems theory. The adaptive cycle model refers to four distinct phases of change in the structure and function of a system: growth or exploitation, conservation, release or creative destruction, and reorganisation. The release or creative destruction phase seems to relate to Schumpeter’s (1942) notion of creative destruction – the process by which innovations continually displace existing technologies and ways of doing things.

Figure 6 depicts the adaptive cycle model, including its links with resilience.

Figure 6: Adaptive cycle model and resilience



Source: Pendall, Foster and Cowell (2010), adapted from Holling and Gunderson (2002)

#### 4.4.2 Complex adaptive systems theory relates to the evolutionary perspective of resilience and is prominent in regional resilience work

Complex adaptive systems theory relates to the evolutionary view of resilience, as that perspective is based on adaptation and change over the long-term (Bristow and Healy 2014, Martin and Sunley 2015).

Pendall, Foster and Cowell (2010) argued that the adaptive cycle model is the fullest expression of system resilience based on evolutionary theories. The adaptive cycle model implies that as systems mature, their resilience reduces and they become 'an accident waiting to happen', and when systems collapse, 'a window of opportunity' opens up for alternative systems configuration (Davoudi 2012). Each phase of the cycle is associated with a level of resilience, defined as the system's vulnerability to surprise, stresses and shocks (Pendall, Foster and Cowell 2010). The adaptive cycle model does not allow us to say that a system is, or is not, resilient. Rather, a key insight from the model is that resilience levels vary continually as a system adapts and changes.

Complex adaptive systems theory, including the adaptive cycle model, is widely referenced in studies about regional resilience (see for example: Pendall, Foster and Cowell 2010, Christopherson, Michie and Tyler 2010, Davoudi 2012, Bristow and Healy 2014). For example, Bristow and Healy (2014) argued that complex adaptive systems theory implies that regional economies can be understood as broad and diverse entities driven by the decision-making of an array of different individual actors – firms, policymakers, labour, consumers, and civil society, etc. This theory also implies that in regional economies and other social systems, resilience has a strong behavioural element and emerges not only from inherent structural conditions, but also from the stimulus of human beings and their decisions.

## 4.5 Transition theories

### 4.5.1 Transitions are evolutionary processes with emergent properties

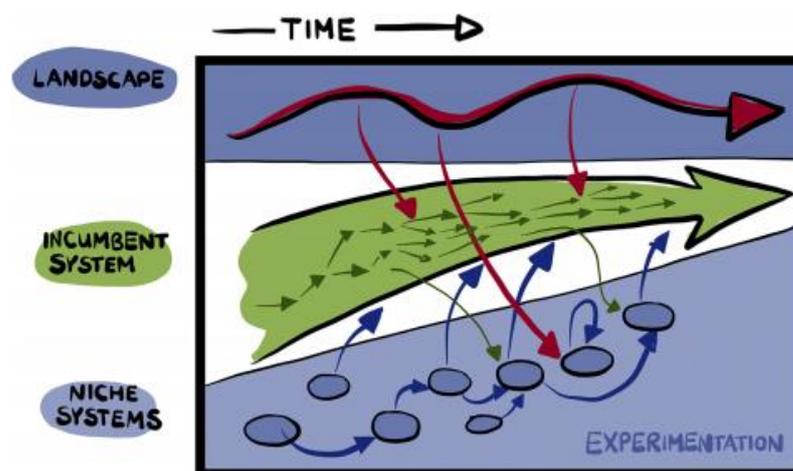
'Transition' is commonly defined as the process or a period of changing from one state or condition to another. The field of transition studies was developed to explain historic transitions in socio-technical systems such as transport, electricity, and large-scale sectoral change (Barry, et al. 2018).

The multi-level perspective model (see Geels 2011) is a prominent one in the field of transition studies. This model argues that transitions come about through complex interactions at three levels (see Figure 7):

- At the micro level, niche-innovations build up internal momentum, through learning processes, price/performance improvements etc.
- At the macro level, landscape changes (macro-economic, cultural, political etc) create pressure on the incumbent system and create windows of opportunity for niche-innovations.
- At the meso level, the alignment of the processes above enables the breakthrough of novelties in mainstream markets where they compete with the existing system.

Key insights from the multi-level perspective model include the role of innovation in disrupting the incumbent system, and that strong forces, such as vested interests and path dependency, work towards preserving the incumbent system or status quo. The model therefore highlights that disruption is a feature of transition as new ideas, technologies, products and interests clash with old ones.

Figure 7: Multi-level perspective model



Source: Leendertse and Rijnsoever (2020), adapted from Geels (2011)

#### **4.5.2 Transitions involve a clash between the status quo (per the equilibrium perspective) and emergent systems (per the evolutionary one)**

Transition studies and resilience concepts are both concerned with systemic change and the forces that bring about that change.

The equilibrium perspective of resilience is about the return to a single previous state, and so seems to have some parallels with the incumbent system (status quo) level of the multi-level perspective model. The evolutionary perspective of resilience is about adaptation and change in systems over the long-term, and so seems to have some parallels with emergent systems arising from transition processes.

In some ways, transition concepts such as the multi-level perspective model provide a way of linking the equilibrium and evolutionary perspectives of resilience. In particular, the model highlights the tensions between the equilibrium and evolutionary perspectives of resilience, and implies that elements of each perspective may operate at the same time.

## **4.6 Sustainability**

### **4.6.1 Sustainability is the ability for something to be maintained at a certain rate or level over time**

In a general sense, sustainability is about the ability for something to be maintained at a certain rate or level over time. In an economic context, one widely-cited definition is: “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987).

The term sustainability is often used in the context of the environment, recognising that the Earth’s resources are finite, and should be used conservatively and wisely with a view to the long term.

However, the concept of sustainability does not just relate to the environment. One way to think about sustainability is in terms of the maintenance or management of capitals stocks (or ‘capitals’) and flows, per Treasury’s Living Standards Framework (Treasury 2018). For example, workers’ skills (human capital) can be combined with machines (physical capital) and raw materials (natural capital) to generate goods and services (consumption flow). But if one of these capitals, such as physical capital, is not adequately managed for sustainable, long-term use, the consumption of future generations may be in jeopardy.

### **4.6.2 Sustainability and resilience tend to be seen as positively related, but the relationship may vary depending on the definitions used**

Both sustainability and (the evolutionary perspective of) resilience share a long-term, systemic perspective, with the aim of guiding systems into the future. One distinction between the two is that resilience is concerned with shocks and disturbances to a

system, whereas this is not necessarily the case for sustainability. Otherwise, resilience can be seen as a component of sustainability, sustainability as a component of resilience, and resilience and sustainability can be seen as separate concepts (Marchese, Bates and Clark 2018).

Some argue that the long-run sustainability of a system depends on the resilience of that system (Treasury 2018, Stanley 2011), which implies that resilience is a determinant of sustainability and the two are positively related. However, if sustainability is conceived as the maintenance of various stocks or 'capitals', and 'capitals' are seen as a source of resilience (see section 3), then essentially sustainability is a determinant of resilience.

But sustainability and resilience do not necessarily go hand-in-hand. For example, Keenan, et al. (2021) argued that certain resilience processes may perpetuate stability features that thwart or delay an economic transition toward (environmental) sustainability. This argument broadly draws on equilibrium-based definitions of resilience such as 'bouncing back', which imply rigidities in industry structures that may limit the capacity of economies to adapt consistent with sustainability goals.

## **4.7 Productivity**

### **4.7.1 Productivity is a measure of efficiency**

Productivity is a measure of the efficiency with which inputs (labour, capital and raw materials) are converted into outputs (goods and services) (Pells 2018). Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input. Productivity rises when the volume of output increases more rapidly than the volume of input and falls if the volume of input increases more rapidly than the associated output.

### **4.7.2 In the short term, productivity and resilience may be negatively related**

In general, there is thought to be a trade-off between productivity and resilience (Faggian and Ascani 2021). Building redundancy into a system before a disruption occurs, as discussed in section 3, is thought to be one of the main mechanisms for this trade-off. One example is hospital configuration and design that accommodates more patients in the midst of an epidemic or other disaster (eg extra beds) (Linkov, Trump and Hynes 2019). This extra capacity is good from a resilience perspective, as it enables the maintenance of core health services when faced with an increased demand for such services following a disruption. But from a productivity/efficiency perspective, the extra capacity is essentially extra inputs which, if no disruption occurs and therefore output does not increase commensurately with inputs, reduces productivity.

Another oft-cited example of the effect of redundancy on productivity is in the context of supply chain resilience (see for example Faggian and Ascani 2021). For example, while holding extra stocks of raw materials etc can reduce a firm's (or economy's) vulnerability to supply chain disruptions, these extra inputs reduce productivity if there is no commensurate increase in output. Also in the context of supply chains, another

example of the potential trade-off between productivity and resilience is that, if a search for efficiency increases the complexity of global supply chains, this complexity may lead to a reduction in resilience (Gölgeci, Yildiz and Andersson 2020).

Other mechanisms that may result in a potential trade-off between productivity and resilience include diversity and dispersity (Stanley 2011). These mechanisms may work against agglomeration and economies of scale, which essentially assume that the more concentrated an activity, the more productive it is likely to be.

### **4.7.3 In the long term, the relationship may be more complex**

A trade-off between resilience and productivity tends to be based on short-term (equilibrium-based) theories. In the longer term, there is likely to be a complex relationship between productivity and resilience, per evolutionary-based perspectives, and based on dynamic rather than static efficiency. For example, innovation and learning play a key role in the view of resilience as long-term adaptability to multiple shocks; innovation is also a key driver of productivity growth. In recognition of this long-term view, Gölgeci, Yildiz and Andersson (2020) argued that, to ensure their survival, firms need to maintain both efficiency and resilience concurrently over time.

## **4.8 Inclusion**

### **4.8.1 Inclusion is concerned with distribution, equity and social connections, and is generally thought to have a positive relationship with resilience**

As with resilience (and many other concepts), inclusiveness can be defined in different ways. The OECD (2018) described ‘inclusive growth’ as “economic growth that creates opportunities for all segments of the population and distributes the dividends of increased prosperity, in both monetary and nonmonetary terms, fairly across society”.

When inclusion means social connections, there tends to be a positive theoretical relationship between resilience and inclusion. For example, communities with strong social connections are thought to have higher levels of trust and support for each other which helps them in the face of natural disasters and other challenges (Chen, Craven and Martin 2021). The term ‘communitas’ has been developed to refer to the improvisational social bonds and spontaneous mutual support that arise within communities when disaster strikes (Matthewman and Uekusa 2021).

When considering distribution and resilience, Stanley (2011) argued along broadly similar lines – that the pre-existing economic order prior to a shock can greatly influence how actors behave and make decisions. Economic equity is likely to improve resilience because it builds community capacity to band together and persevere through adversity. People need to feel that they are valued by, and have a stake in, their community.

Similarly, poverty and income disparity may undermine the social fabric and reduce community resilience (Stanley 2011). Somewhat relatedly, Geronimus (2023) coined the term ‘weathering’ which refers to the process of chronic social and psychological

stress that activates harmful biological processes among people in marginalised communities, ageing their bodies prematurely.<sup>3</sup> Such discrimination grinds people down and can lead to debilitating illness and early death. Thus, in the context of the health and wellbeing of individuals, a lack of inclusion seems to lower personal resilience.

The arguments above generally run from inclusion to resilience, and see inclusion and resilience as positively related. However, some authors, while not necessarily explicitly saying so, essentially consider the relationship from the other direction (ie resilience as a determinant of inclusion). In particular, there is a concern that resilience can operate as a discourse which transforms public issues into personal troubles and can end up victim-blaming (Matthewman and Uekusa 2021); essentially this view sees a negative relationship between resilience and inclusion. These ideas are picked up in some Māori conceptions of resilience (see section 6).

---

<sup>3</sup> <https://www.theguardian.com/books/2023/mar/17/weathering-by-arline-geronimus-review-how-discrimination-makes-you-sick>

## 5 Measurement

Unsurprisingly, there is a lack of agreed approaches to measuring resilience. In general, the concept seems hard to operationalise, which implies that care should be taken when interpreting resilience studies. In particular, evolutionary perspectives of resilience, while valuable, are hard to measure. Relevant methods include broad assessments of system resilience and performance.

### 5.1 Broad approaches and considerations

#### 5.1.1 A number of alternative approaches are available

As yet there is no generally accepted method for how the concept of resilience should be operationalised and measured empirically (Martin and Sunley 2015). This is not surprising, given the ambiguity around definitions and concepts. Martin and Sunley (2015) summarised some of the broad measurement approaches available for measuring the resilience of regional economies – see Table 3.

*Table 3: Broad methods for measuring regional resilience*

Method	Focus	Examples
1. Case study based	Mainly narrative based, may involve simple descriptive data and interviews with key actors, interrogation of policies	Munich (Evans and Karecha, 2013); Cambridge and Swansea (Simmie and Martin, 2010); Buffalo and Cleveland (Cowell, 2013) British Columbia mill towns (Lyon, 2014)
2. Resilience indices	Singular or composite, comparative, measures of (relative) resistance and recovery, using key system variables of interest	UK regions (Martin, 2012); US cities and counties (Augustine et al., 2013; Han and Goetz, 2015; Rockefeller Foundation/Arup, 2015)
3. Statistical time series models	Impulse response models; error correction models. These estimate how long it takes for impact of shock to dissipate (how much of the impact is subsequently eliminated per unit time period)	US regions (Blanchard and Katz, 1992); UK regions (Fingleton et al., 2012)
4. Causal structural models	Embedding resilience in regional economic models to generate counterfactual positions of where system would have been in the absence of shock	US metropolitan areas (Doran and Fingleton, 2013); EU regions (Fingleton et al., 2014; Sensier et al., 2016)

Source: Martin and Sunley (2020)

In a somewhat similar vein, Hosseini, Barker and Ramirez-Marquez (2016) provided a breakdown of alternative approaches for assessing resilience, based on a review of the topic.

- Qualitative assessment approaches which include:
  - conceptual frameworks which provide insights about the notion of resilience but do not provide a quantitative value
  - semi-quantitative approaches which generally involve the aggregation of expert opinion along multiple dimensions into an index
- Quantitative assessment approaches which include:
  - measures which generally assess resilience by comparing the performance of a system before and after a disruption. Some measures are static in nature, while others offer a time-dependent perspective on system performance
  - structural based approaches which emphasise the structure or characteristics of a particular system to derive a measure of its resilience. This involves observing system behaviour and modelling or simulating the characteristics of a system.

Other reviews of methods to assess economic resilience include Modica and Reggiani (2014), who reviewed measurement approaches used in recent studies of regional resilience, and Noy and Yonson (2018), who reviewed methods of measuring the vulnerability and resilience of economies to disasters triggered by natural hazards.

Overall, these reviews highlight the wide range of, and lack of agreement about, indicators and methods of measuring resilience. Conostas, d'Errico and Pietrelli (2022) argued that, while pluralism may be necessary to address contextual variation, the variety of approaches used to measure resilience makes it difficult to communicate with stakeholders and to compare the results from one setting to another.

### 5.1.2 General considerations for measuring resilience include:

- **Be clear about the underlying definition or concept being targeted.** While clarity about definitions and concepts is always important in measurement, it is particularly important regarding a 'fuzzy' concept like resilience (Pendall, Foster and Cowell 2010). In particular, resilience indicators must be easily interpreted and only have a single (monotonous) relationship with whatever is being measured (Schipper and Langston 2015). Put another way, indicators need to be based on established notions of resilience success and failure (Linkov, Trump and Hynes 2019). For example, is an increase in the rate of movement of people out of regions facing long-term decline a good or bad thing from a resilience perspective? If this is not clear, then inter-regional migration is not a useful indicator of resilience.
- **In particular, consider the core function or performance of the system.** Many measurement approaches are based on tracking a key variable(s) or indicator(s) through time to examine the effect of a shock(s) on the variable. For example, studies about regional resilience often use measures of regional economic growth, employment rates, standards of living and quality of life (Christopherson, Michie and Tyler 2010). To be valuable, such studies need to capture some aspects of the

core function or performance of the system through time. In the context of regional and community resilience, important considerations might include reflecting community preferences (see section 3), and including social, distributional, and environmental indicators as well as economic ones (Sensier and Uyarra 2020).

- **Consider the time period of analysis.** The dimension of time is critical to resilience studies (Carpenter, et al. 2001). Equilibrium measurement approaches tend to focus on relatively short time periods and specific shocks. Time is measured in moments – pre-shock, shock and post-shock (Christopherson, Michie and Tyler 2010). But the evolutionary perspective of resilience involves a long-term view and so might involve using a time series covering a number of different shocks and perturbations (Linkov, Trump and Hynes 2019).
- **Consider the nature of shocks.** Fundamentally, resilience is about change and shocks, perturbations and other disturbances to a system. It is therefore useful to understand the nature of shocks and how they affect the system in question. For example, how are the causes behind systemic shock understood and interpreted (Christopherson, Michie and Tyler 2010)? The interpretation of the causes – the story that is told about why an adverse event occurred – is critical to what will be considered successful adaptation or resilience.

### **5.1.3 Approaches based on the equilibrium perspective of resilience tend to be easier to implement than those based on the evolutionary one**

In general, the measurement approaches used in studies about economic resilience are equilibrium-based ones – they assume some sort of ‘return to normal’ following a single shock. Indicators include time to recovery for the relevant variable, and avoidance of losses following the particular shock (in broad terms, measuring the area shaded red in Figure 3 above).

One of the reasons for the prevalence of equilibrium-based approaches is likely to be that they are easier to implement than evolutionary-based ones. The latter, while desirable, may be challenging to operationalise in practice. For example, features of complex adaptive systems (see section 4) like feedback loops, non-linearities, tipping points etc are very difficult to model in practice (Pendall, Foster and Cowell 2010, Quinlan, et al. 2016). Carpenter, et al. (2001) argued that the adaptive cycle model, while very valuable conceptually, is not a testable hypothesis. It is difficult to understand cause-and-effect relationships in dynamic complex systems (Sanchez, van der Heijden and Osmond 2018).

### **5.1.4 Assessing resilience based on the evolutionary perspective requires a long-term, systemic view**

Despite the challenges described above, it may be feasible to use system-based tools and methods to provide some insights about resilience based on evolutionary perspectives. This reflects that the evolutionary perspective of resilience, which emphasises the capacity of a system to adapt and change over time in the face of numerous shocks and disturbances, closely relates to system theories (see section 4).

A complex adaptive systems view of regional resilience per the evolutionary perspective emphasises the importance of relationships and interactions between different actors in the system, and the behaviour of agents within the system (Bristow and Healy 2014). This suggests that models and approaches like agent-based modelling and system dynamics may be relevant. These types of models are computer simulations used to study the interactions between people, things, places, and time, and to test policy and scenario options by answering ‘what-if’ questions (Currie, Smith and Jagals 2018).

Aligica (2013) discussed this systems view in the context of institutional resilience. This author argued that institutional resilience is not about maximising a certain performance variable (criterion) but about trying to manage a complex set of interrelated variables. In practical terms, this requires appropriate information and a knowledge base about institutional arrangements.

Quinlan, et al. (2016) argued along somewhat similar lines and identified a number of different approaches for assessing and measuring resilience in socio-ecological systems. These approaches spanned quantitative and qualitative techniques and included modelling, scale analysis, scenarios, network analysis, indicators for key variables, interviews and focus groups. In particular, the authors commented that participatory activities, such as bounding the problem, defining the focal scale, developing timelines based on past disturbances and considering cross-scale interactions, can contribute to a complex adaptive systems perspective of resilience. Case studies can also be used to gain a rounded picture of resilience based on evolutionary concepts. Case studies can draw on mixed methods and cover a long time period.

Importantly, Quinlan, et al. (2016) argued that *assessing* the resilience of a system, by drawing on a range of different data and methods, is generally more useful and practical than *measuring* resilience via a single metric or model. This reflects that understandings of complex adaptive systems will always be partial and incomplete because of the dynamic nature of these systems. It is therefore useful to design approaches like resilience assessment that acknowledge this uncertainty and (like building resilience itself) adopt an iterative approach based on learning.

Quinlan, et al. (2016) argued that such assessments of system resilience have been used in fields such as ecology and natural resource management, but do not appear to have been used much in the context of economic systems. Having said that, there are some examples of assessments of resilience in an economic context; the Reserve Bank (2022) and others have analysed the resilience of financial systems. In addition, indicator frameworks and other broad assessment frameworks seem to be fairly widely used in the context of regional and community resilience. For example, the Canadian Centre for Community Renewal (2000) developed an indicator framework aimed at creating a portrait of a community’s strengths and weaknesses, in order to help identify the community’s resilience in the face of change. Similarly, Sutton and Asku (2022) advocated for the use of a broad range of indicators and methods when taking a system-based and evolutionary approach to investigating the resilience of regions.

## 5.2 Illustrative examples

### 5.2.1 Simple metric of resilience of business interruption to disasters

Dormady, et al. (2022) developed a simple resilience metric (RM) in the context of the resilience of business activities to natural disasters:

$$RM = \frac{\textit{AvoidedLosses}}{\textit{MaxPotentialLosses}}$$

This metric can be read on a percentage basis, where for example, an RM value of 0.075 indicates that a firm avoided 7.5% of its maximum potential losses using a resilience tactic.

This metric relies on some assumptions or counterfactual analysis about what would have happened to the firm's revenue etc in the absence of the tactic's use, in order to estimate 'avoided losses' and 'maximum potential losses'. To do this, Dormady, et al. (2022) conducted a survey of US firms affected by Superstorm Sandy and Hurricane Harvey. The survey was designed to identify tactics that firms used to avoid business interruption in the face of the disasters, and to estimate the avoided losses associated with the use of those tactics and the maximum potential losses in the absence of tactics.

The metric above is essentially based on the equilibrium perspective of resilience, as it covers a relatively short time period and assumes some sort of return to 'normal' production.

### 5.2.2 Computable general equilibrium model of transport resilience

Chen and Rose (2018) used a computable general equilibrium (CGE) model to assess the vulnerability and economic resilience of different modes of transport to different shocks. CGE models are a class of economic model that use economic data to estimate how an economy might react to changes in policy or external shocks etc. Key features of CGE models include that they are based on interdependencies of sectors within the economy – they characterise the economy as a set of interconnected supply chains.

Specifically, Chen and Rose (2018) included air, road, rail, water and local transit in the model, and incorporated various resilience tactics including modal substitution, trip conservation, excess capacity, relocation/rerouting, and service recapture. To illustrate the model's capabilities, it was applied to the transportation system failures in the aftermath of Hurricane Katrina.

The authors commented that CGE models have been used extensively to model various types of disasters including considerations of resilience. The authors also identified various limitations of the model: for the most part, it assumes the economy is in equilibrium; it is static, so that it does not trace the time-path of impacts; it is based on a deterministic approach on the basis of a single base year of data. The model therefore appears to be based on the equilibrium perspective of resilience.

### 5.2.3 Index of regional resilience

The Australian Productivity Commission (2017) developed an index to rank regions most at risk of failing to adjust to disruptive events. The index was based on the idea that resilience outcomes are influenced by the adaptive capacity of communities and the ‘capitals’ they have at their disposal – see Table 4 below. This reflects the concept that the more resources from which a region is able to draw, the more resilient it is likely to be (see section 3).

The Commission identified a number of indicators relevant to adaptive capacity (see Table 4 for some examples). The Commission used Principal Components Analysis – an approach that summarises data by identifying the elements that explain the most variation – to enable the construction of a single index.

*Table 4: Example indicators of adaptive capacity*

Type	Example indicators
<b>Human capital</b>	Proportion of people aged 15–64 who have completed year 12 or higher Proportion of employed people in high- to medium-skilled occupations Proportion of the labour force who are employed Estimated proportion of people aged 15+ who self-assessed their health as better than fair
<b>Financial capital</b>	Proportion of households with equivalised household income greater than \$1250 a week Ratio of total investment income to population Proportion of households who live in an owner-occupied dwelling
<b>Physical capital</b>	Remoteness, based on Accessibility/Remoteness Index Proportion of households that access internet from the dwelling Estimated proportion of people aged 18+ who do not find it difficult getting to places needed with transport
<b>Natural capital</b>	Proportion of employed people working in agriculture industry Proportion of employed people working in mining industry Proportion of land as national parks or nature reserves
<b>Social capital</b>	Proportion of people who volunteered Estimated proportion of people aged 18+ who felt very safe/safe walking alone after dark Estimated proportion of people aged 18+ who felt they had experienced discrimination Estimated proportion of people who are homeless
<b>Other</b>	Herfindahl index of industry diversity Proportional change in population aged 15–64 over five years Proportion of people who travel to work in a different region

*Source: Australian Productivity Commission (2017)*

The Commission acknowledged the challenges of measuring resilience via a single index. The Commission supplemented the findings from the index with an analysis of long-term patterns and trends in Australian regions, and with case studies about specific regions. This mixed methods approach, and focus on adaptive capacity in the construction of the index, appears to broadly be in line with the evolutionary perspective of resilience.

#### **5.2.4 Case studies of regional resilience**

Simmie and Martin (2009) used the adaptive cycle model – which relates to evolutionary perspectives of resilience (see section 4) – as a conceptual starting point to investigating regional resilience. The authors commented that this model is highly suggestive. The model has the advantage of linking key attributes and processes of regional development, such as innovation, the dynamics of capital accumulation and the mechanisms that generate connectedness between and among local firms and institutions, with the notion of resilience. However, the authors also noted that the model is not without its challenges.

To explore the model, the authors undertook case studies of two UK cities that have experienced quite different economic histories and outcomes – Cambridge and Swansea. Key features of the case studies are that they:

- covered a fairly long time frame – 40-50 years
- included some basic time series analysis (employment and number of business start-ups in the two cities)
- included some descriptive qualitative analysis (a description of key events in both cities over the last 40-50 years, grouped by elements of the adaptive cycle model).

Overall, the authors appear to have used a fairly simple approach to exploring a complex concept. The key finding of the study – that Cambridge is a more resilient city than Swansea – seem intuitive, but does raise questions about the value-add of a resilience lens over other ways of examining regional performance. Compared with Swansea, Cambridge has a higher stock of human capital (and other capitals) which likely contributes to a range of advantageous outcomes, not just enhanced resilience, as discussed in section 3.

## 6 New Zealand

**Kaupapa Māori offers a unique New Zealand perspective on resilience. Otherwise, New Zealand has broadly followed international approaches for defining, conceptualising and measuring resilience. For example, Treasury’s Living Standards Framework includes the idea of drawing on capitals to improve resilience.**

### 6.1 Definitions

In general, New Zealand studies of resilience have adopted international definitions as discussed in section 2. However, there are some instances where specific agencies or authors have developed their own definitions of resilience.

One New Zealand-developed definition of resilience which is fairly highly cited is that developed by the New Zealand Government (2019) in the National Disaster Resilience Strategy | Rautaki ā-Motu Manawaroa Aituā: “The ability to anticipate and resist the effects of a disruptive event, minimise adverse impacts, respond effectively post-event, maintain or recover functionality, and adapt in a way that allows for learning and thriving”. This is a broad definition of resilience which covers most of the definitional elements in Table 2.

### 6.2 Concepts

#### 6.2.1 Kaupapa Māori offers a valuable perspective on resilience

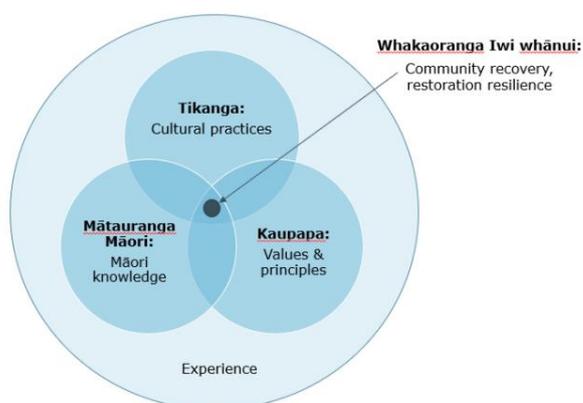
Here we identify some studies about Māori conceptions of resilience. The main take-outs are that Māori hold wide-ranging perspectives on the topic of resilience, and kaupapa Māori can offer valuable insights about community resilience not just for Māori but also for the community at large.

There is no single agreed definition of resilience for Māori (Chen, Craven and Martin 2021). Having said that, Māori notions of resilience are often motivated by a wider agenda to reclaim, reconstruct, and reformulate research to advance social justice, cultural survival, restoration, self-determination and healing for Māori (Wolfgang, Houkamau and Love 2021). Some therefore argue that resilience for Māori needs to incorporate acceptance and resistance, reactive and proactive strategies, survival and flourishing, individual and collective resilience, and tensions between state control and self-determination (Penehira, Green, et al. 2014, cited in Wolfgang, Houkamau and Love 2021).

Kenney and Phibbs’ (2014 and 2015) work on Māori concepts of resilience is fairly highly cited. These concepts were identified using qualitative research methods (semi-structured interviews and focus groups) to explore the Māori disaster management

response to the Christchurch earthquakes. Key findings were that during the emergency management phase, Māori risk management initiatives were collaborative, effective and shaped by kaupapa (cultural values), specifically the value, 'aroha nui ki te tangata' (extend love to all people). These community-based approaches, which drew on cultural attributes including Māori knowledges, values and practices (see Figure 8), were generally considered to be more effective in reducing disaster risk and enhancing resilience than were individually-focused mainstream approaches. The authors argued that the Māori response to the Christchurch earthquakes has wider relevance for how governments and international agencies may think about cultural strengths as a mechanism for mitigating disaster risk. In other words, there are benefits to non-Māori as well as Māori from drawing on Māori perspectives of resilience.

**Figure 8: A conceptual framework for Māori resilience**



Source: Chen, Craven and Martin (2021), based on (Kenney and Phibbs (2015))

Other conceptual work argued that Māori cultural values are a critical determinant in recovery and resilience of Māori communities (see for example Wolfgramm, Houkamau and Love 2021). These authors developed a conceptual model of Māori resilience based on insights from Māori demonstrations of community resilience during COVID-19. The authors argued that for Māori resilience is relational, encompassing the individual and collective, and can be defined as “the means by which Indigenous people make use of individual and community strengths to protect themselves against adverse outcomes”.

However, the term ‘resilience’ has negative connotations among some in Māoridom. For example, Penehira, et al. (2014) argued that, by definition, resilience theories assume an acceptance of responsibility for disadvantage. That is, “by examining and developing theories and models of resilience we buy into the idea that this is the way it is and we need simply to get better at bouncing back and being resilient”. Instead, these authors advocated for the term ‘resistance’, which “represents an approach of collective fight-back, exposing the inequitable distribution of power, and actively opposing negative social, political and economic influences”. In a similar vein, the use of the term ‘vulnerable’ to describe population groups has been criticised by Māori and other scholars (Chen, Craven and Martin 2021).

Wider concepts from te ao Māori seem to align with the evolutionary perspective of resilience. In particular, kaitiakitanga (sustainable guardianship and protection) resonates with the evolutionary perspective's goal of maintaining the health of a system in the long term. Kaitiakitanga and other concepts are picked up in Treasury's He Ara Waiora framework which helps the Treasury to understand a Māori perspective on wellbeing.<sup>4</sup> This framework emphasises that the natural world is paramount and inextricably linked with human wellbeing, per the evolutionary perspective.

### **6.2.2 The Living Standards Framework has been used in resilience studies**

Treasury's Living Standards Framework aims to capture things that matter for New Zealanders' wellbeing, now and into the future.<sup>5</sup> The Framework complements Treasury's He Ara Waiora framework. The Living Standards Framework revolves around the idea that New Zealand's wealth (capitals) can accumulate or deteriorate over time and be used to generate flows that improve current and future wellbeing. The Framework is therefore relevant to resilience (Frieling and Warren 2018).

Some New Zealand studies about resilience explicitly or implicitly draw on the ideas in Treasury's Living Standards Framework as a conceptual starting point. Reasons for doing so include an interest in the idea of drawing on capitals to improve resilience (see section 3), as well as the desire to reflect existing New Zealand policy frameworks. For example, Chen, Craven and Martin (2021) reviewed literature about what matters, and what works, for community resilience. The authors used the Living Standards Framework as an organising framework to ensure the review is consistent with government and policy frameworks. They argued that building social capital – the relationships, connections, and community participation that occurs on-the-ground between individuals and groups – matters to community resilience in the face of a major shock. In another example, the conceptual framework that underpins the New Zealand Resilience Index (see below) also draws on the Living Standards Framework.<sup>6</sup>

### **6.2.3 The 'Singapore paradox' links with evolutionary concepts of resilience**

Briguglio (2003, cited in Briguglio, et al. 2008) coined the phrase the 'Singapore paradox', as a concept about the resilience of small, advanced open economies. While not specifically about New Zealand, the concept seems relevant to New Zealand which shares some (but not all – see below) characteristics with Singapore. The idea is that although Singapore is a small island economy highly exposed to exogenous economic shocks, it has managed to attain, and more importantly maintain, high levels and rates of economic growth. Briguglio argued that this apparent 'paradox' reflects Singapore's ability to build its resilience in the face of external shocks. This paradox seems to relate to the idea in the evolutionary perspective of resilience and anti-fragility (see section 4) – that constant exposure to previous shocks improves resilience to future shocks.

---

<sup>4</sup> <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/he-ara-waiora>

<sup>5</sup> <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>

<sup>6</sup> <https://resiliencechallenge.nz/the-new-zealand-resilience-index/>

## 6.3 Measurement

### 6.3.1 New Zealand researchers have used many methods to study resilience

Looking across studies about resilience in New Zealand, a key take-out is that New Zealand researchers have drawn on many of the methods discussed in section 5. Encouragingly, mixed methods approaches, which can provide a rounded view of the resilience of complex systems, seem fairly common.

One example of a research programme using diverse techniques is the ‘Resilience to nature’s challenges’ National Science Challenge, which is focused on the resilience of New Zealand to natural disasters.<sup>7</sup> The research programme uses wide-ranging research and scientific methods, including case studies on the resilience of specific industries and communities to natural hazards (see for example Fountain, et al. 2021, discussed below), as well as a resilience index. The New Zealand Resilience Index (NZRI), which is under development, uses quantitative indicators to assess place-based communities’ resilience across six ‘capitals’: social, cultural, economic, built, natural environment, and governance/ institutional capital.<sup>8</sup>

Another example of a mixed methods approach is that used by Kaye-Blake and others regarding the resilience of rural communities in New Zealand (see Kaye-Blake (2022) for a summary of the key insights, and Brown, Kaye-Blake and Payne (2019) for a detailed discussion). The authors used mixed methods comprising both quantitative and qualitative techniques. The quantitative techniques included the development of a resilience index with social, cultural, economic and institutional dimensions, mainly based on Census data. Qualitative techniques included community-based workshops.

Other methods used to study resilience in New Zealand include:

- a workshop with practitioners to assess community resilience to natural disasters (Kwok, et al. 2016)
- case studies, comprising key informant interviews and desk research, to examine the resilience of the agrifood tourism sector in North Canterbury to the 2016 Kaikōura earthquake (Fountain, et al. 2021)
- a case study, based on qualitative research, of resilience among dairy farms in the Bay of Plenty (Cradock-Henry 2021)
- a panel of social security data across urban areas to examine the effect of the Global Financial Crisis and COVID-19 shocks on urban areas; the approach also linked the social security data with census data to identify urban characteristics that point to economic resilience (Cochrane, Poot and Roskrug 2022).

---

<sup>7</sup> <https://resiliencechallenge.nz/>

<sup>8</sup> <https://resiliencechallenge.nz/the-new-zealand-resilience-index/>

### **6.3.2 While not specifically about ‘resilience’, some studies have examined the effect of various shocks on the New Zealand economy**

Grimes and other researchers at Motu Economic and Public Research have undertaken quantitative studies about the effects of different types of shocks on aspects of the New Zealand economy. While the studies are not labelled under a ‘resilience’ banner, they provide useful insights on the topic. They include ones about the effects of the closure of a major local employer on population and employment in small towns (Grimes and Young 2009), and about the effects of the Canterbury earthquakes on various aspects of firm performance (Fabling, Grimes and Timar 2014) and on the local labour market (Fabling, Grimes and Levente 2016). These studies used micro (firm- or individual-level) data and various counterfactual techniques, such as comparisons with unaffected regions, to examine the effects of the shocks.

In a similar vein, Noy at Victoria University of Wellington has undertaken a number of quantitative studies on the application of economics to the management of natural hazards, disasters, and climate change.<sup>9</sup> Some of these studies have had a resilience focus. These have used panel data (cross-country time series data), micro data, and various modelling techniques.

Easton (2023) took an economic history lens to examining shocks in New Zealand. This study was commissioned by the Productivity Commission for its inquiry into the resilience of the New Zealand economy to supply chain disruptions. The study aimed to describe how New Zealand has attempted to improve economic resilience over its economic history, and to outline key learnings from the past.

### **6.3.3 New Zealand has been included in cross-country resilience studies**

One widely-cited cross-country study that included New Zealand is Briguglio, et al.’s (2008) one about economic vulnerability and resilience. The authors constructed an index which covered four aspects of a country’s economic resilience, namely macroeconomic stability, microeconomic market efficiency, good governance and social development. The authors also developed a vulnerability index which covered economic openness, export concentration and dependence on strategic imports. The indices were populated with data from various sources for the period 2000-2004. Based on these two indices, New Zealand was categorised in the ‘best case’ group of countries due to its low vulnerability and high resilience as measured by the indices.<sup>10</sup>

---

<sup>9</sup> <https://people.wgtn.ac.nz/ilan.noy>

<sup>10</sup> New Zealand ranked highly on all four components of the resilience index ie macroeconomic stability, microeconomic market efficiency, good governance and social development. It is not clear why New Zealand performed well (ie had a low ranking) in the vulnerability index, as details on the construction of this index were sparse and the authors didn’t provide a breakdown of the three components of the vulnerability index ie economic openness, export concentration and dependence on strategic imports. Presumably New Zealand’s low vulnerability ranking reflects our relatively low trade openness, if this was measured as trade intensity, as historically New Zealand has had a relatively low trade intensity (Pells 2022).

## 7 Discussion

Like many other concepts, resilience has multiple definitions and seems hard to measure. Policymakers may therefore want to take a fairly critical eye to resilience studies, and to consider the underlying value of the concept itself. When thinking about towards which shocks policy effort might be targeted, and how to deal with those shocks, policymakers might want to pay particular attention to New Zealand's distinctive features.

### 7.1 What have we learnt about the resilience literature?

Despite a large and growing body of literature on resilience, there are no widely-accepted economic theories about resilience. Instead, different authors have developed conceptual frameworks about the resilience of regional economies for example. These frameworks have some commonalities – they often draw on the evolutionary perspective of resilience, and/or include various 'capitals' as a source of resilience, and/or include the role of governance and institutions. But the frameworks also vary considerably. Meaningfully assessing the ideas in the frameworks in a practical sense seems to be challenging.

Therefore, a key take-out from this review is the need to take a fairly critical eye to resilience studies. Is the underlying definition and concept of resilience clear? Does the measurement approach target the underlying concept? Does a resilience lens add anything over other economic development lenses?

Resilience is not the only concept that suffers from a lack of agreed definitions, or that is hard to operationalise in terms of measurement. Many other prominent ideas in economics, such as sustainability, absorptive capacity, dynamic capabilities etc, have similar issues. The question that then arises is: how valuable is the underlying concept?

This paper has argued that resilience *is* a useful concept. The evolutionary perspective of resilience in particular makes us think about the nature of the shocks and challenges (and opportunities) that the economy and society might face in the future, how to adapt to those challenges, and what goals are important in the long term. This questioning of long-term goals seems important in the face of existential challenges like climate change, which are leading some to fundamentally question the viability of the current economic system.

The equilibrium perspective of resilience also has some valuable insights, for example in terms of preparing for and withstanding known risks and maintaining consistent performance.

## 7.2 About which types of shock might we be most worried?

Resilience is about the study of shocks and other disturbances. Clearly, policymakers cannot prepare for every eventuality, and doing so is not necessarily valuable. So about which types of shocks and disturbances might they be most worried?

Probably the biggest concern is significant large-scale events. Markets and people can generally adjust and cope with relatively minor shocks – the economy is changing all the time. But events that have large widespread effects, or that have strong concentrated effects in a particular location or sector, probably warrant the most attention. This highlights that, to have a significant effect, a shock generally needs to interact with a social setting. For example, earthquakes happen all the time, but it is the ones that affect heavily populated areas and the built environment about which policymakers tend to be most concerned.

Also important are long-term trends that may go unnoticed and unchecked – the frog-in-a-pot syndrome. These trends come through strongly in the literature about regions facing decline. Climate change is a trend that seems to be particularly relevant to New Zealand in this context. A large proportion of New Zealand's emissions come from agriculture and in particular dairy. Regions whose economies are reliant on emissions-intensive sectors are likely to face major challenges as the structure of the economy changes in response to reducing emissions in line with New Zealand's climate goals. As well as reducing emissions, adapting to the effects of climate change is also important given that many settlements in New Zealand are coastal and prone to sea level rise and flooding.

This highlights that one way of thinking about the most relevant shocks is to consider New Zealand's distinctive features. These features include New Zealand's small and geographically dispersed population, geographic isolation, unusual topography, predisposition to earthquakes other natural disasters, unusual economic structure with persistent strengths in agriculture, and unique indigenous Māori culture. Shocks to which New Zealand might be most vulnerable include earthquakes, volcanic eruptions, supply chain disruptions and major shifts in overseas markets/consumer preferences.

## 7.3 How can we deal with these shocks?

This review has highlighted that resilience strategies are highly context-specific. This implies that policy responses need to be tailored to individual types of shocks. Clearly, resources available to prepare for and respond to a multitude of specific shocks are limited. So what might be some priority areas?

There is a distinction between shocks that can be prepared for in advance and those that cannot. Where risks are known, risk management and other preparedness strategies can be used in advance. For example, New Zealand has considerable experience dealing with seismic risk eg strengthening building structures and encouraging people to prepare for earthquakes. However, it is debatable whether there is the same level of preparedness for volcanic eruptions.

Where there is deep uncertainty and it is challenging to prepare in advance, the evolutionary perspective is instructive. The evolutionary perspective emphasises taking a long-term view of the relevant system. This view therefore incorporates long-term trends. For example, in the context of New Zealand's vulnerability to major shifts in overseas markets/consumer preferences, it is important to monitor such trends.

Importantly, this long-term view sees the economic system as nested in, and a subset of, the environment, which is useful when considering challenges like anthropogenic climate change and which aligns with Māori conceptions of wellbeing as expressed in He Ara Waiora. This long-term view can also be useful in identifying system vulnerabilities. For example, if stop-banks are persistently being breached during flooding events, is the best policy response to build them higher? Or is it better to consider relocating people and activities to lower-risk locations?

The evolutionary perspective highlights the *capacity* of a system to deal with *multiple* shocks and disturbances. Resilience comes about through a built-in flexibility of the system, a flexibility based not on command and control, that is, on rigid structures, but on rules, incentives, and learning. This perspective might lead to an examination of:

- the resourcefulness or inherent potential (the 'wealth' of a system, or its capital)
- internal controllability (which is a function of the connectedness between internal controlling variables, and the governance systems that provide the rules for its use)
- adaptive capacity (eg liquidity of financial systems, adaptation of natural systems, diversity and effectiveness of social network structures).

Building such a capacity to deal with multiple shocks might involve using some of the cross-cutting strategies identified in this paper. These strategies include building variety, dispersity, redundancy and optionality into systems. Again, New Zealand's distinctive features are helpful when considering how some of these cross-cutting strategies might be implemented. For example, how feasible is it for New Zealand's comparatively small regions to build variety in their economic structures? How can redundancy be built into transport systems given that New Zealand is a long, thin, mountainous country and will face progressive climate change and other risks?

Another cross-cutting strategy is the idea that resilient communities have various 'capitals' or resources from which to draw. There are two key implications here. Firstly, equity considerations are central when considering resilience policies. People on low incomes and/or with limited savings may have limited reserves and means to prepare for and deal with emergencies. In the event of disasters, public funds are often used to support people who do not hold private insurance for example. But improving the long-term capacity of people and communities to deal with shocks might ideally involve policies that address underlying issues like low saving rates and wealth inequality.

Secondly, it is important that, whatever resources are available to communities, they make the best use of them. Doing so requires strong local governance and institutions which can set long-term goals and strategies for their communities, anticipate and prepare for known risks, and help communities adapt to inevitable trends as well as unexpected shocks. This local effort needs to be supported by central government.

## 8 Conclusions

Resilience is a valuable but contested concept. The study of resilience, with its focus on shocks and disturbances, can shake up our thinking and make us question some of our basic assumptions and measures of success and failure. In particular, studying resilience makes us question what aspects of a system should be preserved through time, and ultimately makes us think about the long-term viability of an economic system.

The evolutionary perspective of resilience, which takes a long-term, systemic view, and encompasses various shocks and disturbances, is generally seen as the most valuable in an economic context. This reflects that it is very hard to predict where the next shock will come from, and that different economic systems may deal with some types of shocks better than others, so focusing on the adaptability and long-run health of a system seems useful.

One insight from the evolutionary perspective of resilience is that, rather than aspiring to control change in systems assumed to be stable, policy should aim to manage the capacity of systems to adapt to change. In the context of regional resilience, building such capacity might involve developing strong local governance arrangements and institutions supported by central government policies, as well as making effective use of the region's resources such as its human, physical and environmental capital. Also important is local communities identifying what matters to them in terms of the long-term economic performance of their region and developing a collective and forward-looking position on how to survive disruptions. Insights from te ao Māori and kaupapa Māori may be instructive in developing such a long-term, collective view.

However, the evolutionary perspective of resilience is not without its challenges. For example, when resilience involves system transformation, this raises questions about what *is* actually retained over time if the system's core function changes. At the extreme, the thing that is maintained is the very existence of the system. Another challenge with the evolutionary perspective of resilience is that it is hard to measure.

This paper has focused on definitions and concepts about, and approaches for measuring, resilience, and so has generally drawn on highly-cited international studies. A logical next step would be to use the ideas in this paper to examine existing evidence about the resilience of the New Zealand economy. In other words, what have we learned about the resilience of the New Zealand economy based on existing studies? This might involve using an evolutionary perspective of resilience and building on previous studies of the economic history of shocks in New Zealand.

Another potential topic for further investigation is the effectiveness of policies aimed at enhancing resilience. This reflects that resilience is a challenging concept to define and measure, so understanding the successes (and failures) of resilience-focused policies seems valuable if challenging.

## References

- Aligica, P. 2013. "Institutional Resilience and Institutional Theory." In *Institutional Diversity and Political Economy: The Ostroms and Beyond*, by P. Aligica, 101-133. Oxford: Oxford University Press.
- Allenby, B., and J. Fink. 2000. "Social and ecological resilience: toward inherently secure and resilient societies." *Science* 2000; 24(3): 347–64.
- Australian Productivity Commission. 2017. *Transitioning Regional Economies*. Canberra: Australian Productivity Commission.
- Barry, J., T. Hume, G. Ellis, and R. Curry. 2018. *Society Wide Transitions*. Belfast: Queen's University.
- Bourbeau, P. 2018. "A Genealogy of Resilience." *International Political Sociology (2018) 12*, (International Political Sociology (2018) 12, 19–35) 19–35.
- Briguglio, L., G. Cordina, N. Farrugia, and S. Vella. 2008. *Economic Vulnerability and Resilience Concepts and Measurements*. Helsinki: World Institute for Development Economic Research.
- Bristow, G., and A. Healy. 2014. "Regional Resilience: An Agency Perspective." *Regional Studies*, 48:5, 923-935.
- Brown, M., W. Kaye-Blake, and P. Payne. 2019. *Heartland Strong*. Auckland: Massey University Press.
- Bruneau, M., S. Chang, R. Eguchi, G. Lee, T. O'Rourke, and A. Reinhorn. 2003. "A framework to quantitatively assess and enhance the seismic resilience of communities." *Earthquake Spectra*, 19, 733–752.
- Canadian Centre for Community Renewal. 2000. *The Community Resilience Manual*. Port Alberni: Canadian Centre for Community Renewal.
- Carpenter, S., B. Walker, J. Anderies, and N. Abel. 2001. "From Metaphor to Measurement: Resilience of What to What?" *Ecosystems (2001) 4*: 765–781.
- Chen, E., B. Craven, and R. Martin. 2021. *Community resilience: A rapid evidence review of 'what matters' and 'what works'*. Wellington: Ministry of Social Development.
- Chen, Z., and A. (2018). Rose. 2018. "Economic resilience to transportation failure: a computable general equilibrium analysis." *Transportation*, 45(4), 1009-1027.
- Christopherson, S., J. Michie, and P. Tyler. 2010. "Regional resilience: theoretical and empirical perspectives." *Cambridge Journal of Regions, Economy and Society* 2010, 3, 3–10.
- Cochrane, W., J. Poot, and M. Roskrug. 2022. *Urban Resilience and Social Security Uptake: New Zealand Evidence from the Global Financial Crisis and the COVID-19 Pandemic*. Bonn: IZA Institute on Labor Economics.
- Constas, M., M. d'Errico, and R. Pietrelli. 2022. "Toward Core Indicators for Resilience Analysis: A framework to promote harmonized metrics and empirical coherence." *Global Food Security*, 35.
- Cradock-Henry, N. 2021. "Linking the social, economic, and agroecological: a resilience framework for dairy farming." *Ecology and Society* 26(1): 3.

- Currie, D., C. Smith, and P. Jagals. 2018. "The application of system dynamics modelling to environmental health decision-making and policy - a scoping review." *BMC Public Health* 18, 402 (2018).
- Davoudi, S. 2012. "Resilience: A Bridging Concept or a Dead End?" *Planning Theory & Practice*, Vol. 13, No. 2, 299–333.
- Dormady, N., A. Rose, A. Roa-Henriquez, and C. Morin. 2022. "The cost-effectiveness of economic resilience." *International Journal of Production Economics* 244 (2022) 108371.
- Early, L., and R. Chapman. 2013. *Defining resilience: Background paper for the Resilient Urban Futures programme*. Wellington: New Zealand Centre for Sustainable Cities.
- Easton, B. 2023. *Learnings from The New Zealand Economic History of Shocks*. Wellington: Productivity Commission.
- Fabling, R., A. Grimes, and L. Timar. 2014. *Natural selection: Firm performance following the Canterbury earthquakes*. Wellington: Motu Economic & Public Policy Research.
- Fabling, R., A. Grimes, and T. Levente. 2016. *Labour Market Dynamics Following a Regional Disaster*. Wellington: Motu Economic & Public Policy Research.
- Faggian, A., and A. Ascani. 2021. *Productivity and resilience: A post-COVID-19 perspective*. Paris: OECD.
- Fountain, J., N. Cradock-Henry, F. Buelow, and H. Rennie. 2021. "Agrifood Tourism, Rural Resilience, and Recovery In a Postdisaster Context: Insights and Evidence From Kaikōura-hurunui, New Zealand." *Tourism Analysis, Volume 26, Numbers 2-3, 2021*, 135-149.
- Frieling, M., and K. Warren. 2018. *Resilience and Future Wellbeing: The start of a conversation on improving the risk management and resilience of the Living Standards capitals*. Wellington: Treasury.
- Geels, F. 2011. "The multi-level perspective on sustainability transitions: Responses to seven criticisms." *Environmental innovation and societal transitions, 2011*, 1 24-40.
- Geronimus, A. 2023. *Weathering: The Extraordinary Stress of Ordinary Life in an Unjust Society*. New York: Little, Brown Spark.
- Gölgeci, I., H. Yildiz, and U. Andersson. 2020. "The rising tensions between efficiency and resilience in global value chains in the post-COVID-19 world." *Transnational Corporations*, 27(2), 127-141.
- Grimes, A., and C. Young. 2009. *"Spatial Effects of 'Mill' Closures: Does Distance Matter?"* Wellington: Motu Economic & Public Policy Research.
- Holling, C. 1973. "Resilience and stability of ecological systems." *Annual Review of Ecology and Systematics*, 4: 1–23.
- Holling, C., and L. Gunderson. 2002. "Resilience and adaptive cycles." In *Panarchy: Understanding Transformations in Human and Natural Systems*, by C. Holling and L. Gunderson, 27–33. . Washington DC: Island Press.
- Hosseini, S., K. Barker, and J. Ramirez-Marquez. 2016. "A review of definitions and measures of system resilience." *Reliability Engineering and System Safety* 145 (2016), 47–61.

- IPCC. 2018. "Annex I: Glossary." In *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*, by Intergovernmental Panel on Climate Change, 541-562. Cambridge: Cambridge University Press.
- Kaye-Blake, W. 2022. "Resilience is a meaningful, measurable trait of communities." *New Zealand Economic Papers*.
- Keenan, J., B. Trump, W. Hynes, and I. Linkov. 2021. "Exploring the Convergence of Resilience Processes and Sustainable Outcomes in Post-COVID, Post-Glasgow Economies." *Sustainability* 2021, 13,13415.
- Kenney, C., and S. Phibbs. 2015. "A Māori love story: Community-led disaster management in response to the Ōtautahi (Christchurch) earthquakes as a framework for action ." *International Journal of Disaster Risk Reduction*, 14, 46–55.
- Kenney, C., and S. Phibbs. 2014. "Shakes, rattles and roll outs: The untold story of Māori engagement with community recovery, social resilience and urban sustainability in Christchurch, New Zealand." *Procedia Economics and Finance*, 18.
- Ketels, C. 2016. *Review of Competitiveness Frameworks*. Dublin: Irish National Competitiveness Council.
- Knight, F. 1921. *Risk, uncertainty and profit*. Boston, MA: Hart, Schaffner & Marx; Houghton Mifflin Company.
- Kwok, A., E. Doyle, J. Becker, D. Johnston, and D. Paton. 2016. "What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand." *International Journal of Disaster Risk Reduction*, Volume 19, October 2016, 197-211.
- Leendertse, F., and J. Rijnsoever. 2020. "A practical tool for analyzing socio-technical transitions." *Environmental Innovation and Societal Transitions* 37 (2020) 225–237.
- Linkov, I., B. Trump, and W. Hynes. 2019. *Resilience-based Strategies and Policies to Address Systemic Risks*. Paris: OECD.
- Marchese, D., M. Bates, and S. Clark. 2018. "Resilience and sustainability: Similarities and differences in environmental management applications." *Science of the Total Environment* 613–614 (2018) 1275–1283.
- Martin, R. 2012. "Regional economic resilience, hysteresis and recessionary shocks." *Journal of Economic Geography* 12 (2012) 1–32.
- Martin, R., and P. Sunley. 2015. "On the notion of regional economic resilience: conceptualization and explanation." *Journal of Economic Geography*, Volume 15, Issue 1, January 2015, 1-42.
- Martin, R., and P. Sunley. 2020. "Regional economic resilience: evolution and evaluation." In *Handbook on Regional Economic Resilience*, chapter 2, by G. Bristow and A. Healy, 10-35. Edward Elgar Publishing.
- Matthewman, S., and S. Uekusa. 2021. "Theorizing disaster communitas." *Theory and Society* (2021) 50: 965–984.

- Modica, M., and A. Reggiani. 2014. "Spatial Economic Resilience: Overview and Perspectives." *Network Spatial Economics (2015) 15*: 211–233.
- Munoz, A., J. Billsberry, and V. Ambrosini. 2022. "Resilience, robustness, and anti-fragility: Towards an appreciation of distinct organizational responses to adversity." *International Journal of Management Reviews, 2022, 24*: 181–187.
- New Zealand Government. 2019. *National Disaster Resilience Strategy | Rautaki ā Motu Manawaroa Aituā*. Wellington: Ministry of Civil Defence & Emergency Management.
- Noy, I, and R. Yonson. 2018. *Economic Vulnerability and Resilience to Natural Hazards: A Survey of Concepts and Measurements*. Wellington: Victoria University of Wellington.
- OECD. 2021. *Fostering Economic Resilience in a World of Open and integrated Markets: Risks, Vulnerabilities and Areas for Policy Action*. Paris: OECD.
- OECD. 2014. *Guidelines for resilience systems analysis*. Paris: OECD.
- OECD. 2018. *Opportunities for All: OECD Framework for Policy Action on Inclusive Growth*. Paris: OECD.
- Pells, S. 2018. *How useful are our productivity measures? A literature review*. Wellington: MBIE.
- Pells, S. 2022. *New Zealand's areas of (economic) strength: A literature review*. Wellington: MBIE.
- Pendall, R., K. Foster, and M. Cowell. 2010. "Resilience and regions: building understanding of the metaphor." *Cambridge Journal of Regions, Economy and Society 2010, 3*, 71–84.
- Penehira, M., A. Green, L. Smith, and C. Aspin. 2014. "Māori and indigenous views on R and R: Resistance and resilience." *MAI Journal: A New Zealand Journal of Indigenous Scholarship, 3 (2)*, 96-110.
- Penehira, M., A. Green, L. Smith, and C. Aspin. 2014. "Māori and indigenous views on R&R." *MAI Journal, 3(2)*, 96–110.
- Productivity Commission. 2023. *Improving Economic Resilience: Issues Paper*. Wellington: Productivity Commission.
- Quinlan, A., M. Berbes-Blazquez, L. Haider, and G. Peterson. 2016. "Measuring and assessing resilience: broadening understanding through multiple disciplinary perspectives." *Journal of Applied Ecology 2016, 53*, 677–687.
- Rahman, T., S. Paul, N. Shukla, R. Agarwal, and F. Taghikhah. 2022. "Supply chain resilience initiatives and strategies: A systematic review." *Computers & Industrial Engineering 170 (2022) 108317*.
- Raworth, K. 2012. *A safe and just space for humanity: can we live within the doughnut?* Oxfam.
- Reserve Bank of New Zealand. 2022. *The Financial Stability Report*. Wellington: Reserve Bank of New Zealand.
- Rose, A. 2009. *Economic Resilience to Disasters*. Los Angeles: University of Southern California .
- Rose, A. 2007. "Economic resilience to natural and man-made disasters: multidisciplinary origins and contextual dimensions." *Environmental Hazards 7*: 383–398.

- Sanchez, A., J. van der Heijden, and P. Osmond. 2018. "The city politics of an urban age: urban resilience conceptualisations and policies." *Palgrave Commun* 4, 25 (2018).
- Schipper, E., and L. Langston. 2015. *A comparative overview of resilience measurement frameworks: Analysing indicators and approaches*. London: Overseas Development Institute.
- Schumpeter, J. 1942. *Capitalism, Socialism, and Democracy*. New York: Harper & Row.
- Sensier, M., and E. Uyarra. 2020. *Investigating the Governance Mechanisms that Sustain Regional Economic Resilience and Inclusive Growth*. Manchester, UK: The University of Manchester.
- Simmie, J., and R. Martin. 2009. "The economic resilience of regions: towards an evolutionary approach." *Cambridge Journal of Regions, Economy and Society* 2009, 1–17.
- Stanley, C. 2011. "The Ecological Economics of Resilience: Designing a Safe-Fail Civilization." Thesis, Waterloo, Ontario.
- Stiglitz, J., A. Sen, and J. Fitoussi. 2009. "Report by the Commission on the Measurement of Economic Performance and Social Progress."
- Stockholm Resilience Centre. 2011. *What is resilience? An introduction to social-ecological research*. Stockholm: Stockholm Resilience Centre.
- Sutton, J., and G. Asku. 2022. "Regional economic resilience: towards a system approach." *Regional Studies, Regional Science*, 9(1) 497-512.
- Taleb, N. 2012. *Antifragile: Things that Gain from Disorder*. New York: Random House.
- Tierney, K. 2014. *The social roots of risk*. Stanford: Stanford University Press.
- Treasury. 2018. *Living Standards: A Short Guide to 'Sustainability for the Future'*. Wellington: Treasury.
- United Nations Office for Disaster Risk Reduction. 2009. *2009 UNISDR Terminology on Disaster Risk Reduction*. Geneva: United Nations Office for Disaster Risk Reduction.
- United Nations. 1987. *Our Common Future (Brundtland Report): Report of the World Commission on Environment and Development*. New York: United Nations.
- Watkiss, P., A. Hunt, W. Blyth, and J. Dyszynski. 2014. "The use of new economic decision support tools for adaptation assessment: A review of methods and applications, towards guidance on applicability." *Climate Change* 10584-014-1250-9.
- Wolfgramm, R., C. Houkamau, and T. Love. 2021. "Manawa Ora - a conceptual model of Māori resilience." In *Management Perspectives on the Covid-19 Crisis*, by Kenneth Husted & Rudolf R. Sinkovics (eds), 121-132. Edward Elgar.
- World Economic Forum. 2013. *Global Risks 2013 Eighth Edition: An Initiative of the Risk Response Network*. Geneva: World Economic Forum.

