

Productivity

by the numbers

May 2021



Productivity by the numbers

The New Zealand Productivity Commission Te Kōmihana Whai Hua o Aotearoa¹

The Commission – an independent Crown Entity – completes in-depth inquiry reports on topics selected by the Government, carries out productivity-related research, and promotes understanding of productivity issues. The Commission aims to provide insightful, well-informed, and accessible advice that leads to the best possible improvement in the wellbeing of New Zealanders. The New Zealand Productivity Commission Act 2010 guides and binds the Commission. You can find information on the Commission at www.productivity.govt.nz or by calling +64 4 903 5150.

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¹ The Commission that pursues abundance for New Zealand.

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Foreword



The Productivity Commission produces *Productivity by the numbers* to keep the public informed about New Zealand's productivity trends, looking at both the latest statistics and longer-run productivity performance.

Here at the Commission, we seek to promote a broad public understanding of productivity-related issues. To that end, this publication includes an introductory chapter on the concept of productivity and why it matters. One of the key issues the chapter touches on, but by no means resolves, is the relationship between productivity and the things New Zealanders really care about – the things that contribute to our wellbeing. What we do know is that productivity is an important driver of improving material living standards.

The impacts of the Covid-19 pandemic on the economy have been, and will continue to be, an issue that warrants attention. The productivity statistics in this report cover the year to March 2020 and so pre-date the impacts of the pandemic. Over the coming years, the short-term impacts of the pandemic will be evident, although we would warn against placing too much emphasis on year-on-year productivity fluctuations, especially for informing policy. Regardless of what the future holds, the pandemic serves as a sharp reminder that building the resilience of workers and the wider economy to economic shocks is of enduring importance.

Productivity by the numbers is primarily based on data produced by Stats NZ. The publication benefited enormously from expert review provided by The New Zealand Treasury, Ministry of Business Innovation and Employment and Australian Productivity Commission. I would also like to thank my fellow Commissioners Ganesh Nana, Bill Rosenberg, and Andrew Sweet for their insightful comments. And I acknowledge the dedicated work of the team – Judy Kavanagh, Ben Temple, Penny Mok, Philip Stevens, Jenesa Jeram, Nik Green and Louise Winspear.

We hope this publication will be a useful resource for individuals and organisations to participate in the conversation about what we need to do to lift New Zealand's productivity.

Prof. Gail Pacheco

Commissioner

New Zealand Productivity Commission

May 2021

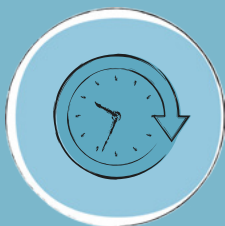
Key points

New Zealanders produce 7 times more than 150 years ago



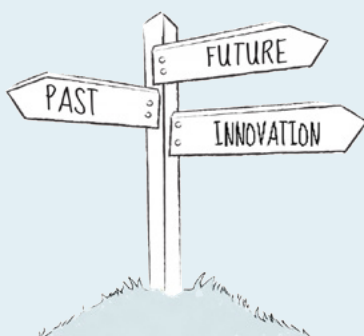
New Zealanders work longer

34.2 hours per week
compared with
31.9 hours per week
in other OECD countries



New Zealanders produce less

\$68 output per hour
compared with
\$85 output per hour
in other OECD countries



Productivity matters for wellbeing

- Achieving higher productivity – producing more with what we have (people, knowledge, skills, produced capital, and natural resources) – means there is more to go around.
- Real wages increase more rapidly when productivity growth is strong. Real wages are more likely to increase in high-productivity growth industries.

New Zealand’s productivity growth has declined

- Globally there has been massive growth in productivity over the last century. However, New Zealand experienced comparatively less productivity growth after the Second World War, and has gone from being one of the most productive economies to one of the least productive in the OECD.
- Working more hours and putting more people into work has been the main way that GDP has grown over the last decades.

New Zealanders are working hard but producing less

- New Zealand’s productivity performance in 2019-20 was weak and highly varied across industries.
- Growth in 2019-20 was (again) driven by more hours worked – almost half of GDP growth was accounted for by increases in labour input.

Innovation is key to lifting productivity

- Innovation and technological change are critical to productivity growth. The Productivity Commission’s latest inquiries, *Frontier firms* and *Technological change and the future of work*, suggest priority actions for Government.
- Research into productivity growth is key. Important areas for future research include productivity in the public sector, firms, innovation and the labour market.

Part 1

Productivity matters



Image supplied by: Fletcher Building

Productivity and wellbeing

The end-goal of improving productivity – and the statutory objective of the Productivity Commission – is to support the overall wellbeing of New Zealanders, having regard to a wide range of communities of interest and population groups in New Zealand society. Productivity is not the only influence on wellbeing, but in determining our material living standards, it is an important one (Box 1).

To improve material living standards, particularly with a growing population, New Zealand needs a more productive economy. Increasing productivity is about getting more (output) for less (input), rather than by making people work harder, wearing out plant and machinery or depleting natural resources.

Economists are notorious for emphasising trade-offs and saying there is no such thing as a “free lunch”. However, lifting productivity is the closest thing to a free lunch there is. Achieving higher productivity – producing more with what we have (people, knowledge, skills, produced capital, and natural resources) – means there is more to go around.

It also means we can produce the same (or even more) with less input. Indeed, as a society we may choose to take the benefits of improved productivity by working fewer hours or having a less harmful impact on the natural environment.

Improving productivity can make it easier to make growth sustainable, providing higher material living standards for both current and future generations. Improving productivity also enables us to enjoy more leisure time, spend on improved collective wellbeing, and pursue desired social and environmental outcomes. Sustainable economic growth provides future generations more opportunities to meet their needs and respond to unforeseen challenges.

Goals for more growth should specify more growth of what and for what.

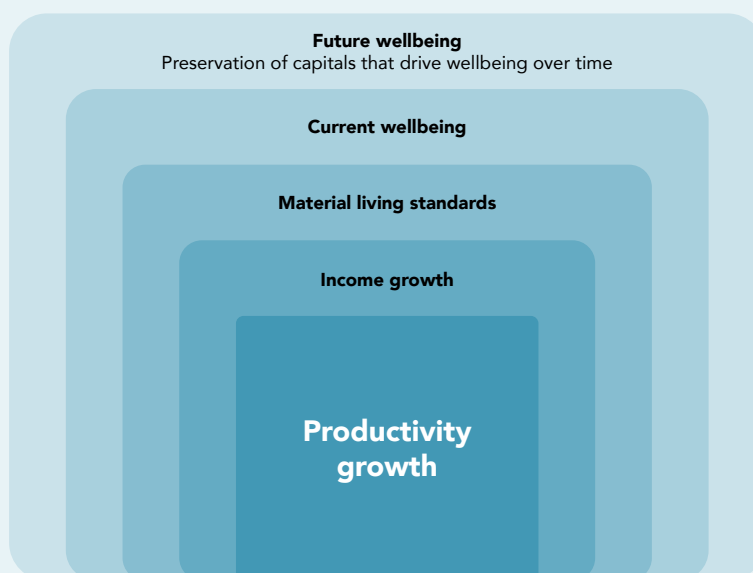
Simon Kuznets – The New Republic (1962)

Box 1 'Wellbeing' and how it relates to material living standards and productivity

There are many ways to think about and describe the concept of 'wellbeing'. Some emphasise levels of happiness experienced by individuals (Layard, 2006), while others centre around the ability of people to enjoy lives of their choosing (Nussbaum, 2011; Sen, 1985).

Material living standards have a bearing on most definitions of wellbeing (Carver & Grimes, 2019; Deaton, 2008). However, the relationship between material living standards and wellbeing is not straightforward because of the many different ways in which wellbeing can be conceptualised. In this document we focus on productivity as it contributes to growing incomes, which in turn contributes to higher material living standards (Figure 1).

Figure 1 How productivity growth relates to current and future wellbeing



Source: Based on (OECD, 2020; Pells, 2018a)

Ever since the 1930s and 40s, economists have emphasised that national product or income is not the same as wellbeing (Kuznets 1934). Understanding productivity, income growth and their contribution to wellbeing is an important area of research and there have been conceptual and methodological advances in recent years (Asian Productivity Organization & OECD, 2021). In New Zealand, for example, the Treasury has developed a 'Living standards framework' for assessing the impacts of policy on wellbeing based around the 'four capitals' – natural capital, social capital, human capital and financial/physical capital.

Measured productivity growth in recent times, globally and locally, has been weak. Who suffers most when economies underperform? It is typically the least skilled, qualified, or experienced, and people with the fewest social and economic resources. Inequalities tend to increase where productivity growth is weak because some people have fewer options than others (OECD, 2015).

People with high or above-average educational attainment, and those starting life with a lot of resources, can have more opportunities and be more able to adjust or relocate.

Even when economies are performing well, the process of productivity growth can be painful. When market shares or resources move from less productive to more productive firms and industries – with some closing or shrinking and others opening or expanding – some people benefit from new opportunities and higher incomes while others experience disruption and job uncertainty.



The relationship between work, productivity and wellbeing is a complex one because work is not done by “units of labour”, it is done by humans (Box 2).

Box 2 Work and its relationship with wellbeing, happiness, and labour productivity

Work matters for earning income, but also directly for wellbeing by providing social connection and self-identity. Research into subjective wellbeing shows that losing a job has significant negative effects on people’s health and happiness beyond the loss of income (Layard et al., 2012; Sage, 2019; Winkelmann & Winkelmann, 1998).

The ‘happy-productive worker’ thesis, drawn from organisational psychology literature, argues that worker wellbeing is a key determinant of employee and firm productivity (DiMaria et al., 2020). Higher employee wellbeing has long been associated with higher morale, leading to higher productivity (Strauss, 1968, Leibenstein, 1966, 1979).

The way in which productivity growth is pursued may at times undermine both worker wellbeing and performance. Several theoretical and empirical studies have looked at situations where treating labour as simply an ‘hours paid’ input into production can undermine the wellbeing of workers and their performance. Studies have found that personal satisfaction, social approval and status can be important drivers for individuals, teams, and entire organisations (Gibbons & Roberts, 2013, p. 58). In some situations, extrinsic mechanisms to encourage worker performance may undermine intrinsic motivation (Gneezy et al., 2011).

Other studies have explored whether efforts to increase labour productivity actively harm the wellbeing of workers (Isham et al., 2021). Studies have looked at the harm caused by heightened job demands that result from downsizing in an attempt to cut costs (Corbett, 2015) and the impact of greater job insecurity from more flexible labour market policies intended to make it easier for firms to innovate (Bartelsman et al., 2016; Sverke et al., 2002).

The issues connecting productivity, outcomes, and wellbeing deserve evidence-based analysis. The potential for insights about these connections was a key reason why the Productivity Commission was established – to research, to promote understanding, and to “get under the hood” of productivity and what it means for New Zealanders.

Productivity and material living standards

Productivity is calculated as the ratio of the volume of output produced, relative to the volume of inputs – such as labour and capital – used (Hulten, 2007;

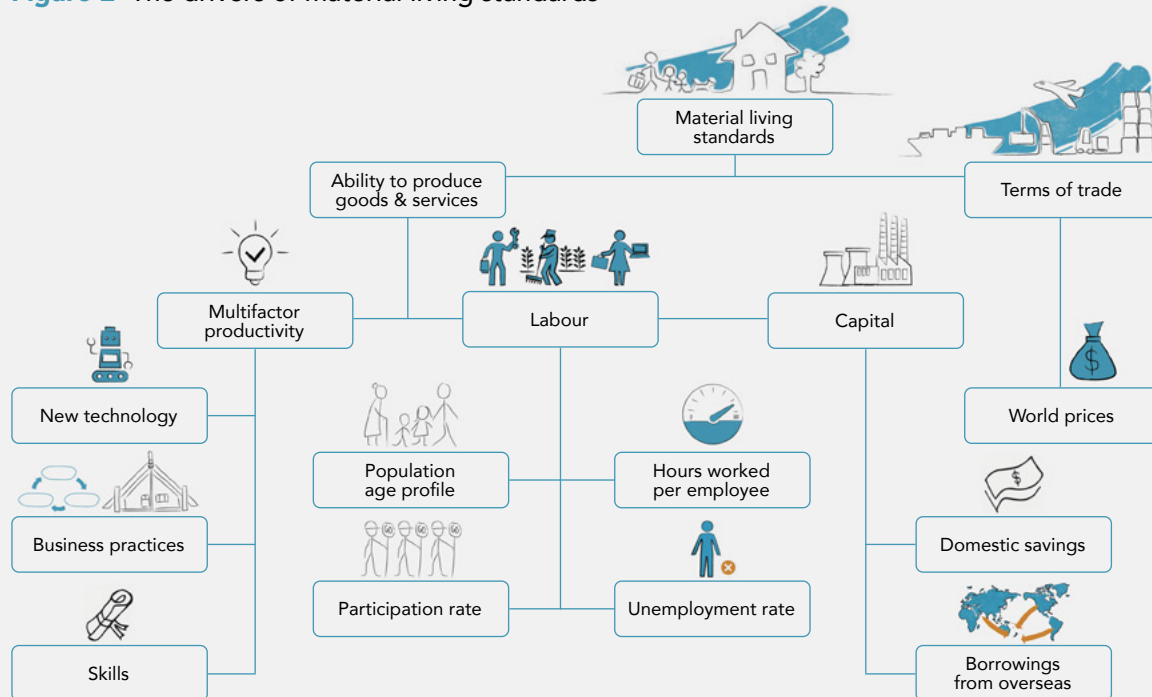
OECD, 2001). Technically, volume is a combination of both quantity and quality, meaning that output measurement captures economic value. Productivity can go up if the number of apples go up, but also if they get tastier. It can also go up if we invent a new fruit. Simply put, productivity measures how well an organisation, industry or country is using the resources available to it. Here, in *Productivity by the numbers*, we explore how New Zealand’s economy transforms inputs into outputs.

Innovation lies at the heart of growth, and the majority of the growth in productivity and material living standards has come from combining inputs into new products and services – like antibiotics and anti-slip mats – rather than from combining inputs to be better hunters or gatherers (Stevens, 2011).



A Robotics Plus apple packer packs at twice the speed of a human, all day, everyday.
Image supplied by: Robotics Plus

Figure 2 The drivers of material living standards



Source: Adapted from APC (2020a).

Note: Income from producing goods and services and a positive terms of trade increase material living standards over time. Material living standards are made up of more than income, encompassing other important determinants of wellbeing like housing conditions.

Figure 2 is a stylised representation of how material living standards are primarily determined by a country’s ability to efficiently produce goods and services – both for domestic consumption and for export to other countries, enabling other goods and services to be imported (for direct consumption or as inputs to further production). The main elements of Figure 2 are discussed further below.

Ability to produce goods and services

Goods and services are usually the most tangible and easily identified outputs from production. Because most goods and services – and the capital and labour used to produce them – are exchanged in markets, these inputs and outputs can be valued

at the prices paid for them. Stats NZ estimates output using internationally recognised standard metrics of value-added – the amount by which output is increased exclusive of intermediate inputs used in production, adjusted by changes in prices.²

In the accounting framework used to measure national productivity, three factors determine how well a country is able to produce goods and services:

- the amount of labour;
- the amount of capital; and
- how well they are combined.

Finding better ways of combining capital and labour to increase output is captured by multifactor productivity.

² In this context, prices contain two components. One is important information about the relative value of current and new products and services. The other is merely a nominal one that needs to be removed in analyses such as this. We need to distinguish the changes that are due simply to a general increase in prices (ie, inflation) from changes that come from a substitution to more valuable goods and services, or the introduction of new or improved ones.

Labour

A key determinant of the ability to produce goods and services, and therefore higher material living standards is labour, or work. The degree to which labour produces goods and services is called labour productivity. Incomes can grow when:

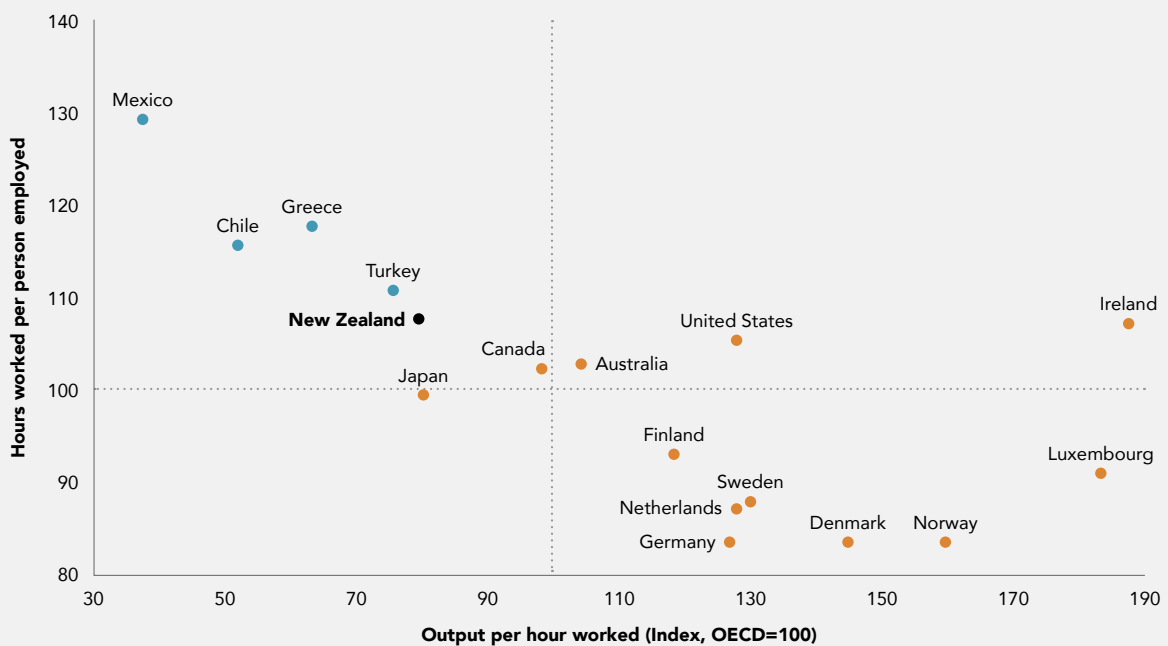
- people already in employment work more (ie, put in more hours);
- people who have been unemployed gain paid work;
- people outside of the workforce gain paid work (ie, increases in the participation rate); or
- the value of total goods and services sold increases faster than hours worked.

Only the last is labour productivity growth.

Growing material living standards by earning higher incomes from long working hours has its limits. There are only so many hours in the day people can work, and long working hours can contribute to stress and other harms. And people value things other than work, such as leisure and spending time with family.

Figure 3 shows New Zealand compared with other OECD countries, showing New Zealanders work more hours, but achieve less output per hour than many typical comparator countries.

Figure 3 New Zealanders work longer hours and get less output per hour than most OECD countries



Source: Productivity Commission analysis of OECD data.

Notes: 1. Countries in the top half of the OECD in terms of GDP per capita are shown in orange, those in the bottom half in blue.
2. Output per hour worked is based on GDP per hour worked in current USD.

Capital

Capital refers to physical and financial assets – the equipment and structures that are used in the production of goods and services. Examples include computers, machinery, vehicles, software, and buildings.

Introducing new capital can increase the relative volume or value of output by replacing labour, reduce the costs of production, make workers more productive, or allow new goods and services to be created (NZPC, 2020b). New Zealand firms are, by the standards of other developed countries, capital-shallow, meaning that workers have relatively limited equipment etc. to work with (NZPC, 2020a).

The accumulation of more and better capital equipment per worker over time is known as ‘capital deepening’. Using domestic savings and international borrowing to invest in productive capital assets makes workers more productive, increasing labour productivity.

While labour and capital are treated as separate inputs into producing goods and services in Figure 2, they do not operate in isolation. For example, the availability of labour can affect firm decisions about whether to invest in capital. In areas where labour is scarce or otherwise very costly, firms may invest more heavily in technology to meet their production goals. One example is Japan, where an aging population,

declining workforce and limited inflows of migrants have created strong incentives for firms to automate (Schneider et al., 2018).

Multifactor productivity

In addition to increasing the supply of capital and labour, firms can improve how their workers make use of skills, their equipment and other inputs. This is captured as multifactor productivity (MFP). MFP measures the overall efficiency with which all the measured inputs combine to produce the measured outputs.

While increases in MFP are commonly referred to as ‘technical change’ or improvements in efficiency, they are more accurately interpreted as some combination of technological progress, efficiency gain, deviation from constant returns to scale, unobserved change in capacity utilisation, departure from economy-wide long-run equilibrium, or measurement error.

When all inputs in the production process are measured and accounted for, MFP growth can be interpreted as the amount of growth in real output that is not explained by the growth in inputs.

This residual – what is not explained by growth in inputs – has been described as a ‘measure of our ignorance’ (Abramovitz, 1956).

Box 3 A broader range of factors that could explain MFP growth

The Treasury’s Living Standards Framework captures some of the factors that could explain MFP growth:

- **Natural capital:** all “aspects of the natural environment that support life and human activity.” (New Zealand Treasury, 2019)
- **Human capital:** the “capabilities and capacities of people to engage in work, study, recreation and social activities.” (ibid)
- **Social capital:** the “norms, rules and institutions that influence the way in which people live and work together and experience a sense of belonging.” (ibid)

Existing statistics either do not, or only partially, capture these capitals. However, ongoing work by a range of policy agencies, national statistics offices, and international agencies to expand and refine productivity statistics is improving measurement (Asian Productivity Organization & OECD, 2021; Dasgupta, 2021; New Zealand Treasury, 2019a). We discuss some of these improvements and some persisting measurement gaps later in this report in Box 4.

MFP is most useful as a measure of productivity growth over a whole economic (or 'growth') cycle, as annual movements in measured MFP can be volatile and not necessarily represent true changes to the underlying productive capacity.³ That is because when estimating MFP growth, capital utilisation is assumed to remain constant, yet we know that when there is a sudden drop in demand, firms may not choose to sell capital but rather utilise it less. Particularly relevant for New Zealand is variation in the weather, which can affect primary production volumes and the utilisation of processing capacity.

The long-run drivers of MFP stem from using technology and new skills in new, innovative ways. Innovation is an inherently risky long run game, but being entrepreneurial, and making continual investments to maintain, improve, and adapt skills, equipment, and technology, are key to improving performance and national productivity. What makes firms successful in the long term is learned in many ways: from business schools as well as the school of hard knocks, from previous experiences of success (and failure) by observation, from experience and trial and error. For example, the Commission (2021) found in its recent *Frontier firms* inquiry that Kaupapa Māori firms and enterprises adopting long-term inter-generational perspectives may provide lessons. We discuss some of these lessons in Box 9 of Chapter 4.

Considering these factors, MFP measures should only be used for longer-term productivity analysis. One must also be careful making cross-country comparisons using MFP, as quite strict assumptions need to be made.⁴ Consequently, most studies across countries use labour productivity as the metric for comparison.

Terms of trade

In one important case, New Zealanders can enjoy higher material living standards without higher productivity.

If no activity within the country raises its productivity, yet prices of the country's exports go up, or the prices of its imports go down, New Zealanders can purchase more goods and services. Such changes are favourable shifts in the country's terms of trade.⁵

Welcome as such changes are, they are often outside a country's control – particularly for a small country like New Zealand with large exposure to commodity markets. However, higher export prices might be possible through sales teams accessing markets where consumers are willing to pay more. Lower prices might result from a cheaper source of imported intermediate inputs being discovered.

Terms of trade improvements may not be good for everyone; although consumers benefit from lower import prices, some domestic workers may be worse off if the increased foreign competition causes them to lose their jobs and they are unable to find new jobs or jobs of similar quality.

New Zealand's small size and exposure to competitive international markets makes its citizens vulnerable to changes in international prices. A combination of higher import prices and lower export prices (a weakening terms of trade) would make people worse off. Such changes are a risk faced by small trading nations.

Figure 4 illustrates the contributions to gross domestic income (GDI) per capita over the last 25 years. While most of the growth in income has been due to gains in labour productivity, a rising contribution to GDI has come from improving terms of trade.⁶

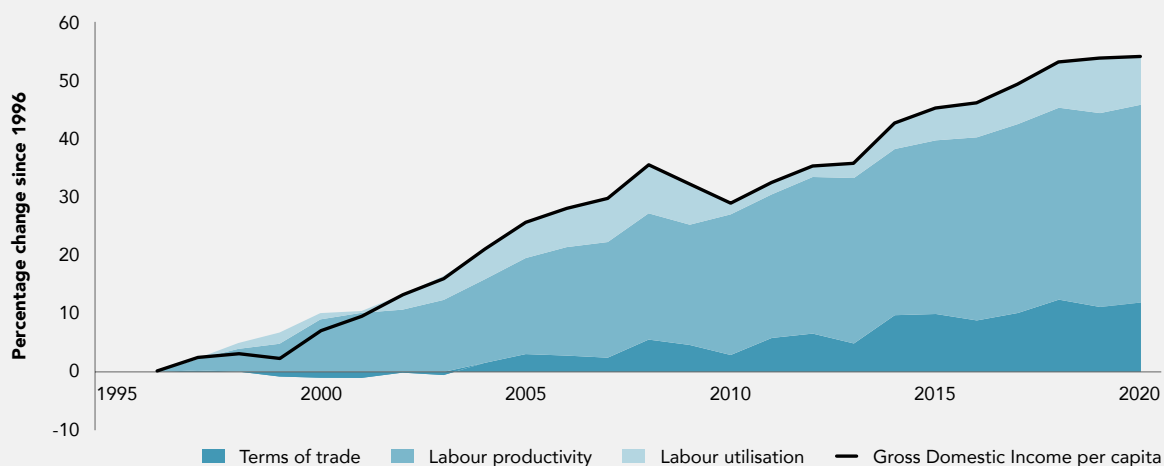
3 In *Productivity by the numbers* 'growth cycles' have been determined using statistical techniques and chosen to represent high points in capacity utilisation of the economy. See Stats NZ (2020), 'Productivity statistics: 1978–2020' <https://www.stats.govt.nz/information-releases/productivity-statistics-19782020> and Stats NZ (2007), 'Extracting Growth Cycles from Productivity Indexes'.

4 One must always be careful to read the footnotes in such comparisons.

5 One dramatic example of the effects of a favourable shift in the terms of trade was given by former Australian Reserve Bank governor Glenn Stevens in 2010, when he noted that in 2005, "a ship load of iron ore was worth about the same as about 2 200 flat screen television sets." Five years later – due largely to rapidly rising iron ore prices – the same ship load was "worth about 22 000 flat-screen TV sets". Note that this example also highlights the gains from the increasing productivity in flat-screen TV production. In the last decade or so, flat screens moved from an expensive luxury to being standard.

6 Material living standards have been estimated by Gross Domestic Income (GDI) rather than Gross National Income (GNI) or Gross Domestic Product (GDP) to focus on how much consumption is possible from selling what New Zealanders produce. GDI indicates the income that was paid to generate GDP.

Figure 4 Growth in per capita income has come from increases in labour productivity, labour utilisation and improving terms of trade



Source: Productivity Commission analysis of Stats NZ data.

Note: The figure shows the contribution of labour productivity, labour utilisation and the terms of trade to gross domestic income (GDI), since 1996 (ie, 1996=0).

Recognising the limitations of standard productivity measures

Productivity measures are a powerful tool for investigating the nature and sources of growth in material living standards. However, some limitations need to be kept in mind, especially when using the measures to inform policy.

What’s in and what’s out often depends on what can be easily measured

Stats NZ’s productivity statistics cover the “measured sector”, which is predominantly market industries. The measured sector covers approximately 80% of New Zealand’s GDP and cuts across the three

main sectors of the economy ie, primary, goods-producing and services.⁷ The measured sector does not include production which is difficult to measure.

In New Zealand the quantity of labour for businesses is measured by hours paid not hours worked, so our productivity measures exclude unpaid household, community and voluntary work – all of which can contribute to individual, family and social wellbeing (Waring, 1990). Measuring these activities requires gathering information about how people spend their time (rather than their money), which was last collected by Stats NZ in 2010. This is a gap in measurement, and it is important to acknowledge that while a large portion of material living standards result from market exchange, a large portion also results from household production and community enterprise.

Official productivity statistics also exclude most public services or measure them in ways which differ from services provided by the market.

⁷ MS-11 set contains data back to 1978 and includes: Agriculture, Electricity, Gas, Water and Waste Services, Construction, Wholesale Trade, Retail Trade, Accommodation and Food Services, Transport, Postal and Warehousing, Information, Media, and Telecommunications, and Financial and Insurance Services. The more recent MS-16 set starts in 1996 and includes the sectors in the MS-11 plus: Rental, Hiring, and Real Estate, Professional, Scientific and Technical Services, Administrative and Support Services, Arts and Recreation Services, and Other Services.

Collective goods and services, such as population or sub-population public health initiatives, are especially hard to measure. Where public services are free or only nominally charged, measurement would under-estimate their value to recipients.

Many government services are not captured by official productivity measures

although estimates for the education and health sectors are presented by Stats NZ alongside the measured sector. National accounts have traditionally valued public sector outputs at the cost of their production (which assumes that there is no productivity growth over time). This means that productivity growth will appear as zero, by definition, for many government services.

There have been several attempts in New Zealand and overseas to improve the measurement of public services and their productivity. In 2010, Stats NZ published a feasibility study for measuring publicly provided health and education sector productivity in New Zealand and concluded that it was feasible to estimate productivity performance over time in a similar manner to that in the measured sector. We present long run trends in New Zealand's health and education sector productivity in Chapter 3.

It is important to adjust for changes in quality

The education and health productivity measures published by Stats NZ are significant improvements over past practice, but do not capture all changes in the quality of public services. The Stats NZ numbers simply measure changes in the volume of outputs: cost-weighted equivalent full-time students for education, and cost-weighted inpatient and day patient hospital events for healthcare. They can pick up the influence of production shifting from lower to higher value output if the weights account for differences in quality,⁸ but they do not pick up whether schools have become more effective at teaching or whether hospitals are better at healing people.



Quality adjustment therefore matters for providing a fuller picture of public sector productivity. There are techniques available for adjusting public sector productivity data to reflect changes in the quality of services. Several case studies were explored in the Commission's inquiry into State Sector Productivity (NZPC, 2018a). In the case of the education sector, for example, Gemmell, Nolan and Scobie (2017) tested a range of quality adjustments to productivity estimates for New Zealand schools based on sector level data. They found that the most reliable adjustments provided a broadly consistent picture of flat or declining measured productivity in the school sector.

Adjusting for quality is also important for better understanding productivity growth in market industries. For example, the current labour measures may not fully capture changes in skill levels within the workforce (ie, the 'quality' of labour, or 'human capital'). This will underestimate labour productivity growth and overreport MFP growth. As with the public sector, there are techniques for adjusting market industry labour data to reflect changes in the skill composition of the workforce and therefore better identify how 'quality' improvements have contributed to productivity growth (McNaughton, 2008).

⁸ In the case of cost weighting, this assumes that the relative costs reflect the value society places on differences in quality. This may be appropriate when better, more expensive ways of serving the public replace less expensive ones. However, in many cases quality improvements can come through cost-saving innovations that also increase quality. For example, keyhole surgery can be both cheaper and a better patient experience, and have less risk than more invasive surgery.

Significant gaps in the measurement of inputs remain

There are also gaps measuring the capital input. Official measures of capital focus on physical and financial assets valued at market prices. However, estimating capital accumulation with market prices can miss spill-overs and network effects from new capital investment. Intangible assets like knowledge, technology, ideas in development, reputation, and brands are not measured as capital and instead are captured within the MFP 'residual'. They are picked up, but conflated with other influences on MFP, making understanding the issues and designing appropriate policy, difficult.

Other factors that matter both for productivity growth and wellbeing are either not directly measured or only partially captured in the MFP 'residual'. These include social capital (such as levels of trust among citizens and the quality of our institutions) and natural capital (from which people draw the ecosystem services the environment provides). A risk of not explicitly incorporating these capitals is that degradation may go unnoticed

and economic growth and productivity will be overstated. Mismeasured economic growth achieved through environmental depletion reduces the total capital available for future years and the potential wellbeing of future generations. A recent review of the economics of biodiversity conducted for the UK Treasury illustrates this point starkly.

Estimates show that between 1992 and 2014, produced capital per person doubled, and human capital per person increased by about 13% globally; but the stock of natural capital per person declined by nearly 40% (Dasgupta, 2021, p. 1).

The Asian Productivity Organization (APO) and OECD have noted, "an accurate estimation of output and input measures is key for the appropriate measurement of MFP" (2021, p.82). They have recently recommended adding a number of environmental productivity indicators to official statistics sets (Box 4).

Box 4 Options for measuring environmental productivity

- **Energy productivity:** "output generated (in terms of real GDP) per unit of total primary energy supply... expressed as USD per tonne of oil equivalent."
- **Material resource productivity:** "output (in terms of real GDP) generated per unit of non-energy materials (ie, excluding fossil fuel energy carriers) used."
- **CO₂ productivity:** "economic value generated (in terms of real GDP) per unit of CO₂ emitted, in terms of gross direct emissions from fossil fuel combustion."
- The APO and OECD also recommend the development of an **environmentally adjusted MFP measure**, in which natural assets are included as inputs, based on their annual extraction rates and unit extraction rents.

Source: APO/OECD, 2021, pp.106-111.

There are also challenges in measuring outputs

One manifestation of technological progress which has challenged measurement of outputs is the digitalisation of goods and services, including:

- the rise of internet streaming services has largely replaced the purchase of CDs, LPs and other physical music media (APC/NZPC, 2019);
- high-quality cameras and photo editing tools now come bundled with smartphones, rather than as separate products;
- online tools now “allow more and more households to provide services to themselves that used to be produced by private companies. For example, households are now able to use search engines and travel websites to book flights and plan holidays, while this would previously have required a dedicated travel agent” (OECD/APO, 2021, p.22); and
- rapid increases in computer processing and internet download speeds can make it difficult to measure the value of the services they provide over time (eg, a smartphone from 2015 is arguably not comparable to a smartphone which uses 5G technology in 2021).

Adjustments may therefore be needed on the output side to ensure productivity statistics reflect technological progress, which have changed the quality and nature of the goods and services over time to be more service-like. Baumol’s ‘cost disease’ is the idea that the inability of some labour-intensive activities to substitute labour with technology (capital) would cause costs in such activities to rise over time, relative to other activities (Baumol, 1996). Baumol further argued that productivity growth is elusive in service industries because services are poorly suited to standardisation and (by implication) to substitution by technology; and because their quality depends (or is thought to depend) on the amount of human labour they involve (Baumol, 1993).

The difficulty identifying standardised outputs and prices, with each industry containing unique problems that depend on measuring intangibility, quality and interaction with inputs provided by consumers of the service, make any potential improvements hard to measure.

How are productivity gains distributed?

At an aggregate level, productivity growth improves material living standards. However, it does not follow that everyone’s individual wellbeing, material living standards, income, or consumption, improves with higher productivity.

Governments play an important role in supporting economic inclusion and determining how the benefits of greater productivity are shared.

What is the potential for regressive impacts?

Weak productivity performance may affect low-income consumers more than high-income consumers. Productivity growth typically makes goods and services cheaper, better, or both – freeing up money for other purposes. Conversely, where poor productivity results in higher prices for significant items of household expenditure, this imposes a larger burden on the budgets of the poor.

Consumers tend to gain from productivity growth (depending on competitive conditions), while other groups may lose. For example, where industries compete against overseas producers, the benefits from improved productivity manifesting in lower prices and new products may go to consumers, but not to domestic firms and their workers. The process of resource reallocation – where some firms close or shrink and others expand – can be disruptive to families, communities, industries and regions, especially those with few other choices.

Aggregate productivity measures do not tell us much about how the benefits of productivity are distributed. Other measures can give us a better picture, but even interpreting these raise ambiguities (Box 5).

Box 5 Productivity measures reveal little about distribution of material living standards

Who gets the biggest share of gains from productivity improvement?

The labour income share (LIS) is one way of measuring how productivity gains are allocated, dividing total wages and salaries paid by nominal GDP.⁹ Under this approach, capital income's share is whatever is left over. The LIS indicates how income is split *across inputs to production*, rather than *across people*. A decline in the LIS not necessarily evidence of falling material living standards at the lower end of the income distribution. If productivity growth is fast enough, real wages could still be rising at a reasonable pace even when the LIS is falling. This may be preferable to an economy in which the LIS is constant because real wages and productivity are both stagnating. On the other hand, any growing inequality could lead to social consequences and resistance to change – which can hold back productivity growth.



What we do know is that productivity growth is important for overall income growth.

Real wages increase more rapidly when productivity growth is strong. Real wages are more likely to increase in high-productivity growth industries.

(Nolan & Fraser, 2018)

Income growth matters for the material living standards of households, and also enables governments to redistribute wealth to address inequality and hardship. However, tackling inequality and hardship requires an understanding of how people's circumstances differ. For example, research by AUT's New Zealand Work Research Institute showed that while 7 percent of working households were in poverty, 12.3 percent of working single-parent households were in poverty (Plum et al., 2019).

Future directions for research into the distribution of impacts from productivity changes are discussed in Chapter 4.

⁹ (Rosenberg, 2017) uses official New Zealand data on labour share from wages and self-employment from 1939, finding a rise in the LIS until the 1970s and a steep fall in the 1980s. The (OECD, 2012, p. 20) reports a small fall in New Zealand's LIS over 1990–2009. (Meehan et al., 2015) find a falling LIS over 33 years for 11 industries, which is supported by (Nolan & Fraser, 2018) with an extended dataset for 16 industries. (Reddell, 2017) highlights a decline 1972–2002 and subsequent rise 2002–16, while (Wilkinson & Partridge, 2019) argue the decline in the LIS halted around 1991 when it subsequently trended back up.

Part 2



New Zealand's productivity history

A global productivity slowdown

The global financial crisis (GFC) appeared to leave a legacy of slower productivity growth in many economies. However while economic shocks like the GFC can have ongoing effects that hold back productivity and living standards for years (Coleman & Zheng, 2020), labour productivity had been slowing in several OECD countries even before the GFC.

For many developed countries, the highpoint of productivity growth occurred in the period following the Second World War (Figure 5). Growth rates fell over the 1970s to 1990s and then briefly picked up in the late 1990s as information and communication technologies diffused through their economies (NZPC, 2014). New Zealand did not see as much productivity growth in the decades after the Second World War as other OECD countries. This made New Zealand's drop in productivity growth in the 21st century less stark than for many others.

Figure 5 Most OECD economies experienced strong productivity growth in the 1950s & 60s (except New Zealand) followed by a slowdown



Source: OECD (2015).

Note: Growth rates across the periods are annual average percentages.

The worldwide productivity boost from information and communications technology (ICT) ran out in the early 2000s, leading to anaemic productivity growth across the developed world from then on, with South Korea the only economy experiencing annualised labour productivity growth greater than 3% in the period since 2004. New Zealand, like most other advanced economies, experienced labour productivity growth rather closer to 1% over the same period. Japan and many European economies experienced a deceleration from annualised growth of 4-6% in the 50s and 60s to 2-3% in the 1970s, 80s and early 90s.

Why a global slowdown?

The reasons for this recent slowdown are not well understood, and several possible explanations have been suggested. These explanations include:

Changes in industry composition in developed countries

Manufacturing has declined as a proportion of economic activity in many developed countries, contributing to a reduction in the relative size of the tradeable (exporting) part of their economies.¹⁰ A reduction in the tradeable sectors of the economy could be expected to lower aggregate productivity growth. However, some empirical studies have found that this has not been the case in Australia (APC, 2020b) and the United Kingdom (Goodridge et al., 2018). In these two countries, reallocation of labour from low- to high-productivity firms has contributed positively to aggregate productivity. Industry composition in developed countries has shifted towards the services (including digital) sectors of the economy, where measurement of productivity is more difficult (see below).

Changes in the nature of technological progress

Some have argued that the supply of economically transformational ideas has simply dried up and it's getting harder to find new ones (Bloom et al., 2017; Gordon, 2018). A more optimistic view is that transformational ideas have not dried up completely, but the current slowdown reflects a temporary

pause, as firms work to understand and successfully implement new technologies, like machine-learning and artificial intelligence (Brynjolfsson et al., 2018).

Slower technology diffusion

An increasing productivity gap between the leading (frontier) firms and other firms has been observed, suggesting that the benefits of new technologies are not being spread or shared as widely as was the case in the past. There are competing hypotheses for this gap between frontier and laggard firms, including the rising importance of uncodified knowledge for the successful implementation of new technologies, increasing returns to scale and the emergence of 'winner-takes-all' markets (Andrews et al., 2016).

Services, digitalisation and measurement issues

Service industries, including digital and information technology services, now make up a significant share of economic activity (see Figure 13). Since most productivity measures are based on sales and cost-based value data, free goods and services may appear to be a reduction in measured productivity, despite significant productivity benefits (or at the very least, benefits to NZ consumers). Digital products, for example, are likely to have higher value than reflected in the prices paid (APC, 2020a) and services are notoriously difficult to measure. As a result, official measures of output (GDP) may undercount the actual amount of value being generated in the economy (Varian, 2016). However, few scholars believe that mismeasurement resulting from digitalisation accounts for all or even most of the reported productivity slowdown (Byrne et al., 2016; Pells, 2018b; Syverson, 2017).

Macroeconomic imbalances

The global productivity slowdown has been attributed to 'secular stagnation' post GFC caused by an increased propensity to save and decreasing propensity to invest, which has led to excess savings pulling down demand, interest rates and growth (Summers, 2016).

Directions for future research, building on these potential explanations, are outlined in Chapter 4.

¹⁰ Tradeable industries are industries where the majority of the output faces international competition. Non-tradeable industries are industries where the majority of the output faces no international competition.

Lacklustre growth in New Zealand for many decades

New Zealand's early development was driven by a few key technologies

New Zealanders have adopted and adapted technologies since the first days of human settlement, particularly in agriculture. Initial technologies were embodied in imported plants and seeds (eg, kumara, grass) and cultivation methods. Early technology adoption by Māori was driven by the need to feed local communities and adapt to local conditions.

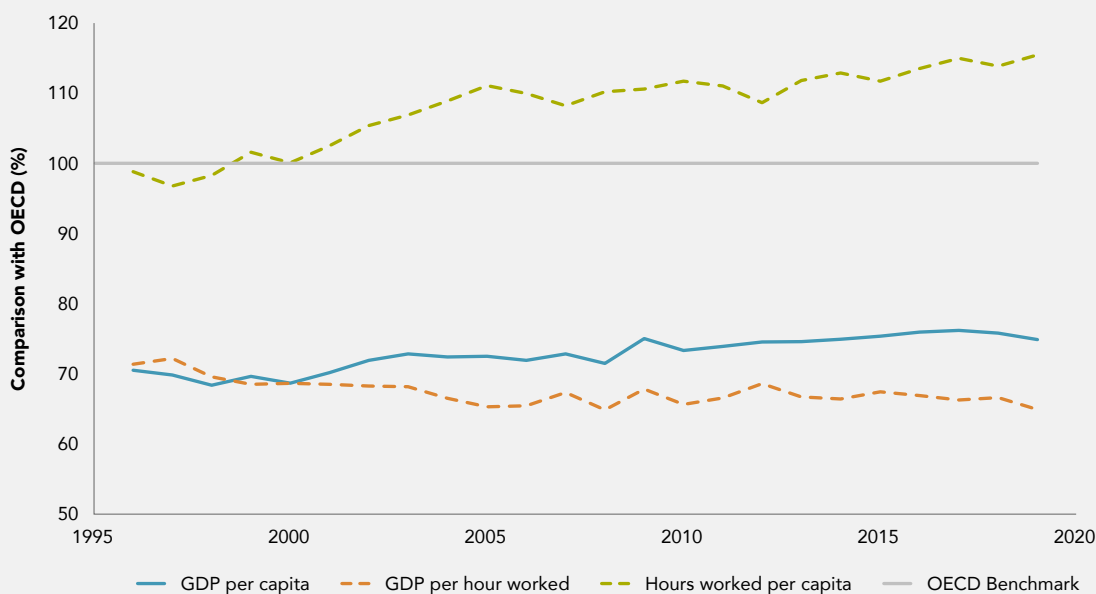
Technological change in agriculture, however, has been a double-edged sword for New Zealand. While the development of refrigerated shipping in the 1880s increased incomes and encouraged new

firms and industries, other technologies such as the development of synthetic fibres reduced demand for crossbred wool in the 1960s and contributed to falling export prices for wool products, negatively affecting the terms of trade.

Statistical comparisons show countries overtaking and outperforming New Zealand

New Zealand's poor performance from the 1990s is part of a longer-run trend, with labour productivity (Figures 5, 6 & 7) and per capita income growth (Figures 8 and 9) trailing those of many other developed countries after the Second World War. These trends have seen New Zealanders' material living standards fall from the global top at the beginning of the 20th century (Box 6) to below the OECD average today.

Figure 6 New Zealanders have worked more hours, achieving less output per capita than economies in the top half of the OECD



Source: Productivity Commission analysis of OECD data.

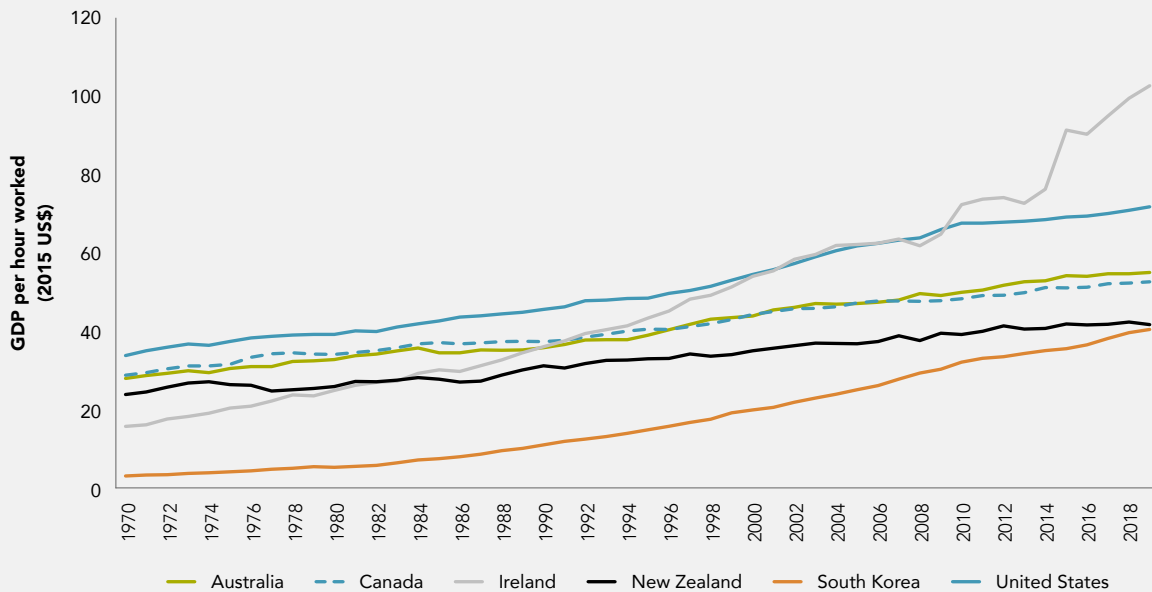
Note: Chart shows the sources of New Zealand's GDP per capita, GDP hour worked, or hours worked per capita relative to countries in the top half of the OECD in terms of GDP per capita, 1996-2019 where 100% represents the employment-weighted average of the following 18 economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Japan, Luxembourg, Netherlands, Norway, Sweden, Switzerland, US and UK.

Working more hours and putting more people into work has been the main way that GDP has grown (and how New Zealanders have earned income) over the past few decades.

In Figure 7 we focus on the impact of this slower productivity growth and New Zealand's starting position in terms of output value per hour worked. In 1970, New Zealand's output per hour worked was lower than its peers, with the exception of Ireland and South Korea. These two countries appear to have undergone fundamental transformations. New Zealand's productivity has increased at a very

modest rate, slightly less than Australia and Canada, and slipping further behind the US. Note that the nature of Ireland's fundamental transformation means that its economic data now include more activities that involve little domestic economic activity and employ relatively few people. Ireland's measured GDP now includes a disproportionate number of large multinationals, an aircraft leasing sector, and 'contract manufacturing' where goods are made offshore but registered as Irish manufacturing activity for accounting purposes. These activities arguably overstate Irish GDP (Boland, 2016).

Figure 7 New Zealand's productivity growth has been sluggish



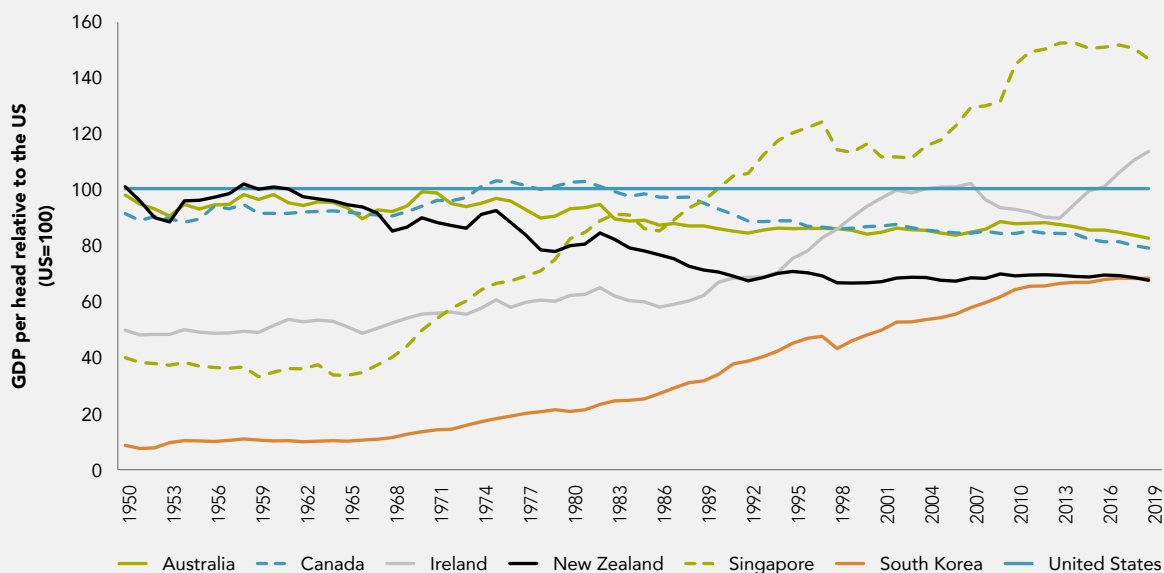
Source: Productivity Commission analysis of OECD data.

The United States has long been at the forefront of the world economy, so it is useful to look at the performance of economies relative to the United States. To obtain a longer view of New Zealand's performance relative to other countries, Figure 8 shows output per head (rather than hours worked) from 1950 to 2019, relative to the United States. The United States output per head grew steadily across this period. The figure shows the long relative decline of New Zealand (and, to a lesser extent, Australia) over the past 70 years, and the rise of Ireland, South Korea and Singapore. In 1950, New Zealand produced a similar output per head as Australia and the US. After a dip in the early 1950s, New Zealand and Australia broadly followed the United States' growth rate and so continued to lag behind for the rest of the decade.

In the early to mid-1960s, New Zealand's output per head, along with Australia's, began to drop behind the United States. At the same time, Singapore's GDP per head began to grow strongly. The Irish economy saw a steady increase in GDP per head relative to the other countries, then (while subject to measurement issues described in relation to Figure 7, above) shot up in the 1990s, stagnated in the first decade of the 21st century, and then restarted in the last decade. South Korea's growth has been more of a steady transformation.

Australia, Canada and New Zealand have experienced similar patterns of starting similar to the United States and then declining. Of the three, New Zealand's decline in output per head relative to the United States started soonest and its relative decline has been the largest. Canada's relative decline started last of the three economies, and in 2019 its GDP per head was similar to Australia's.

Figure 8 New Zealand's output per person has been dropping behind the frontier



Source: Productivity Commission analysis of Conference Board Total Economy data (July 2020).
Note: Per capita GDP are in 2019 US\$.

Box 6 Measuring New Zealand living standards before GDP

Measurement of productivity and material living standards generally relies on Gross Domestic Product (GDP) data. GDP estimates the total value of the final goods and services produced in an economy in a particular period. However, the consistent measurement of national GDP across countries did not begin until the 1940s (Coyle, 2015). To assess material living standards and incomes prior to the emergence of GDP, researchers have had to use other information. Such analyses have shown that Pakeha New Zealanders enjoyed very high standards of living (in terms of health and wages) in the late 19th and early 20th centuries.

Brooke (2009) used wages and prices for key consumer goods (eg, food, building materials, clothing, heating and lighting) to construct 'real wage' indices for Australia, Britain and New Zealand. He found that the wages of unskilled New Zealanders caught up with Britain in the 1850s and grew faster thereafter. New Zealand wages caught up to Australian levels no later than 1900, placing them in the top global ranks, along with Canada and the USA.

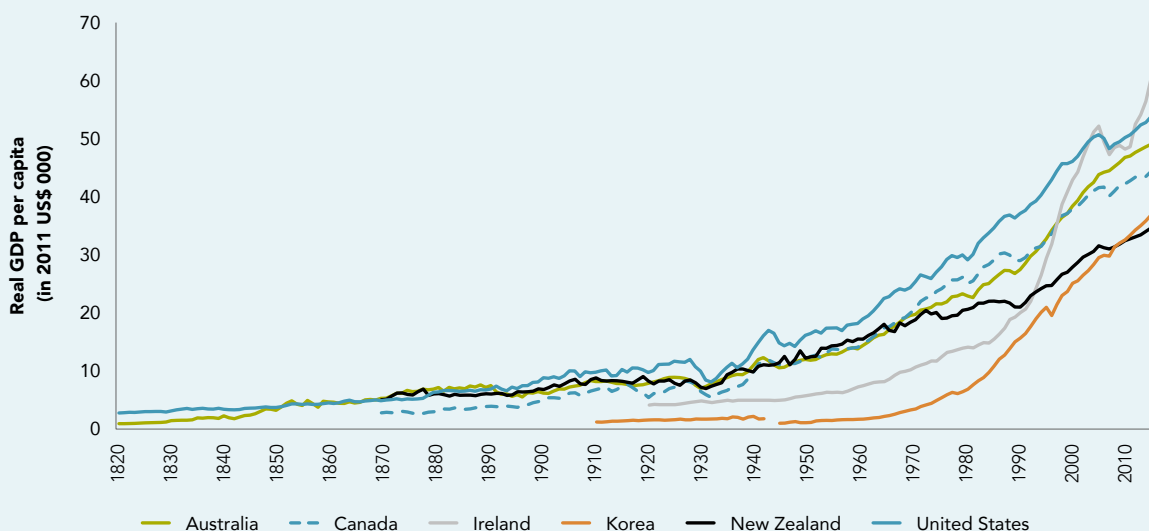
Another measure of living standards is physical health and mortality. Brooke (2009) notes that late 19th century New Zealand infant mortality rates were much lower than those in other countries and that this gap persisted well into the early- to mid-20th century. Brooke & Cheung (2020, p. 205) report on the heights of New Zealand soldiers in the Boer War, noting that they were "on average, as tall as soldiers from Australia and Canada, two other countries with an historically high standard of living". However, high material living standards were not shared consistently across the community. Easton (2020, p. 205) reports life expectancy data from 1900, which showed dramatic gaps between Māori and non-Māori New Zealanders.

Table 1 Life expectation at birth in years in about 1900

	Male	Female
NZ non-Māori	58.1	60.6
Māori	30.0	27.0
England & Wales	46.4	50.1
Australia	52.2	56.8
United States	48.3	51.1

Attempts have been made since to construct GDP data for the periods prior to the 1940s. One of the most famous was led by British economist Angus Maddison, who developed estimates of per-capita GDP stretching back many centuries. Maddison's work suggests that in 1900, New Zealand's per capita income (expressed in 2011 US\$) was \$5 942 – behind the USA (\$6 252), Australia (\$5 992) and Belgium (\$5 950), but ahead of the UK (\$5 608) and Canada (\$4 630). Figure 9 shows New Zealand's economic growth trajectory start diverging from comparator countries in the 1960-70s.

Figure 9 New Zealand's output per person was near the frontier for over a century



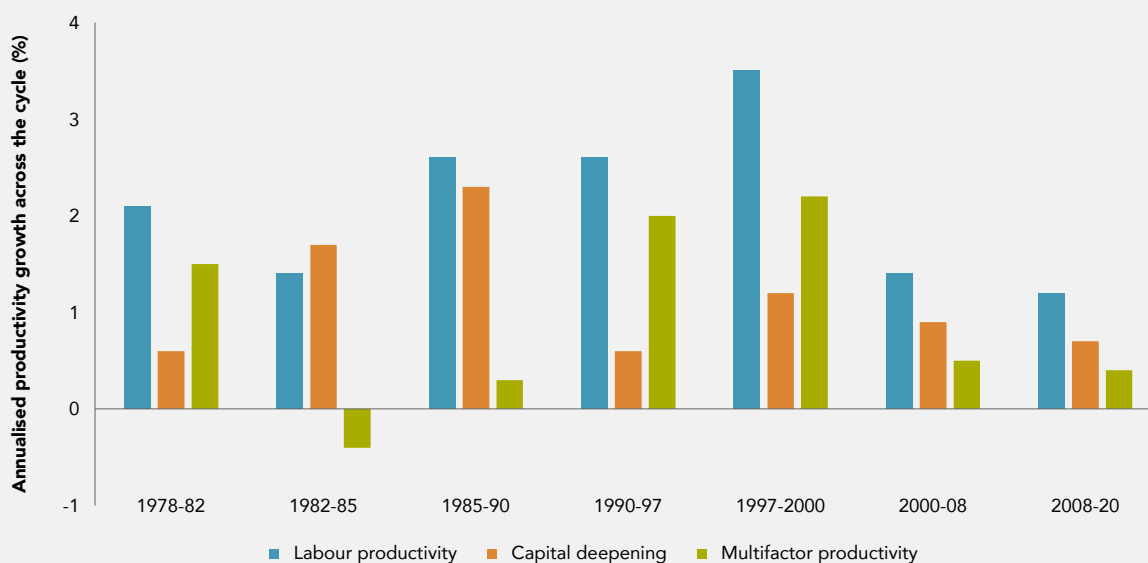
Source: Maddison Project Database 2020 (Bolt & van Zanden, 2020).

Productivity trends by source and industry

New Zealand experienced strong productivity growth in the 1990s (Figure 10). During this period labour productivity was driven mainly by multifactor productivity (MFP), after a decade of capital deepening. The New Zealand economy underwent significant change in the 1980s as a result of public sector reform, opening the economy up to international competition and transferring

state enterprises into the private sector. This was associated with an increase in capital stocks and capital intensification (Diewert & Lawrence, 1999). Overall, labour productivity growth has tended to be more steady than its components. When either MFP growth or capital deepening has been weak, the other has tended to offset it with strong growth.

Figure 10 Most of New Zealand's labour productivity growth has come from MFP since the capital deepening of the 1980s



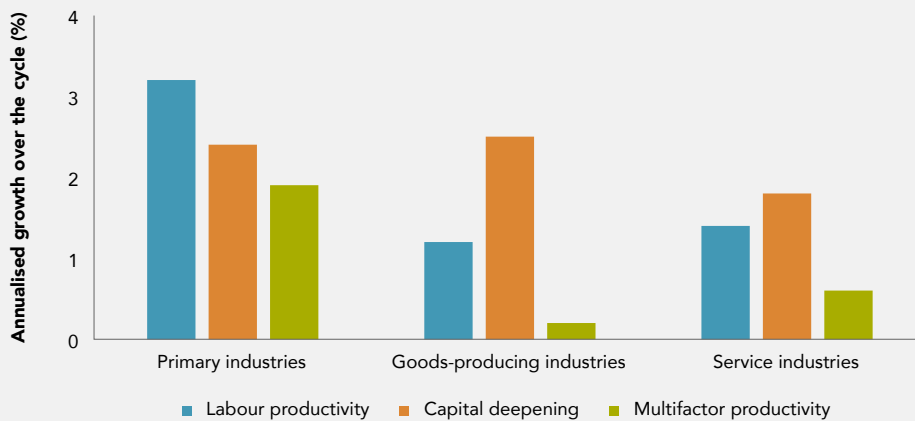
Source: Productivity Commission analysis of Statistics NZ (2021) *Productivity statistics: 1978–2020* data: Table 2.09, Productivity in the former measured sector.

Note: Growth rates are average annual percentage changes. 2008-20 may be an incomplete growth cycle, as the end of the cycle has not yet been observed.

If we look at the highest level of industry breakdown, we see that the fastest growth in labour, and multifactor productivity over the past occurred in primary industries. The primary industries have had

the highest productivity growth over the past 40 years (Figure 11), although that growth peaked in the late 1980s and early 1990s and has been more subdued since (Figure 12).

Figure 11 Productivity growth has been strongest in primary industries between 1978 and 2020



Source: Productivity Commission analysis of Statistics NZ (2021) data.
Note: Growth rates are average annual percentage changes.

Figure 12 Most of the improvement in primary industry productivity occurred in the decade from 1985



Source: Productivity Commission analysis of Statistics NZ (2021) data.
Note: Growth rates are average annual percentage changes in labour productivity, capital deepening and MFP in the primary industries. 2008-20 is an incomplete growth cycle.

New Zealand's primary industries have long been productivity growth leaders, built off technology diffusion and adoption (Hawke & Lattimore, 1999). The comparatively rapid productivity growth of

the primary industries over the 1980s and 1990s is generally attributed to the wide-ranging economic reforms during that era (Box 7).

Box 7 Agricultural reform and productivity growth

Prior to the 1980s reforms, New Zealand had in place a range of regulations and subsidies aimed at shielding farmers from large swings in international prices for their goods or inputs. The fiscal cost and generosity of these policies had increased sharply over the 1970s and early 1980s, in response to rising oil prices and falling terms of trade.

The removal of agricultural subsidies and regulation over the mid-1980s prompted productivity growth through several channels. First, farmers were more economical with their inputs. Fertiliser use fell by almost half over 1985-87. Repairs and maintenance and capital purchases were deferred, and farm employee numbers fell. Second, farmers shifted production towards more profitable markets. Land devoted to livestock and arable farming fell, while horticulture, dairy and forestry shares grew. Third, there were a number of on- and off-farm innovations, which sought to raise the value of output. Rae, Nixon & Lattimore (2004) cite the development of branding, marketing scale and a retail trade for the deer industry as one example of post-1984 off-farm innovation.

These aggregate productivity gains came at a cost for some farmers. Farmland prices fell significantly over the 1980s and many farmers faced large drops in incomes. Around 5% of commercial farmers were declared bankrupt or left farming altogether. However, the impact was smaller than some expected. The Government provided compensation packages to assist struggling farmers to leave, in the expectation that 20% would lose their farms. Ultimately, only 1% of farmers took the exit packages.

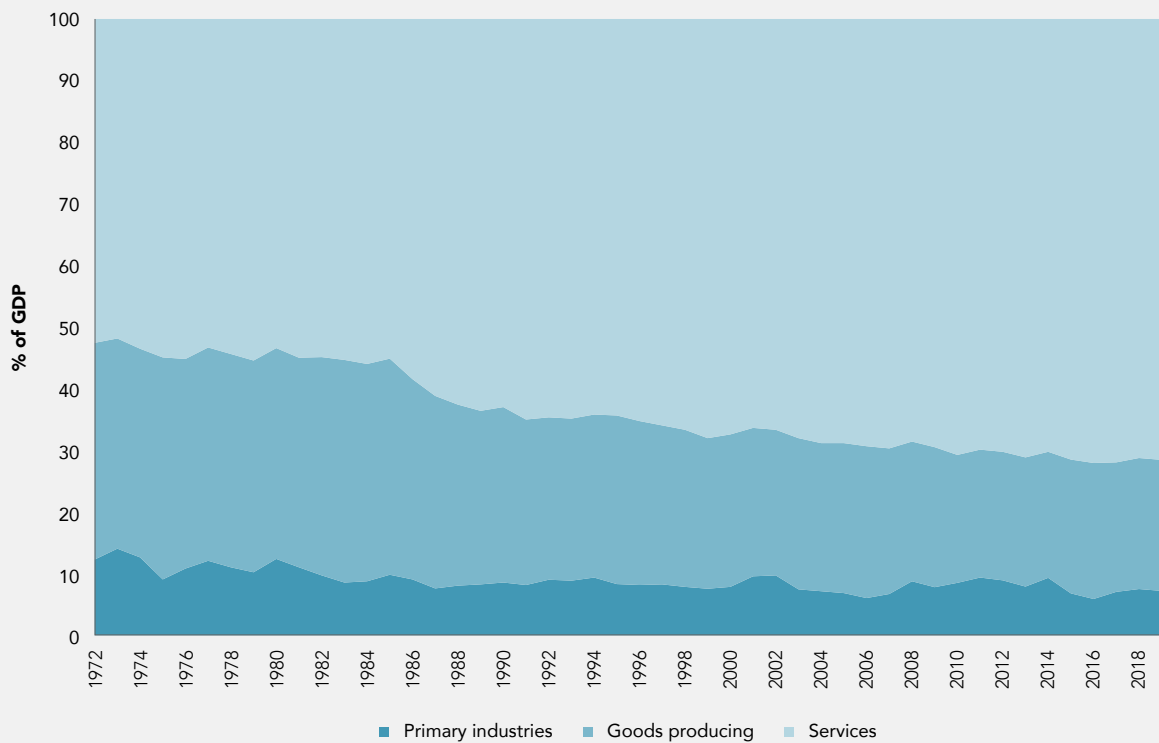
Source: Rae, Nixon & Lattimore (2004); Lattimore (2006).



As in other developed countries, the share of GDP generated by primary industries has fallen over time. However, primary industries still make up a higher share of New Zealand's GDP compared to other developed countries.

The share of national income produced by goods-producing industries (eg, manufacturing) has also fallen over time, consistent with patterns in many other developed countries. The largest fall in the goods-producing sectors' share occurred in the mid-1980s, reflecting economic reforms including the withdrawal of protectionist policies such as import quotas, government subsidies for domestic industries and high tariffs (Figure 13).

Figure 13 Most GDP growth has occurred in the services sector



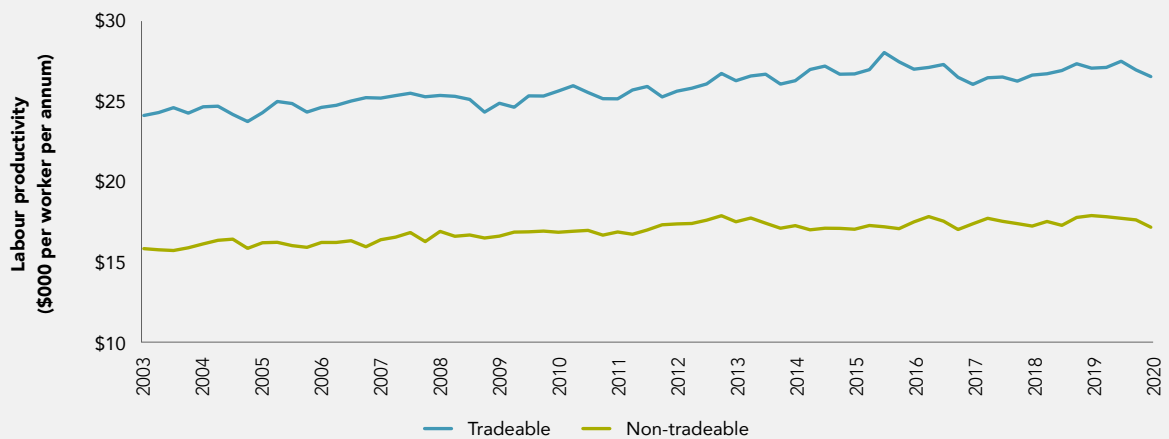
Source: Productivity Commission analysis of Stats NZ (2020) data.

As described in Chapter 1, services industries have lower measured productivity than goods producing and primary industries, in part, due to measurement challenges.

Firms selling tradeable goods and services tend to have higher measured productivity than those selling non-tradeable products. This is the case in New Zealand, where labour productivity in tradeable industries is generally at least 50% higher than the non-tradeable equivalents (Figure 14).

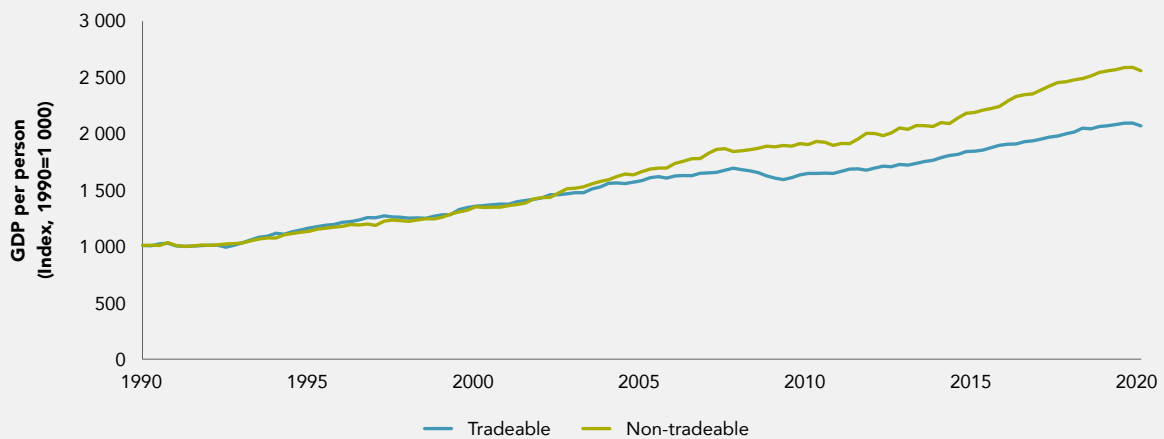
Despite this productivity advantage, non-tradeable sector growth has outpaced that of the tradeable sector, starting in the early 2000s and with a large gap opening up since the Global Financial Crisis (Figure 15).

Figure 14 The tradeable sector is more productive than the non-tradeable sector



Source: Productivity Commission and MFAT analysis of Stats NZ data, described in (Bailey & Ford, 2018).
Note: Labour productivity calculated in 2009-10 NZ\$.

Figure 15 The non-tradeable sector has been growing faster than the tradeable sector



Source: Productivity Commission and MFAT analysis of Stats NZ data, described in (Bailey & Ford, 2018).
Note: Data are indexed to the March 1990 quarter.



The faster growth of the non-tradeable sector implies a change in the composition of the economy towards lower-productivity industries.

Analysis of reallocation at a firm level has reached similar conclusions (Box 8).

Box 8 How industrial composition has affected productivity growth

Overall productivity growth rate reflects not only the rate of growth of productivity in individual firms and industries, but also the change in industrial composition over time. New Zealand's overall productivity growth performance is the result of productivity growth *within* industries weighted by size (from low-performing firms to high-performing firms – through firms growing and shrinking, becoming more or less productive, or entering and exiting) and the shift of resources *between* industries (from low-performing industries to high-performing industries).

Disaggregating productivity growth into contributions from each industry can help improve our understanding of New Zealand's productivity performance by showing how overall productivity growth is affected by changes in the composition of employment or changes in the contribution to output. This is known as shift-share analysis.

Several studies have identified that the dominant driver of New Zealand's labour productivity growth has been productivity performance within individual industries, rather than employment shifts between industries. Particularly between 1996 and 2000, the 'between-industry' effect was negative in New Zealand, meaning that there was decrease in the share of labour in some high-productivity industries and an increase in the share of labour in low-productivity industries. (Conway & Meehan, 2013; Maré et al., 2015; Mason, 2013; Meehan, 2020; Rajanayagam & Warmke, 2012). The impact of these effects is discussed in detail in Meehan (2020).

Reported public sector productivity growth has been low

Stats NZ regularly publishes estimates for education and training and healthcare and social assistance as part of their annual releases of industry-level productivity measures. Figure 16 shows labour productivity indices for education and healthcare and for the measured sector. These show how estimated education and healthcare productivity being persistently below that of the measured sector; while measured sector labour productivity averaged 1.3% between 1996 and 2020, the average for healthcare averaged 0.7% and for education and training averaged -1.3%. As noted earlier, these results have not been adjusted to reflect changes in the quality of output (eg, improvements or decreases in the effectiveness of teaching or hospitals), and so may either over- or under-state productivity growth.

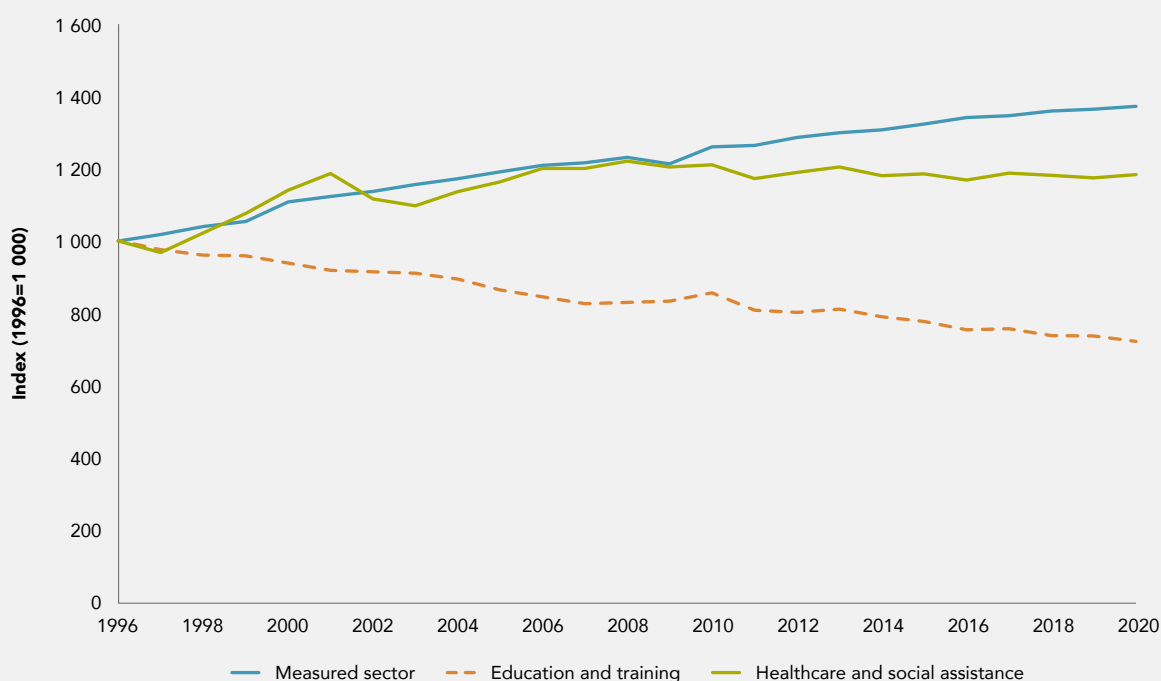
The challenge for New Zealand

Although the specific circumstances have likely changed over time, poor productivity performance is a longstanding problem for New Zealand. Yet it is apparent that no initiative or combination of initiatives has had the cut-through over recent decades to lift New Zealand's productivity.

New Zealand's challenge now is to transition from working ever more hours and depleting capital stocks (especially natural capital), to lifting wellbeing by generating more value from productive inputs.

Trends in New Zealand's more recent productivity performance is explored in detail in Chapter 3. What drives improvements in productivity and what can be done to promote productivity improvement is discussed in Chapter 4.

Figure 16 Productivity growth in the public sector has lagged behind the overall measured sector



Source: Stats NZ (2021) Productivity statistics: 1978–2020.

Part 3

Recent productivity trends



This chapter considers New Zealand's most recent productivity performance. It looks at the reported productivity statistics from two perspectives: the last growth cycle (2008-20), and changes in the latest period (between 2019 and 2020). The analysis presented is based on the most recent release of Stats NZ's productivity statistics: 1978-2020 (Stats NZ, 2021).

Whilst the latest figures understandably have the most proximate interest, it is worth repeating that annual movements can be volatile and often do not reflect changes in the underlying drivers of productivity. Moreover, each new release of productivity statistics comes with revised historical data for both input and output indicators, resulting in updated productivity estimates for previous years. The productivity numbers for the year ending March 2020 are therefore provisional.

Averaging over the whole economic cycle gives us the best opportunity to understand the underlying position of productivity in the New Zealand economy, absent from cyclical variation in capacity utilisation.

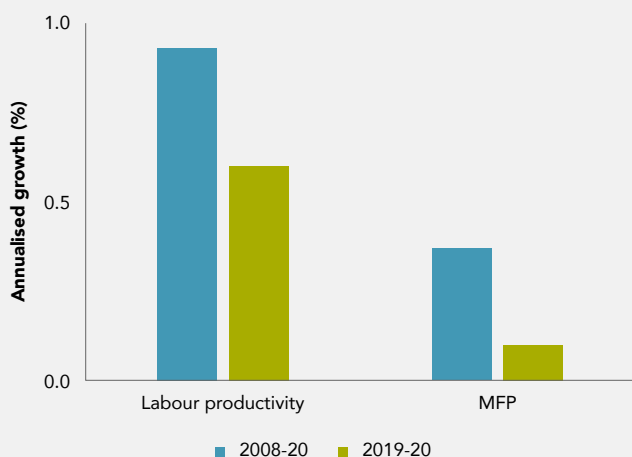
Because the latest data in this section relates to the year ending March 2020, it does not capture the effect of the Covid-19 pandemic or the associated recessionary economic impact.

New Zealand's productivity performance in 2019-20 was weak, even when compared to the previous decade

Figure 17 shows labour and multifactor productivity (MFP) growth rates over both the last growth cycle (average annual rates) and the last year. The figures for the last year's growth have been uniformly lower than the whole of the economic cycle. MFP growth during the past year was a negligible 0.1%. This follows the previous year's decline of -0.3%.¹¹ Prior to this, (MFP) growth has not been this low in the measured sector since the previous recession in 2009 (Figure 19).

¹¹ Note that MFP for the measured sector was revised downwards this year, from 0.3 percent growth in 2018-19 (as reported last year) to -0.3 percent, primarily because of increased capital inputs.

Figure 17 Both labour and MFP growth have fallen



Source: Productivity Commission analysis of Stats NZ data.
Note: The measured sector is ANZSIC06 divisions A to K, M, N, R, and S, and industry LL1. Productivity measured as GDP per input unit.

Slowing productivity growth has happened at a time when use of capital and labour inputs have increased. In other words, most of the growth that did occur came from growth in inputs, rather than productivity. Table 2 sets this out in more detail. The output of the measured sector grew by 1.3% in the last year, lower than the annualised growth rate for each of the last three growth cycles. The positive (but small) increase in labour productivity growth came mainly from capital deepening (an increase in capital-labour ratio). Hours worked and capital have continued to increase, although by less than in the previous decade. These increases in inputs have allowed output growth to continue in 2019-20.

Table 2 The components of measured sector growth, 1996-2020 (% per annum)

	Latest year	Stats NZ growth cycles		
	2019-20	1997-2000	2000-08	2008-20
Measured sector output (value-added)	1.3	2.9	3.5	2.1
Labour				
Labour input (hours paid)	0.8	0.1	2.1	1.2
Labour productivity (GDP per unit of labour input)	0.6	2.8	1.3	0.9
Capital				
Capital input (services for all assets)	1.8	2.5	3.9	2.4
Capital productivity (output per capital input)	-0.4	0.4	-0.4	-0.3
Multifactor				
Total inputs (income-weighted labour and capital input)	1.2	1.1	2.9	1.7
Multifactor productivity (output per unit of labour and capital)	0.1	1.8	0.6	0.4
Capital-labour ratio	1.0	2.4	1.8	1.2

Source: Productivity Commission analysis of Stats NZ (2021) data.
Note: 2008-20 is an incomplete growth cycle. Productivity figures are based on the measured sector series which began in 1996; Annual growth rate for year ended March.

GDP growth was (again) driven by more hours worked

Another way to look at this performance is to decompose changes in output growth into the changes due to increases in labour inputs, MFP, and capital deepening (Figure 18).¹² Growth in capital deepening picks up growth in the capital-labour ratio (weighted by capital’s share of total income). As in previous years, growth in GDP over 2019-20 was driven significantly by more hours worked, with almost half of GDP growth accounted for by increases in labour input. Both the employment rate and paid hours have increased over the last growth cycle. Even so, the contribution of labour input to growth over 2019-20 was low compared to recent years (Figure 18).



As we saw in Table 2, investment in capital has led to an increase in the amount of capital available per worker. This capital deepening contributed 0.5 percentage points to output growth in 2019-20, slightly lower than the average contribution over the last growth cycle (0.6 percentage points).

Figure 18 Contributions to GDP growth, 2008-20 and 2019-20 (%)



Source: Productivity Commission analysis of Stats NZ data.

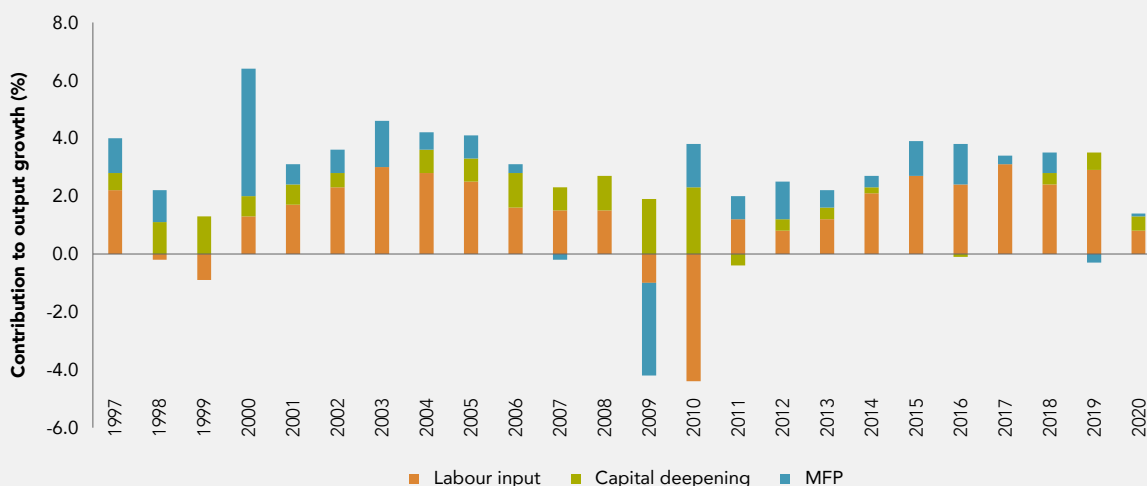
Note: GDP growth may differ from official figures due to rounding. 2008-20 is an incomplete growth cycle.

¹² Output growth is a function of the growth in the amount of labour used in production (labour input) and the effectiveness with which it is used (labour productivity). Labour productivity growth is approximately equal to the sum of the contribution of capital deepening and MFP.

As noted earlier, the figure for the growth cycle hides variation over the cycle. The figures above suggest New Zealand may have been coming to the end of a growth cycle before the arrival of Covid-19.

In June of 2009, New Zealand’s economy had shrunk for the fifth consecutive quarter, making it the longest recession since the 1970s (Hall & McDermott, 2016). This recession coincided with a massive reduction in MFP (as shown in Figure 19). Whilst there was a decline in labour input, the fall in output was mainly due to a fall in MFP and labour productivity. Next year’s data release will tell us more about the economic cycle and the effect of Covid-19, both in terms of the direct effect of the lockdown in New Zealand and the broader worldwide economic slowdown.

Figure 19 Contributions to output growth, 1997-2020 (%)



Source: Productivity Commission analysis of Stats NZ data.

Productivity performance across industries was highly varied

There is considerable variation in labour productivity growth at the industry level (Table 3). Although overall labour productivity growth in 2019-20 was low by recent standards, a number of industries experienced rapid growth.

An industry’s contribution to aggregate productivity depends on both its own productivity and its size (which is a function of resources employed in the industry and resource shifts into and out of the industry). Thus, while the Mining sector has

experienced a leap of 13.7% in output (produced with an increase in both MFP and hours worked), this industry only contributes just over 1% of total output. Conversely, the smaller (but still not insubstantial) growth in Professional, scientific and technical services will have made a larger contribution to aggregate productivity and output growth. This growth has not come from growth in labour inputs, but a growth in MFP. It is a similar story for communications (Information media and telecommunications). This small sector (though likely to have more potential for growth than Mining) experienced growth in productivity and output at the same time as reducing the hours worked by 3.3%. These industries all increased their labour productivity at rates above 5 percent.

Utilities (Electricity, gas, water and waste services) and Construction both experienced a growth in output at the same time as drops in productivity, fuelled by large increases in hours worked by employees. Output in logistics (Transport, postal and warehousing) fell, despite an increase in hours worked, because of a decline in productivity.

Looking at the largest contributors to overall output, Manufacturing (11.4% of GDP) and Agriculture, forestry and fishing (6.5% of GDP) had modest improvements in labour productivity and a deterioration in MFP, while Construction (7.6% of GDP) was negative on both indicators. In contrast, the largest sector Rental, hiring and real estate services (16.3% of GDP) showed positive productivity improvements.

Table 3 Industry productivity growth, 2019-20 (%)

Measured sector	Output growth	Contribution to total output*	Labour productivity growth	MFP growth	Change in hours worked
Agriculture, forestry and fishing	-3.2	6.5	1	-1.5	-4.6
Mining	13.7	1.1	5.3	14	8.1
Manufacturing	-0.3	11.4	0.3	-0.6	-0.7
Electricity, gas, water and waste services	0.4	3.2	-6.7	-2.5	7.5
Construction	2.1	7.6	-2.8	-2.3	5.1
Wholesale trade	1.1	5.5	2.6	1	-1.5
Retail trade	4	5.1	4.3	3	-0.4
Accommodation and food services	-1	2.5	0.4	-0.6	-1.4
Transport, postal and warehousing	-1.1	5	-5.4	-4.4	4.6
Information media and telecommunications	4.3	2.6	7.9	4.8	-3.3
Financial and insurance services	2	6.5	0.1	-1.9	2.0
Rental, hiring and real estate services	1.2	16.3	1.4	2.3	-0.2
Professional, scientific and technical services	4.9	9.1	5.3	3.4	-0.4
Administrative and support services	-0.1	2.3	-2.3	-2.8	2.2
Arts and recreation services	0.9	1.5	-2.2	-1.6	3.2
Other services	0.6	2.1	-1.2	-1.1	1.9
Non-market sector					
Health care and social assistance	2.7	6.8	0.7	0.6	1.9
Education and training	-0.2	4.9	-2	-2.1	1.8

* Contributions to output are the industry outputs as a percentage of total GDP, based on March 2019 GDP (as nominal figures for 2020 are not yet available).

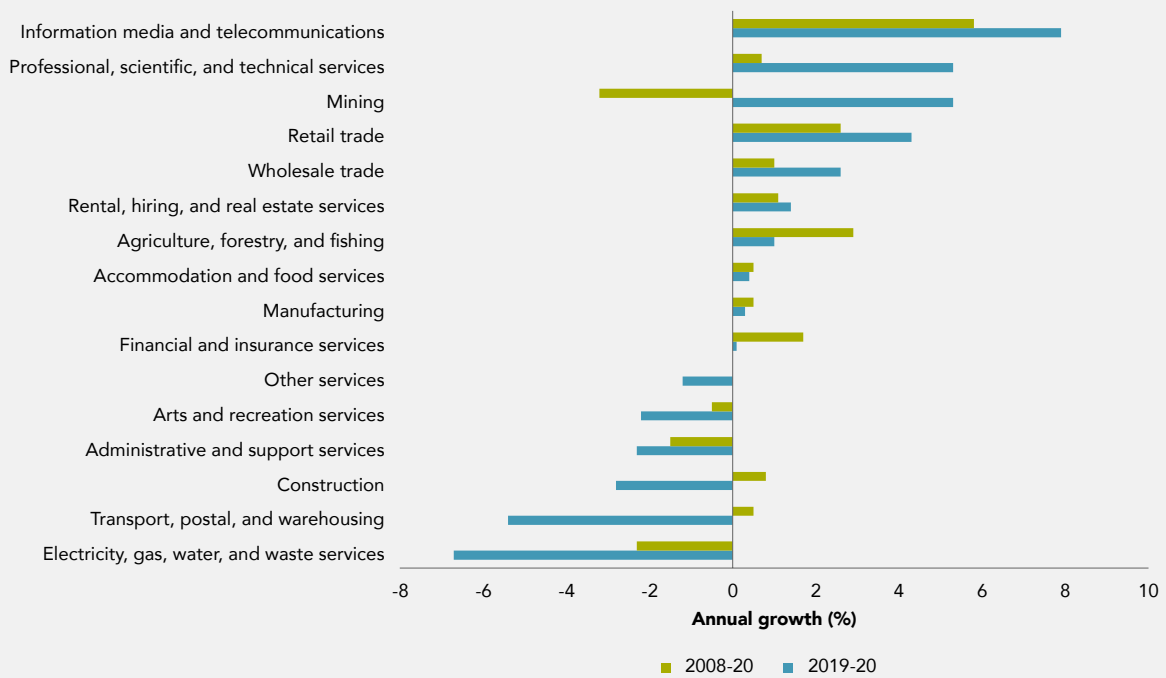
Source: Productivity Commission analysis of Stats NZ (2021) data.

Note: Rental, hiring and real estate services include owner-occupied property operation.

In Figure 20 we compare the latest figures with the whole 2008-20 growth cycle. In 2019-20 year, three sectors – Information media and telecommunications, Professional, scientific and technical services and Mining – all increased their labour productivity at rates above 5 percent. However, these sectors have had three very different experiences regarding labour productivity over the whole 2008-20 cycle. Information media and telecommunications enjoyed a large net increase in labour productivity over the cycle as a whole. In Mining, there has been, on average, a drop over the cycle. Professional, scientific and technical services have remained relatively flat.

Labour productivity fell by more than 5 percent in Electricity, gas, water and waste services and the Transport, postal and warehousing sector in the 2019-20 year. This is the continuation of a trend over the last growth cycle for Electricity, gas, water and waste services, which saw labour productivity growth drop 2% a year over the last growth cycle. Labour productivity was flat for the other two.

Figure 20 Labour productivity growth, 2019-20 and last growth cycle (2008-20)



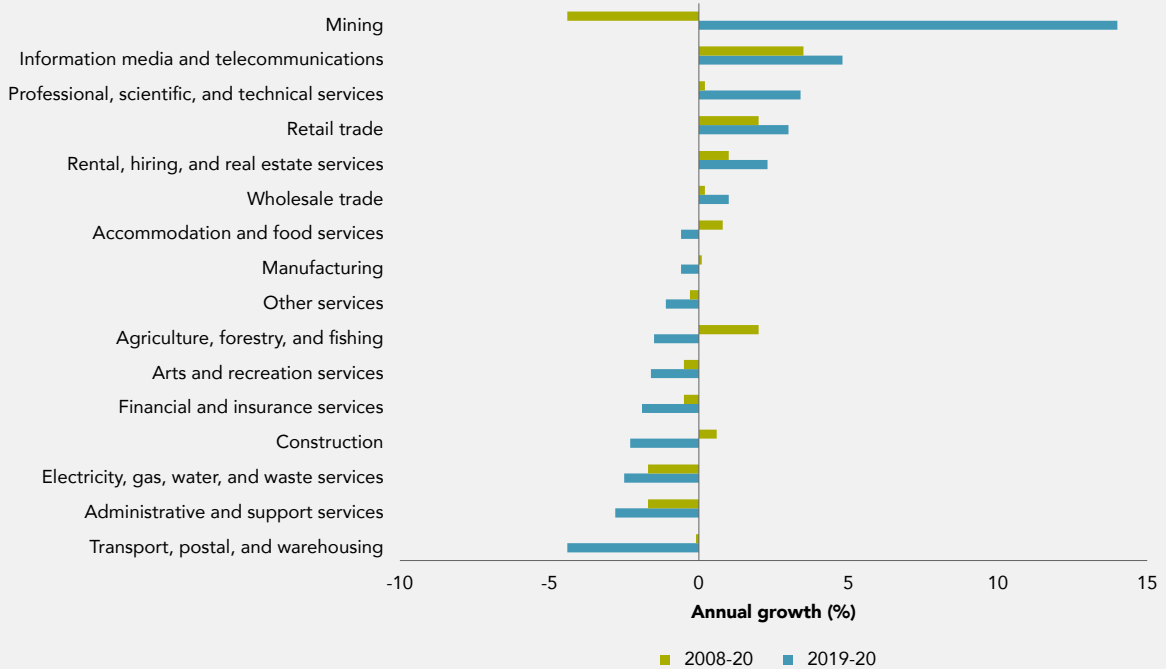
Source: Productivity Commission analysis of Stats NZ (2021) data.

Note: Rates are annualised over the growth cycle. 2008-20 is an incomplete growth cycle.

Similarly, while aggregate MFP growth was negligible over 2019-20, a small number of sectors saw significant increases (Figure 21). Mining MFP increased by 14 percent. Given the negative average MFP growth over the whole cycle, and the nature

of the mining industry, this is likely to be due to a spike in utilisation. Again, Information media and telecommunications sector has consistently had high MFP growth, 4.8% in the last year and an average of 3.5% over the last growth cycle.

Figure 21 MFP growth, 2019-20 and last growth cycle (2008-20)



Source: Productivity Commission analysis of Stats NZ (2021) data.

Note: Rates are annualised over the growth cycle. 2008-20 is an incomplete growth cycle.

Possible impacts of Covid-19 on productivity growth

The Covid-19 pandemic and resulting lockdown has been one of the most economically disruptive events in recent history, with New Zealand's GDP falling by the largest amount on record in the June quarter of 2020 and then rebounding dramatically in the following quarter.

The impact of economic disruptions on productivity growth is far from certain. On one hand, the loss of business confidence resulting from a downturn may lead to a fall of innovation and MFP growth (Oulton, 2018). On the other hand, recessions may cause the weakest firms to fail, creating a "cleansing effect" which raises overall productivity (Osotimehin & Pappada, 2015). For labour productivity, the effects of a recession will depend on the extent to which firms hold on to staff during a downturn, how much firms suffer declines in output, who they decide to retain in the short-run and who they hire over the medium-term.¹³

Responses to the pandemic provide an opportunity to regear

The pandemic has forced many firms to reassess their production processes and invest in technology. The most obvious manifestation of this has been the dramatic rise of video conferencing as an essential work tool, but there are many other examples (eg, the expansion of many 'brick-and-mortar' retailers into online sales). Governments have also revised their systems, streamlining regulatory processes to bring the COVID vaccines to market swiftly.

The disruption caused by the pandemic may have brought forward the changes needed to make the most of technology and accelerate productivity growth.

...but there is a long way to go

Most of the technologies used in New Zealand firms are developed overseas. New Zealand's ability to use these technologies to boost national productivity will depend on how successfully leading foreign firms reorganise themselves to reap the benefits, and how quickly these lessons diffuse to New Zealand.

Recent research suggests that New Zealand firms are not making the most of leading technologies and that global best practices do not flow swiftly into the New Zealand economy. New Zealand firms are a long way behind the 'international frontier' (ie, the performance levels of the world's best businesses). For example, New Zealand's leading firms appear on average to be less than half as productive as top firms from countries such as Belgium, Denmark, Finland, the Netherlands and Sweden (NZPC, 2021). Empirical analysis in Zheng et al (2021) found that the cross-country diffusion of technologies to New Zealand was poor, possibly reflecting New Zealand's geographic isolation from foreign markets, and low levels of international trade, participation in global value chains and capital intensity.

There is a large gap to be closed if New Zealand's productivity growth is to reach the rates needed to push material living standards back towards the top end of the OECD. Chapter 4 outlines some of the Commission's recommendations on how to close that gap.

¹³ (Myers, 2009) for example, argues that during a downturn, labour productivity growth "would be expected not to fall as much as output growth in theory because it is the least productive workers that are laid off first and the more productive workers that are retained; similarly, in an upturn, productivity growth is likely to be lower than output growth because as more workers are taken on, so the skill and experience level of the incremental worker declines, and so does their productive potential."

Part 4

How to improve productivity



What drives improvements in productivity?

Innovation and technology

Chapter 1 emphasises that many factors and interactions affect how efficiently an economy transforms labour and capital inputs into outputs.

Economists have written about the role and importance of:

- improvements in the quality of labour and capital inputs, for example the role of skills and human capital (Lucas, 1988);
- developments in financial and intermediation services (Greenwood & Jovanovic, 1990);
- competitive rivalry and ‘creative destruction’ of low-productivity firms by higher performing ones (Aghion & Howitt, 1992); and
- institutions—including coordinating organisations, understanding the ‘rules of the game’ and changing social norms (Acemoglu & Robinson, 2012).

Underlying them all, however, is the creation and adoption of new technology (Grossman & Helpman, 1991; Romer, 1990).

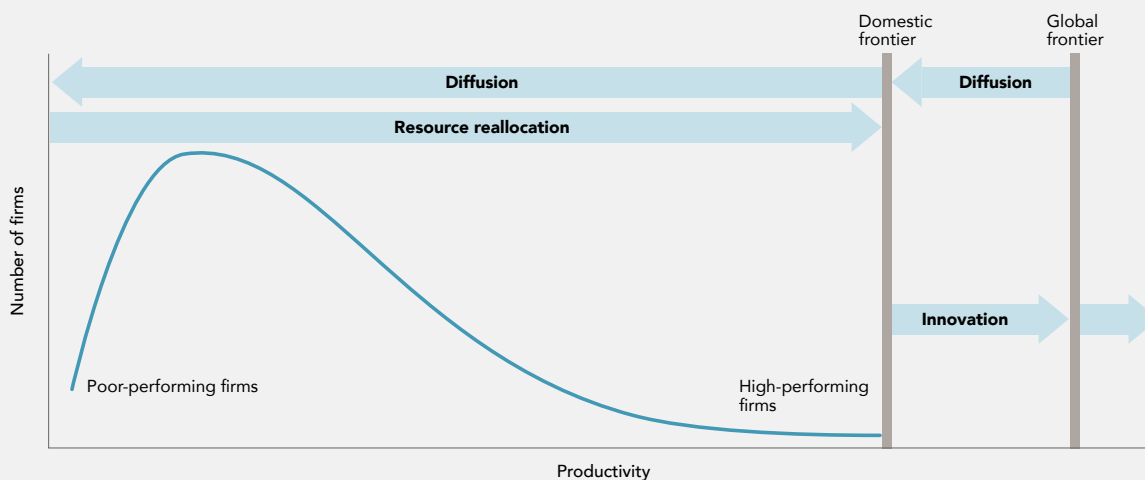
‘Technology’ can take many forms. It encompasses innovation and technological improvements, economies of scope and scale of production, changes in workforce skills and better management techniques, and changes in the mix of inputs.

Different explanations have been put forward to account for why we observe slower uptake of new technologies in some countries compared to others (Kneller & Stevens, 2003). Explanations centre around:

- the barriers to new technologies that result from a country’s institutional arrangements (Parente & Prescott, 1994; Prescott, 1998);
- the usefulness of new technologies – new technologies are typically developed in richer countries and differences in economic conditions and factor prices can make these technologies inappropriate for less developed countries (Acemoglu & Zilibotti, 2001);
- economic geography factors – for example a country’s distance from where new technologies are being developed or used (Keller, 2002, 2004); and
- the potential of a country to absorb capital and new technology from elsewhere into its economy (Eaton & Kortum, 1999; Griffith et al., 2004; Xu, 2000).

The Commission has adopted a firm-level framework to understand the factors that drive productivity growth at the country level (Conway, 2016, 2018; NZPC, 2021), described in Figure 22.

Figure 22 A stylised firm-level framework for understanding productivity growth



Source: OECD (2015); Conway (2016); Allan (2018). The shape of the distribution is based on Di Mauro and Hong (2018).

The framework provides three useful insights about the drivers of productivity. First, it establishes innovation and technological change as critical to productivity growth. *Innovation* – the creation of new goods and services and new ways of working – pushes out the global frontier, enabling more value to be created for the same or fewer inputs.

The second insight is that, while innovation is often led by a small group of high-performing firms, the *diffusion* of innovation and technology to other firms allows the productivity benefits to be shared across an economy. The diffusion of innovations from the domestic frontier to other domestic firms can happen through various channels:

- migration and job churn, where an employee moves from a higher-productivity firm to a firm which, at the time of the move, has lower productivity;
- a merger or take-over of a low-productivity firm by a higher-productivity firm;
- new investment can be accompanied by technologies or methods previously unknown to a firm; and
- interaction with other firms in distribution networks or supply chains, where market intelligence and production techniques are shared explicitly through transactions or implicitly by imitation or learning to manage new complexities.

The third insight relates to the process of *reallocation*. The movement of resources (capital, workers) from poorly-performing to higher-performing firms also raises overall productivity.

What can government do to help?

Effective and fit-for-purpose policy

The importance of good policy foundations has long been recognised as important for lifting productivity. Successive governments have created institutions and implemented policies to tackle the productivity challenge. Some of these are the broad overarching policies that determine the macroeconomic environment, regulatory institutions and practices, and competition policy. Others are the policies and institutional arrangements that govern particular institutions in science, innovation and education.

However, it is increasingly recognised that there is a special role for government to support creating, collating, synthesising, utilising and disseminating knowledge capital for the common good (Dalziel, 2018).

The Commission's two latest inquiries *Frontier firms* and *Technological change and the future of work* suggest some priority actions.



Image supplied by: Miraka

Smart strategies to make the most of our circumstances

The Commission (2021) concluded in its recent *Frontier firms* inquiry that developing smart strategies that deal with New Zealand's remote location and make the most of its circumstances should be a priority. In particular, New Zealand needs to succeed in producing internationally tradeable goods and services at scale, using innovation to make the goods and services distinctive and hard to replicate, thereby gaining and retaining a competitive advantage.

The Māori economy exhibits several characteristics that help its firms to innovate, grow and support improved wellbeing. The need to serve multiple bottom lines (eg, commercial, environmental, social and cultural objectives) can be a strong driver of ambition, which can also flow through to expectations on suppliers.

Further, high shareholder ambition, together with a long-term view, can spur innovation and experimentation, provided the underlying assets are not put at risk.

Māori values can help differentiate Māori goods and services and provide distinctive brand value in overseas markets. The values also closely align with the growth in consumer demand for products with strong environmental and social credentials, such as provenance and authenticity. These findings challenge often-held assumptions that having multiple bottom lines, a long-term view and collectively held assets are a handbrake on growth and productivity. Instead, they show how long investment horizons can support innovation and value creation. Further, innovation is key to serving multiple bottom lines, as innovative solutions are required to solve many of New Zealand's environmental and social challenges.

A selection of key findings and recommendations from the inquiry is in Box 9.

Box 9 Overcoming NZ's productivity challenges: Frontier firms



A key finding of the *Frontier firms* inquiry is that New Zealand needs to take the lead from successful small advanced economies (SAEs), such as Denmark, Sweden and Singapore. These countries have outstanding records of exporting specialised and distinctive goods and services at scale and have achieved world-leading advantages in selected markets.

Central to these countries' success are their leading ('frontier') firms, which invest heavily in innovation, are export-intensive, have scale and sophisticated governance and leadership. Such firms help small countries overcome the barriers of size and distance, as they provide the platform for innovation and exporting that drives productivity growth.

New Zealand has some frontier firms, but they are few in number, relatively small and their performance lags significantly behind those in other SAEs. Indeed, on average, the labour productivity levels of New Zealand's frontier firms are less than half that of top firms in European SAEs (Zheng et al., 2021).

The inquiry found that Māori authorities and small and medium-sized enterprises have been growing faster, are more likely to export, and have higher rates of innovation and R&D, than other New Zealand firms.

To grow the size and number of frontier firms in New Zealand, the Commission recommended a number of policy changes:

- The Government should develop focus areas for innovation policy, to complement its broader and less-targeted supports (eg, the R&D tax credit). Focus areas would be high-potential industries or technologies, reflecting existing and emerging strengths. Implementing focus areas would involve significant and long-term investments by Government and industry, and collaboration across researchers, industry, Māori and Government. They should also be supported by a more proactive and targeted approach to attracting foreign direct investment that is innovative and oriented to exporting. The aim of these efforts would be to establish and maintain strong innovation ecosystems in each of the focus areas.
- Regulatory settings in a number of sectors should be updated to improve competition and enable innovation. These regulatory settings include competition policy for the dairy industry; the introduction of a consumer data right covering areas such as banking, finance and energy; and the rules governing genetic modification technologies.
- Government policy should more consciously foster and learn from Māori frontier firms. This would include reforming the Te Ture Whenua Māori Act 1993 to better enable Māori land-based firms to flourish; improving and supplementing Government procurement processes; prioritising and accelerating action to protect mātauranga Māori and intellectual property; and supporting a Māori-led approach to optimising the Māori business ecosystem.

Source: (NZPC, 2021).

Smoothing the process of reallocation by supporting workers

The Commission's *Technological change and the future of work* inquiry completed in March 2020 focused on the impact of new technology on workers. The inquiry noted that worker mobility and a dynamic labour market matters for productivity because it allows for smooth and beneficial reallocation of resources to more productive firms. But the closure of low productivity firms and the associated loss of jobs can harm wellbeing unless workers can move to other work.

Fabling and Maré (2012) found that the process by which resources are reallocated from poorer performing to better performing firms in New Zealand had an uneven impact on workers, with greater employment losses for low wage workers, young workers and workers with short job tenure. In some respects, this result is surprising as younger workers are likely to be more mobile than older workers who may have greater ties to a particular region and are less likely to be able to retrain for a new job.

Workers who are mobile and able to move jobs easily help facilitate reallocation, and a voluntary move from one job to another is also an important way for workers to climb the jobs ladder and grow their wages and job satisfaction. Changing jobs can be particularly beneficial for younger workers, given that finding good matches for one's skills can have a large bearing on a worker's career and future income.

Coleman and Zheng (2020) examined job-to-job transitions across firms, industries and regions in New Zealand. Just over 20% of employees aged 18-64 – about 420 000 people – had a different job in March 2018 than they had a year earlier.¹⁴ About 40% of these changes were to a new location, and



nearly 60% involved switching industry. Only 20% stayed in the same industry and location. That makes New Zealand's labour market relatively dynamic. A dynamic labour market is beneficial now, but it could become more important if productivity-enhancing technology changes at a faster rate in the future.

The inquiry concluded that New Zealand's broad policy settings assist labour market dynamism by ensuring that access to healthcare, retirement savings, and unemployment benefits are not linked to particular types of work arrangement, jobs or employers. However, income security, opportunities for development, career progression and social protections are important for workers. This consideration underpins the Commission's recommendations for greater income smoothing, and increased access to training and labour-market programmes when people suffer job loss. Employment law should also be more effectively targeted (eg, by reviewing and updating the legal tests for employee status). All these measures are designed to increase resilience and opportunities for today's and tomorrow's workers (NZPC, 2020b) (Box 10).

¹⁴ These estimates do not capture those who changed jobs but stayed employed by the same firm.

Box 10 Options for revising policy settings to better support workers



The Productivity Commission's inquiry into *Technological change and the future of work* highlighted measures that could improve income security for New Zealand workers and promote dynamism in the economy by reducing fears about job loss and facilitate better skills and labour-market matching.

The inquiry concluded that there would be merit in policies that provide greater income smoothing for displaced workers, identifying three options:

- unemployment insurance;
- portable individual redundancy accounts; and
- adjustments to current benefit and tax credit policies.

Each has benefits and drawbacks, and further analysis is required of fiscal costs, economic impacts and wellbeing effects.

Unemployment insurance would most likely provide income replacement at rates similar those in most OECD countries in the immediate period following displacement. But relatively minor adjustments to current benefit and tax credit policies could also substantially increase income replacement rates for those currently facing the largest falls.

Examples to consider might include: relating benefits to previous earnings and paying a higher fixed rate of payment for jobseekers for a limited period; changing eligibility criteria to disregard partners' income for a limited period; creating a grace period for households whose total weekly working hours fall below the eligibility criteria for in-work and family tax credits; and creating new benefits or tax credits that apply for a limited period after job loss.

Directions and questions for future research

Chapter 1 highlighted the value of looking at productivity measures for comparisons – particularly multifactor productivity (MFP) over time (across growth cycles) and labour productivity across economies. Developments in the measurement of different inputs have spurred the creation of new measures that capture concepts that were not previously considered important for national accounts data. These include:

- forms of capital, such as social capital, but also natural capital and ecosystems; and
- intangible assets that generate differences in quality, embody codified or uncoded knowledge (such as business practices and cultural norms), and newer 'ways of working' and verification (eg, Blockchain) provided by technology, including digital services.

Work by The New Zealand Treasury on the Living Standards Framework and by international bodies like the OECD reflects an attempt to identify and measure a wider range of productive inputs. The objective of the work is to better inform policy by distinguishing true productivity improvement – more output from the same or less input – from growth in output that relies on using inputs and increasing resource degradation that would otherwise be ignored.

This section outlines three areas of future research that the Productivity Commission is considering to dig deeper and look beyond aggregate national accounts data.

Getting a better understanding of productivity in the public (and other 'hard-to-measure') sectors

Understanding the public sector's activities is important. Public sector productivity improvements follow the same disruptive process as in other parts of the measured sector: reallocation of capital and labour from low- to high-productivity projects and new technologies and approaches that push out the production possibility frontier. While productivity estimates for the education and health sectors are presented by Stats NZ alongside those for the measured sector, it is an area where comparatively little is known (NZPC, 2018c, 2018b) and where understanding quality is needed to inform quantitative indicators (Gemmell et al., 2017).

The public sector is a large part of the economy and can have an impact on the economic performance of the private sector through diffusion and the services it provides to the private sector.

What it produces also has a direct bearing on the wellbeing of New Zealanders (health, education, policing etc. affect the whole of society, especially the more vulnerable). Moreover, much of what it produces also contributes directly to measured sector productivity: education and training, scientific and other research, infrastructure, etc.

The impact of public policies and government institutions on productivity is important. Evaluating the efficiency and effectiveness of specific interventions is needed – not just to understand whether they work or not (in a simple, binary way), but rather how they worked and how effectiveness depends on context. The LBD and IDI are powerful tools for this, as they capture the characteristics of firms *before a policy is even designed*, and inform the influence of selection effects – both who is selected, and what impact this has on outcomes (Le & Jaffe, 2017; Morris & Stevens, 2009). Natural experiments, circumstances surrounding a programme, or (better still) evaluation criteria built into the policy and implementation design can enable clearer identification of the impact of the policy.



Getting a better understanding of productivity at a firm level

Broadening our understanding of how productivity growth occurs is important – how it starts and how it diffuses through the economy. New Zealand's Longitudinal Business Database (LBD) provides a detailed view of firms' behaviour and performance across a broad range of topics, including how many businesses are started or wound up, how large or valuable different markets are, how connected businesses are to each other and to international markets, and how knowledge is used.

Researchers have learned many important things from the LBD already. For example, exporters are more productive than non-exporters and this difference exists before firms begin to export, rather than learning about the world frontier and increasing productivity by getting out there. Yet when exporting firms enter new markets, they grow (Fabling & Sanderson, 2013). The implication is that exporting reallocates resources from low to high productivity firms, increasing aggregate productivity. Research is needed to help understand:

- more about the characteristics of firms that are productive enough to export, and whether there are opportunities to grow the number of these firms;
- whether policy or regulatory settings impede this process; and/or
- whether there is benefit in identifying and/or supporting such firms.

Foreign-owned firms are more productive than domestically-owned firms, yet when foreign firms buy existing domestically-owned firms, this does not appear to have increased the productivity of firms (Fabling & Sanderson, 2014). Relevant empirical questions include:

- what are the positive or negative spillovers from FDI, and how do the spillovers depend on the type of FDI; and
- whether foreign acquisition of a domestic firm leads to expansion of the firm and thus reallocation of resources to lift aggregate productivity.

We know that competition is related to the level and distribution of productivity improvement (Stevens, 2009) but it is not clear how this works. Is it all through the selection of firms? Does it relate to the incentives to, and the rewards from, innovation or investments in technology (Fabling & Grimes, 2016; Grimes et al., 2012)? Is it through better management capability (Agarwal et al., 2020)? How do local, national and international competition contribute? Is productivity an outcome of competition, or itself an influence on competition?

Better understanding the impact of workers and labour markets on productivity

Labour inputs are vital to production and also represent a mechanism through which MFP can grow: eg, new migrants bringing in knowledge from overseas; worker movements between firms can facilitate adjustment and spread knowledge of new products and production techniques etc.

The IDI provides rich insights into the New Zealand economy from the perspective of individuals and households. It contains information about employment, education, income, benefits, migration, justice and health. The IDI can be linked to the LBD via tax data to better understand the relationships between businesses and the people who work in them. Some questions about spillovers, and the dispersion of best practices through staff movement between firms are:

- what is the impact of migration on productivity?
- what is the impact of people movements on industrial or regional restructuring?

The IDI can also be a means to understand the patterns and impacts of non-market services on productivity and wellbeing.

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Glossary

Term	Definition
Baumol's cost disease	The inability of some labour-intensive activities to substitute labour with technology (capital) over time causes costs in such activities to rise relative to other activities. Where low productivity growth sectors compete for labour with high productivity growth sectors, wages in lower productivity sectors may grow faster than the measured productivity in that sector.
Capacity utilisation	The level of production capacity that is being used to produce output at any given time. Capacity utilisation indicates the output produced with given resources compared with the potential output that can be produced if capacity was fully used.
Capital deepening	An increase in capital intensity (as indicated by the capital-labour ratio) by increasing the amount of machinery, equipment, etc., for each worker. Firms or economies that are 'capital-shallow' have relatively little capital for their labour force to work with.
Capital inputs	The use or consumption of capital in the production of outputs. Capital inputs include, for example, land, buildings, vehicles and computers. In growth accounting and productivity measurement, 'capital' generally refers to traded physical and financial assets – the equipment and structures used to produce goods and services. These capital inputs are distinct from the capitals in The New Zealand Treasury's living standards framework (New Zealand Treasury, 2019b), which additionally provides for: <ul style="list-style-type: none"> • Natural capital: all "aspects of the natural environment that support life and human activity." • Human capital: the "capabilities and capacities of people to engage in work, study, recreation, and social activities." • Social capital: the "norms, rules and institutions that influence the way in which people live and work together and experience a sense of belonging."
Capital-labour ratio	Capital input index divided by labour input index.
Capital services	The flow of services from the stock of past investments. For instance, the capital services provided by an office building include protection against rain, the comfort and storage services that the building provides.
Commodity markets	Markets for buying, selling, and trading raw materials or primary products.
Digitalisation	The process of transforming businesses processes to accommodate digitised information and digital technologies.
Entity	The central unit of analysis, that is, the "thing" whose inputs, outputs and thus productivity is being measured. It can refer to a firm, public sector agency (eg, a school or hospital), region or country.
Frontier firms	Firms at the top of the industry productivity distribution. The 90th percentile (the top 10% of firms) is typically used to define the frontier.
Goods-producing industries	The goods-producing sector includes the following industries: manufacturing; electricity, gas, water, and waste services; and construction.

Term	Definition
Gross domestic income (GDI)	Economic activity based on all the income earned while engaged in producing all goods and services output (ie, income paid to generate gross domestic product, or GDP) in a specific time period. These are the returns to labour and capital such as wages, salaries and profits.
Gross domestic product (GDP)	Economic activity based on the market value of all finished goods and services produced within a country's borders in a specific time period. GDP is calculated either by adding all spending by those who participate in the economy (expenditure approach), estimating the total value of output and deducting the cost of intermediate goods that are consumed in the process (the output, or production, approach), or by calculating the income earned by all the factors of production in an economy and subtracting taxes and depreciation (income approach).
Gross national income (GNI)	Economic activity based on the sum of all income earned by citizens of a country, regardless of where the activity occurs.
Growth cycle	A period defined between two peaks of the growth cycle (which generally corresponds to the business cycle). Peaks are determined using statistical techniques by Stats NZ and are chosen to represent high points in capacity utilisation of the economy. Productivity is best analysed as averaged over growth cycles, removing the effect of changes to capital asset utilisation, labour utilisation and labour quality, which vary cyclically. For more information, see Stats NZ (2007, 2020)
Integrated Data Infrastructure (IDI)	Research database administered by Stats NZ holding linked administrative microdata about people and households relating to their education, income, migration status, justice interactions, and health outcomes.
Industry	Industries are grouped by the Australian and New Zealand Standard Industrial Classification (ANZSIC) to make statistics comparable with other countries' statistics. Examples of industries are agriculture, forestry, and fishing; construction; manufacturing; and retail trade.
Information and Communications Technology (ICT)	Equipment and systems that provide access to digital information through telecommunications infrastructure and devices, including the internet, wireless networks, smartphones and communication channels (ie, instant messaging, voice over internet protocols, or VoIP, video-conferencing, and social networking).
Inputs	The direct and indirect factors involved in the production of outputs. Inputs can be organised into three broad categories: labour, capital, and consumables.
Intangible assets	Assets that are identifiable but are not physical, such as reputation and brand recognition, skills, market research and patents.
Kaitiaki	A guardian or trustee, typically of an environmental area or resource on behalf of others, such as future generations, recognised by tangata whenua (the tribal group with authority in a particular area). Kaitiakitanga relates to the way of managing the environment based on the traditional Māori world view (te ao Māori).
Labour force	The total working-age population (resident, non-institutionalised population of New Zealand aged 15 years and over) who are classified as 'employed' or 'unemployed'. This is larger than the total measure of labour inputs.

Term	Definition
Labour income share	The amount of GDP paid out in wages and salaries, relative to total GDP.
Labour inputs	The labour utilised in the production of outputs, both directly (eg, teachers for school outputs) and indirectly (eg, administrative staff, who contribute to the functioning of an entity).
Labour participation	The total labour force expressed as a percentage of the working-age population.
Labour productivity	Average output per unit of labour input. Labour productivity represents the total volume of output (measured in GDP) produced per unit of labour (measured in terms of the number of hours worked, hours paid, or the number of workers) during a given time reference period.
Labour utilisation	The sum of those in the labour force that are not unemployed (without a paid job but looking for work) or underemployed (in part-time employment but wanting to work more hours). As with unemployment, underutilisation is a broad measure of spare capacity in the labour market.
Longitudinal Business Database (LBD)	Research database administered by Stats NZ holding linked administrative microdata about businesses. Researchers use the LBD to evaluate policies and analyse business performance.
Long-run equilibrium	The point where a perfectly competitive market clears, following the conceptual time period in which there are no fixed factors of production when marginal revenue equals marginal costs (equal to average total costs).
Manaakitanga	Behaviour or practise derived from the traditional Māori world view (te ao Māori), that acknowledges the mana of others as having equal or greater importance than one's own, through the expression of hospitality, generosity, and mutual respect.
Market-provided services	Services that are provided at economically significant prices, usually to generate a profit.
Mātauranga	Modern term for the combined knowledge of Māori living in Aotearoa, comprising the te ao Māori indigenous worldview of relationships between people and the natural world. Humans are not seen as superior or external to the natural world but as existing within it. Natural flora and fauna are kin to humankind and all phenomena dwell in an intricate web of relationships and interconnections, all living within 'the woven universe'. The term encompasses language (te reo), education (mātauranga), traditional environmental knowledge (taonga tuku iho, mātauranga o te taiao), traditional knowledge of cultural practice, such as healing and medicines (rongoā), fishing (hī ika) and cultivation (mahinga kai).
Measured sector (MS-16)	The measured sector is the 16 industries included in Statistics New Zealand's standard productivity statistics from 1996 to 2011, covering all predominantly market industries. The measured sector covered 76.7% of New Zealand's GDP in 2019.
Measurement error	The difference between a measured quantity and its true value. It includes random error (naturally occurring errors expected with any experiment) and systematic error (caused by a misspecification that affects all measurements).

Term	Definition
Multifactor productivity (MFP)	<p>The change in output that cannot be attributed to changes in the level of labour or capital input. It captures factors such as advances in knowledge, improvements in management and production techniques, and mismeasurement. MFP is also known as total factor productivity.</p> <p>MFP is widely interpreted as an indicator of technological change. In the short to medium term, MFP estimates are subject to data limitations and assumptions, such as variations in capacity utilisation, economies of scale and scope, reallocation effects of capital and labour, and measurement error.</p>
National accounts	<p>The aggregated indicators of measured economic activity in an economy, guided by the system of national accounts (SNA), the international standard for measures of economic activity, enabling consistency and comparisons across countries.</p>
Nominal (GDP, GNI etc.)	<p>Measurement of output that uses current prices and not adjusted for inflation (cf. "real" GDP etc).</p>
Non-market provided services	<p>Services that are supplied for free or below economically significant prices, typically by governments or non-profit organisations. Health care and social assistance, education and training, and public administration and safety are the three industries with the highest share of non-market provision in New Zealand.</p>
Outputs	<p>Goods and services produced by entities in economy. Technically volume is a combination of both quantity and quality, meaning that output measurement captures economic value.</p>
Primary industries	<p>Statistics New Zealand defines the primary sector to include the following industries: agriculture; forestry; fishing; and mining. The primary sector does not include further processing of raw materials (such as farm products like raw milk and livestock (classified as food and beverage manufacturing), nor moving goods to market (part of distribution services).</p>
Productivity	<p>Productivity measures illustrate how well an entity uses resources (inputs) to produce goods and services (outputs). It is calculated as the ratio of the quantity of output produced to some measure of the quantity of inputs used.</p>
Productivity frontier	<p>The productivity level of an entity (or entities) that has the best possible production practices. The closer to the frontier the higher an entity's productivity.</p>
Production possibility frontier (PPF)	<p>A curve that illustrates the maximum possible output combinations of two products or services an economy can achieve if all resources are fully and efficiently utilised. The curve is used to demonstrate where and in what products an economy reaches its greatest level of productive efficiency. Other products can be imported for consumption via trade with other nations.</p>
Purchasing Power Parity (PPP)	<p>A metric used to compare economic productivity and standards of living between countries by using a common "basket of goods".</p>
Real (GDP, GNI, wages, etc.)	<p>In contrast to nominal value, the "real" value is the measure of value expressed in terms of constant dollar purchasing power. A price index, with the level fixed at 1000 in a base year, is applied to adjust nominal values of a quantity (such as wages or total output produced) to obtain real values.</p>

Term	Definition
Reallocation	The process of resources (labour and capital) and market share shifting between firms or industries. Shifts from low- to high-productivity firms or industries are considered 'productive'.
Recession	Two consecutive quarters of negative gross domestic product (GDP) growth.
Residual error	The quantity remaining after other things have been subtracted or allowed for.
Returns to scale	<p>The quantitative change in output resulting from a proportionate increase in all inputs or a particular input. Returns to scale are of the following three types:</p> <ul style="list-style-type: none"> <li data-bbox="464 752 1394 808">i. Increasing returns to scale (or to a particular input): output increases at a higher rate than the increase in all inputs (or a particular input). <li data-bbox="464 815 1394 871">ii. Diminishing returns to scale (or to a particular input): output increases in a smaller proportion than the increase in all inputs (or a particular input). <li data-bbox="464 878 1394 969">iii. Constant returns to scale (or to a particular input): output increases at the same proportion as the increase in all factors of production (or as the increase in a particular input).
Services industries	Statistics New Zealand defines the service sector includes the following industries from 1978: wholesale trade; retail trade; accommodation and food services; transport, postal, and warehousing; information media and telecommunications; and financial and insurance services. From 1996: rental, hiring and real estate services; professional, scientific, and technical services; administrative and support services; and other services. Service industries now represent approximately two-thirds (65%) of the economy in 2020, compared with about half in the 1970s.
Shift-share analysis	A technique that decomposes sources of productivity by looking at how labour and/or capital has been reallocated. Shift-share analysis shows how much overall productivity growth has resulted from shifts within industries (from low-productivity to high-productivity firms) and how much has resulted from shifts between industries (from low-productivity sectors to high-productivity sectors).
Terms of trade	The ratio of a country's export prices and its import prices, indicating how many units of exports are required to purchase a single unit of imports. Measurements are often recorded in an index for economic monitoring.
Tradeables/ non-tradeables	Tradeable industries are industries that produce goods and services that can be traded across regions and international borders and are exposed to international competition. Non-tradeable industries are industries where output faces no international competition.

