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New Zealand's Productivity Performance: Taking a Broader View

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This analytical note expands on themes covered in the Secretary to the Treasury's speech to the New Zealand Association of Economist (NZAE) Annual Conference in June 2022.[2] Key findings are summarised in the box below.

Key findings

Since the early-2000s, New Zealand's per capita real income has grown faster than its per capita real Gross Domestic Product (GDP) – reflecting a rising terms of trade. This increasing and persistent difference has important implications for the interpretation of New Zealand's economic performance:

- Using historical GDP is likely to understate the income and wellbeing benefits of the changes in economic structure since the early 1990s.
- The income gain arising from a higher terms of trade is greater when policy settings enable resources to move into higher value production.
- The income gain provides more choices, both for consumption and investment.

Nonetheless, labour productivity growth has been the main source of growth in both per capita income and output measures.

New Zealand's measurement of average annual hours worked tends to produce systemically higher results than other OECD countries, many of which utilise a relatively conservative method. As a result, comparing New Zealand internationally can result in overstated differences in hours worked, and understate New Zealand's labour productivity compared to other countries. But neither this effect nor the terms of trade effect restore New Zealand's past productivity or income relativities against high-income OECD comparators.

[1] Thanks to Alexandra Ferguson from Stats NZ for analysis on hours worked.

[2] Caralee McLiesh: https://www.treasury.govt.nz/publications/speech/economic-policy-challenges-ahead

New Zealand is increasingly a service economy. Using trade-in-value added, as opposed to gross exports, indicates the increasing role of services embodied in the exports of primary and manufacturing industries. This finding reinforces the importance of policies that raise the productivity of services – both for the direct effect on the sector but also the indirect effects on export competitiveness.

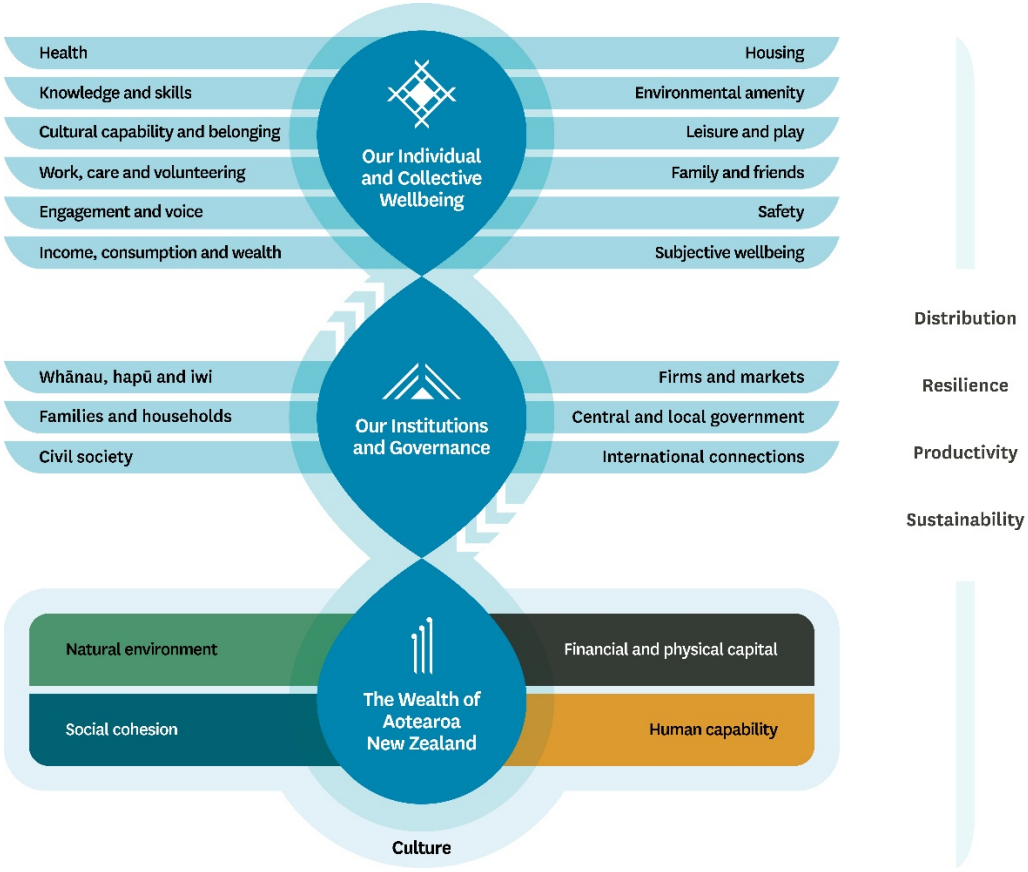
This note indicates areas of possible further research and gaps in the evidence base, including the drivers of changes in the terms of trade and the role of intangible capital in the New Zealand economy. The Treasury is planning further analysis examining the links between productivity, income, and the wellbeing domains of the Living Standards Framework (LSF).

This analytical note is structured as follows. Section one sets out the role of productivity in the Treasury's Living Standards Framework (LSF). Section two briefly describes the key frameworks – growth accounting and firm-level analysis – that are typically used to assess productivity. Both frameworks are evident in Treasury's previous thinking on economic performance, as summarised in Section three. The remining three sections of the note cover the three key findings. The note focuses on trends prior to COVID-19 given the disruption the pandemic will have on productivity, income, and labour measures.

1 Economic performance and the Living Standards Framework

In seeking to understand New Zealand's economic performance and productivity, the Treasury takes a deliberately broad view. We look at performance in terms of a wide range of measures that matter for wellbeing.

Figure 1: The Living Standards Framework



In the LSF shown in Figure 1, economic performance and productivity conceptually encompass all inputs used to produce all outputs that matter for wellbeing.[3] The concept of 'production' is not limited to the formal market economy but includes all institutions within which human activity is organised, including: firms; government; communities; social institutions; families and whānau.

The LSF identifies 12 distinct (though overlapping) domains that are important for New Zealanders' wellbeing. The LSF also identifies *'distribution, resilience, productivity and sustainability'* as analytical prompts that can help us think about how economic policies and systems interact with these domains.

From an LSF perspective, 'economic performance' can be viewed as encompassing activity within all six spheres of 'institutions and governance', and all four analytical prompts. The conventional GDP per hour worked measure of productivity emphasises firm- and market-based production, and the income and consumption domains of wellbeing. This analytical note provides an updated view on productivity and the current structure of the New Zealand economy. As such, it is mainly about the productivity prompt, with a focus on the firms and markets spheres.

While the findings of this note suggest a stronger economic performance than previous assessments, this is not to deny that New Zealand faces a productivity challenge. The gains from a rising terms of trade have provided some offset to the relatively low growth rate of conventionally measured labour productivity, and as such, increased consumption and investment possibilities. However, the findings do not indicate a restoration of past income or productivity relativities. In addition, while the note discusses a new, and wider measure of per capita economic performance (Grimes and Wu, 2021), we consider it important to retain a range of indicators, including conventionally measured labour productivity.

The note examines historical national income gains observed under prevailing settings, including the various other price signals (or lack of price signals) that existed alongside the rising terms of trade. The overall set of price signals has resulted in a reallocation of resources that while rational has also created pressure on natural capital. However, we make no assessment of the net living standards effects. If prices were to change in the future (eg, a wider sectoral application of emissions pricing), then the net reallocation may change.

2 Productivity frameworks

Economy-wide, sectoral, and industry productivity analysis is typically based on a growth accounting framework. In this framework, growth in labour productivity is accounted for by capital deepening – the difference between growth in capital inputs and labour inputs – and growth in multifactor productivity (MFP). The contribution of capital deepening depends on the capital share of income. MFP growth can be equated with technological change only if certain conditions are met (eg, firms seek to maximise profits, markets are competitive, and the coverage of inputs is complete). Measured MFP growth is a residual and will include a range of effects such as: deviations from perfect competition; model misspecification; errors in measurement; adjustment costs; and unobserved changes in capacity utilisation. MFP growth is included as an indicator in the LSF dashboard (under 'firms and markets').

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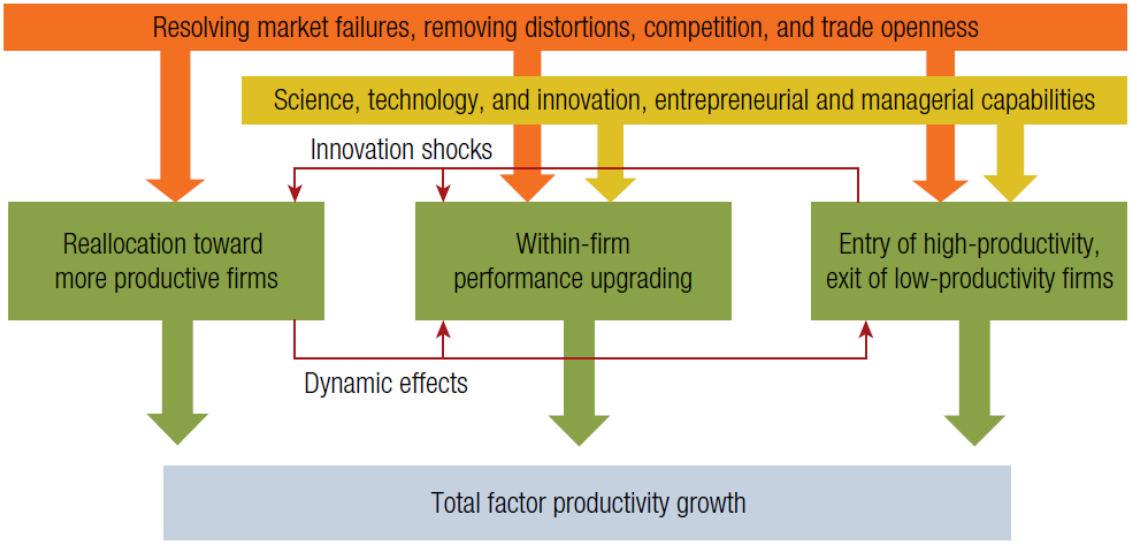
[3] Refer to: https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework.

In terms of firm-level productivity, Figure 2 captures the roles of innovation, diffusion, and reallocation. Similar organising frameworks have been used by the OECD (2015) and adapted for New Zealand by Conway (2016). Relatedly, Syverson (2011) draws a distinction between drivers of productivity that are 'direct/within/internal' to the firm (eg, management, the quality of labour and capital, research and development (R&D), learning-by-doing, product innovation, and firm structure) and drivers that are 'indirect/outside/external' to the firm (eg, spillovers, competition, trade, deregulation, and flexibility of input markets).

Figure 2: A firm-level framework for productivity growth



Source: Cusolito and Maloney (2018)

3 Treasury's previous thinking on economic performance

For most of the last 50 years, Treasury has been focused on the comparative decline in GDP per capita which New Zealand experienced in the post-war years. From the late-1960s to the mid-1990s, real GDP per capita grew in New Zealand, but at a slower rate than in other high-income OECD countries. This period was also characterised by high volatility in growth rates. There were many reasons given for this pattern, but the focus of policy interventions was on addressing:

- The concentration of the economy, (and especially exports) on a narrow range of agricultural commodities. This was associated with an economic theory which argued that because the income elasticity of demand for commodities was low, prices would always fall compared to industrial goods (the so-called 'Prebisch–Singer thesis', see Toye and Toye, 2003).
- There was a key focus on ensuring that unemployment was low, possibly at the risk of low productivity. For example, the public sector was large and undertook a wide range of activities, including telecommunications and electricity production.

The combination of high volatility and the desire to move out of agriculture and into manufacturing during this period led to a centrally directed economy, largely through a combination of import licencing, tariffs, and internal controls. By the mid-1980s the imbalances in the economy reached the point where it became difficult to maintain these settings and a period of far-reaching reforms occurred. These reforms were influenced by the prevailing economic theory about incentives, to expose the economy to market forces.

Since the early 1990s New Zealand has halted its relative GDP per capita decline, but it did not succeed in significantly lifting GDP per capita relative to other high-income countries. This highlighted New Zealand's relatively low productivity growth and increased labour utilisation. In the face of a more stable macro-economy and a more flexible micro-economy, discerning and addressing the productivity issue became ever more important. Over time a set of four possible explanations were identified:

- *Macroeconomic imbalances* – of which at different times the key issues were thought to be the persistently high real exchange rate, the slow growth of the tradables sector relative to non-tradables, the low saving rate and an associated high negative net international investment position.[4]

- *Low capital intensity* – perhaps a result of a persistent interest rate premium, a low domestic saving rate (because home-bias created a shortage of funds available for investing), the skew towards (under-taxed) housing, or the comparatively high off-the-shelf cost of capital goods.

- *New Zealand's small domestic market and distance from other overseas markets* – which limited opportunities to exploit economies of scale and to participate in the rise of Global Value Chains (GVCs).

- *The slow diffusion of productivity-enhancing change* – a result of fewer 'frontier firms' and a larger tail of non-frontier firms. This was variously associated with a lack of investment in knowledge-based capital (KBC), a small labour market with high skill mismatch, and poor or less ambitious management (ie, that all firm owners wanted was a firm that was profitable enough to provide the 'beamer, bach and the boat').

The first three explanations are most closely associated with Treasury's 2014 narrative *Holding On and Letting Go.*[5]

> *There are a range of explanations for New Zealand's poor productivity performance and the underlying causes are contested. While there is a wide range of potential explanations, three main themes emerge from the debate. Each theme emphasises different features of the New Zealand economy, which distinguish it from other advanced economies. One set of arguments emphasises a weakening in the pace of economic policy reform over time and the role of the state sector in restraining economic performance. Another set focuses on the links between New Zealand's lower productivity, high real interest rates and exchange rate, low level of saving and consequential lower level of investment and exports. And a third line of argument focuses on the constraints to New Zealand's economic performance from our small population and distance from international markets. There are merits in all three arguments and they are not mutually exclusive but inter-connected (abridged).*

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[4] The boundary between the tradable and non-tradable sectors is fuzzy. Under common definitions the tradable sector displays a higher *level* of labour productivity (see Bailey and Ford, 2018). Some of this reflects industry structure (eg, the high capital intensity of industries like mining). Although scope for improved productivity in services/non-tradables is acknowledged, economic narratives for New Zealand have emphasised both the productivity levels and growth potential of the tradeable sector, particularly exports.

[5] See: https://www.treasury.govt.nz/sites/default/files/2018-02/holg14.pdf

The fourth, micro-related explanation, is more closely associated with economic narratives prepared by the Productivity Commission (Conway, 2016; 2018; Nolan, Fraser and Conway, 2018). Fabling (2021) summarises several New Zealand firm-based studies that assess the drivers identified by Syverson (2011).

The micro-related explanation has three dimensions in terms of dispersion, convergence, and reallocation (Zheng, Hoang and Pacheco, 2021).[6] First, on average, New Zealand's national frontier firms are approximately five times more productive compared to firms in the bottom 10% of the productivity distribution. This gap is smaller than for a set of selected comparator countries (ie, Belgium, Denmark, Finland, Netherlands and Sweden). This suggests New Zealand has better *within-country* technology diffusion. However, other research places New Zealand's gap closer to the OECD average. Therefore, Zheng *et al* conclude that it is best to view New Zealand's within-country productivity gap as ranging between being somewhat smaller than, and being similar to, the comparator set.

Second, the diffusion process is expensive and difficult to transmit over distance. This is because many international frontier technologies are highly tacit and non-codified, and are not available to all firms. When comparing the productivity convergence exhibited in New Zealand versus the comparator countries, Zheng *et al* find that they both have similar speeds of technology diffusion *within* the country. However, the lack of a statistically significant relationship suggests a breakdown of technology diffusion *from* the comparator frontier to New Zealand.

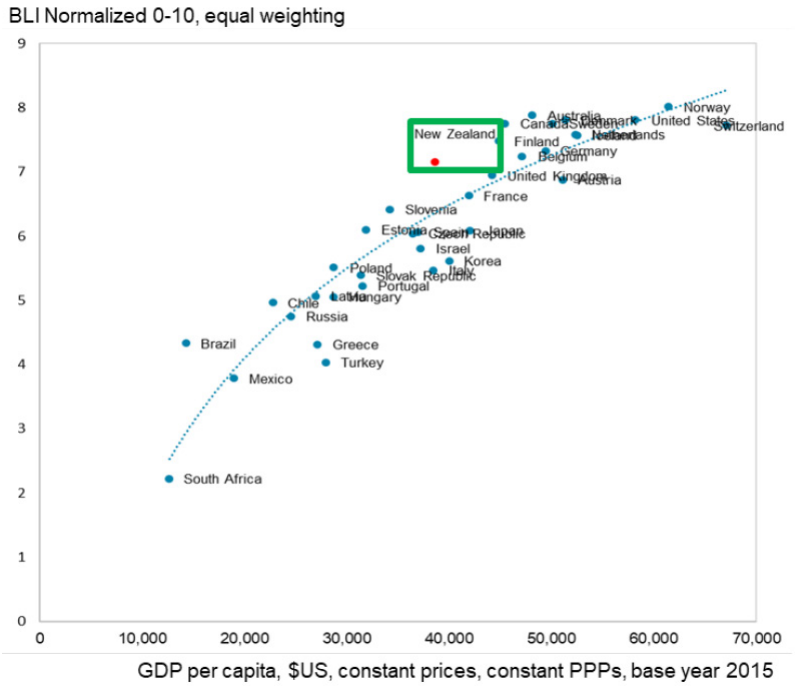
Third, in the European comparator countries, on average, the largest firms (by employment) are in the top productivity decile, the next largest are in the ninth decile, and so on to the bottom decile, which has the smallest firms. In New Zealand the largest firms are in the fifth labour-productivity decile. This result is consistent with the observation that New Zealand has few large, successful, export-orientated firms with high labour productivity. Rather, New Zealand's large firms tend to be middle performers likely serving the domestic market. The least-productive firms in terms of labour productivity still have significant shares of labour in both New Zealand and the European countries. This may reflect sluggish reallocation of resources from some low-productivity firms that survive for a long time (Zheng *et al*, 2021).

[6] One caveat to the Zheng *et al* analysis is that it excludes the agriculture, mining, and financial industries.

4 Key finding one: New Zealand's real income growth

One of the puzzles in Treasury's previous analysis was New Zealand's unexpectedly strong ranking on many wellbeing-type indices, including the Human Development Index (HDI) and the OECD Better Life Index (BLI), in comparison to its relatively lower GDP per capita. For example, using the most recently available data, New Zealand performs better on the BLI (with equal weights across the 11 dimensions) than on GDP per capita, relative to the rest of the OECD, as shown in Figure 3.

Figure 3: Better Life Index and GDP per capita (2017)



Source: OECD Better Life Index

There are 24 indicators in the BLI. The indicator of income in the BLI is household net adjusted disposable income on a per capita, Purchasing Power Parity (PPP) basis. This household income indicator is derived from the System of National Accounts (SNA). It is *net* because it excludes households' consumption of fixed capital on residential housing. It is *adjusted* because it includes social transfers in-kind such as public education and healthcare. It is *disposable* because it is for after-tax labour and capital income, and cash transfers. New Zealand is below the OECD average for this indicator, broadly consistent with its GDP per capita position.[7]

Analysis by the OECD (2016) and Botev, Égert and Turner (2022) indicates a close relationship between household income measures and GDP per capita. However, differences between household income and GDP per capita in real terms may reflect differential movements between consumption and output prices. This is because different

[7] The household income indicator in the LSF dashboard is based on household survey information, thereby allowing distributional analysis. This measure includes most kinds of income except: social transfers in kind; capital gains; and imputed rents for owner-occupiers. For international comparisons, the LSF dashboard uses the OECD BLI national accounts measure of household income.

price indices are used to convert nominal values to real values, respectively the consumption deflator for household income and the GDP deflator for output. These differential price movements reflect various factors, including changes in the terms of trade.

As a result, we have examined the extent to which real GDP misses the income growth resulting from New Zealand's rising terms of trade. A key theme of this perspective is that higher terms of trade can facilitate higher consumption possibilities than otherwise. The BLI dimensions and indicators have no direct measure of household consumption, and as noted, household income is one of 24 indicators.[8] Therefore, New Zealand's relatively high BLI score could reflect:

- That the dimensions where New Zealand scores relatively highly are independent of productivity or income.

- That the income from an elevated terms of trade is being converted into some of the relatively higher scoring BLI dimensions through unmeasured and/or indirect channels. For example, an elevated terms of trade may facilitate (non-BLI measured) household consumption that is generating relatively higher reported life satisfaction.

On this second point, Grimes and Hyland (2020) examine material wellbeing based on households' consumer durables, using household-level data from the OECD's PISA surveys for 40 countries over the period 2000 to 2012. Arthur Grimes argues this analysis shows that New Zealand has high household consumption levels, although it also has high consumption inequality).[9]

The terms of trade and income

Real GDP uses price indices to convert nominal GDP to constant prices and hence volumes. The national accounts measure that captures terms of trade price effects is real Gross Domestic Income (GDI). The key difference between real GDP and real GDI relates to the price index used to deflate nominal GDP – the GDP deflator in the case of the former and something closer to the domestic expenditure deflator for the latter.[10] Real GDP, as a measure of production, values exports as an output and imports as an input. While the choice of price deflator can vary, the aim is to better reflect the international purchasing power of New Zealand's exports. For this reason, real GDI has sometimes been termed *command-basis GDP*. Terms of trade effects are often referred to as trading gains/losses.

Stats NZ publishes a measure of Real Gross National Disposable Income (RGNDI) alongside quarterly real GDP. This measure adjusts for net international investment income, the terms of trade effect, and current net international transfers. The focus of this analytical note is on the terms of trade effect.

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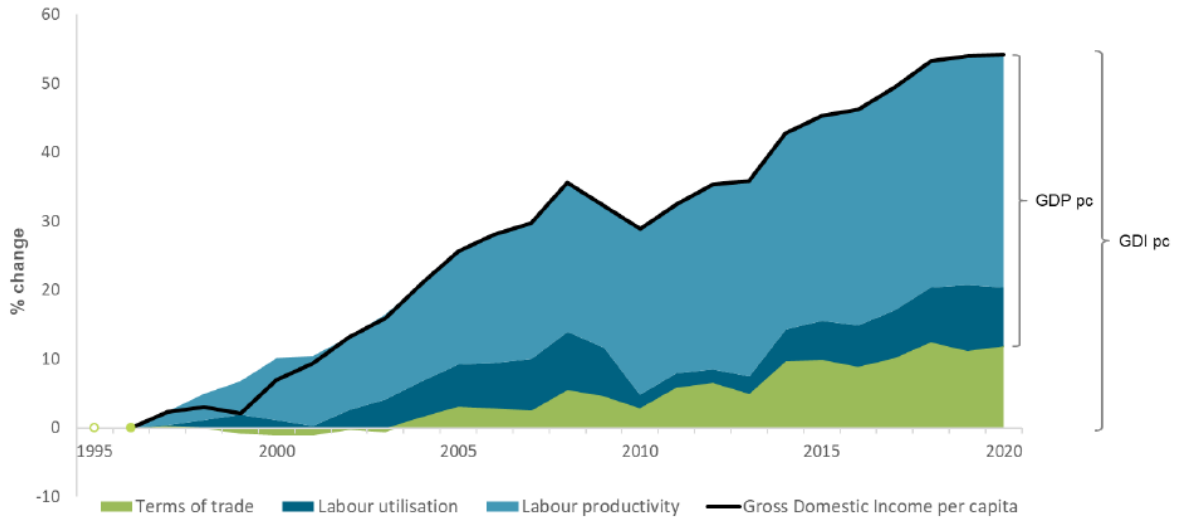
[8] There is a household consumption indicator in the LSF dashboard, but no international comparators.

[9] These points were given more prominence in Arthur's Treasury Guest Lecture (August 2021) compared to Grimes and Wu (2021).

[10] Stohr (2014) notes that in *nominal* terms, GDI is equivalent to GDP and that differences between real GDI and real GDP due to the terms of trade result solely from the deflation procedure. As such, real GDI should not be confused with nominal GDP measured via the income approach (ie, wages and operating surplus).

For most countries, the difference between real GDP and real GDI is small and short-lived. Figure 4 indicates that since the early-2000s, there has been an increasing and persistent difference between per capita real GDP and per capita real GDI for New Zealand. This has been driven largely by increases in export prices. Dairy prices have been a large contributor but there have been price gains across most exports – as well as a change in the composition of imports before the early 2000s and declines in import prices since the Global Financial Crisis.[11] Importantly, Figure 4 indicates that labour productivity is the main source of growth in both of the per capita measures. Increases in labour utilisation (ie, hours per capita) have also played a role.

Figure 4: Sources of growth in New Zealand's real GDP and real GDI per capita

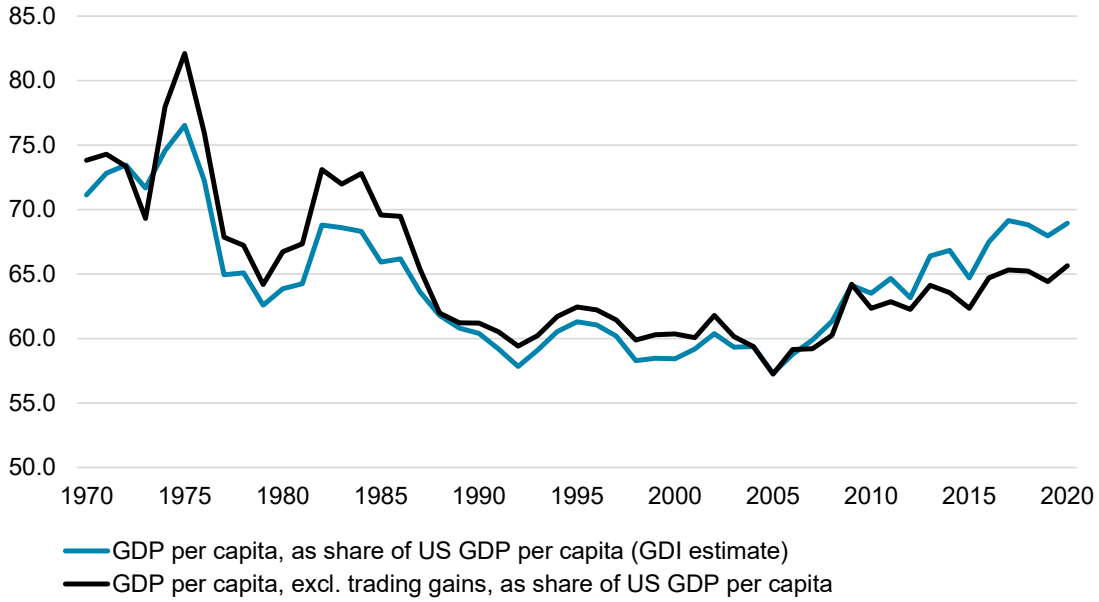


Source: Productivity Commission analysis of Stats NZ data

Although the size and timing of the terms of trade effect depends somewhat on the methodology used, Figure 5 below conveys three main points. First, the weak relative performance of New Zealand's GDP per capita and GDI per capita relative to the United States, which is often considered the global 'frontier' in performance. Second, the modest convergence of per capita GDP (more on this below). And third, the increasing income gains from a rising terms of trade, consistent with Figure 4.

[11] Mellor (2015) finds that capital goods and, to a lesser extent, consumer goods have steadily increased as a share of imports as their deflators have generally declined, while intermediate goods and mineral fuels have done the opposite.

Figure 5: New Zealand's GDP per capita relative to the United States (%)



Note: The OECD use the ratio of NZ/US GDP per capita at current PPP exchange rates to capture trading gains/losses. The OECD apply a separate calculation to exclude trading gains/losses, where the current trade balance is deflated by a single price index, minus real exports, plus real imports. These gains/losses are the difference between real GDI and real GDP. The United States is used as a benchmark because it is often considered to be the productivity leader across a wide range of industries and because there is little difference between values for the United States and the population-weighted upper half of OECD countries.

Source: OECD Economic Survey of New Zealand 2022

Analysis of terms of trade effects on New Zealand's aggregate performance is not new (see Mawson, Carlaw and McLellan, 2003). Ulrich Kohli, a Swiss economist, has analysed them extensively for a range of countries, including New Zealand (Kohli, 2003; 2004; 2014). Kohli (2014) finds that for Australia, New Zealand and Canada, trading gains were an important contributor to real income growth in the period 2000 to 2012. Trading gains were important for Switzerland in the decade 1980 to 1990 and for Norway, in the decade 1990 to 2000. The Australian Productivity Commission (2022) note that on average, during the mining boom, increases in the terms of trade added nearly 1 percentage point to annual growth in Australian GNI per capita in the decade to 2009-10, but just a little over a tenth of a percentage point to the same measure in the following decade, ending in 2019-20.

These earlier estimates of terms of trade effects for New Zealand generally received limited attention, largely because they were made during the early part of the current terms of trade upswing and were likely viewed as temporary.

Technical versus allocative efficiency

Grimes and Wu (2021) argue that the measurement of GDP (and productivity) captures *technical efficiency* (how many widgets are made) and not *allocative efficiency* (are the most valuable widgets being made). This is consistent with the primary example we are of aware where this has happened – to Switzerland in the 1970s and 1980s – where the rise in the terms of trade was a quality rather than a pure price effect (eg, the shift to luxury watches).

The Grimes and Wu distinction between technical and allocative efficiency is somewhat binary. Many reallocation effects will be captured by GDP and can quantified via industry shift-share analysis and firm level dynamic analysis. A more nuanced interpretation is that GDP (and conventional productivity) is *focused* on *technical efficiency* (ie, how many widgets are made) and not on the part of *allocative efficiency* that is associated with changes in the terms of trade that affect real domestic income (ie, are the most valuable widgets being made when taking into account relative external prices). As such, the reallocation effects from external relative price changes can be seen as a sub-set of wider reallocation effects.

While the Grimes and Wu hypothesis does not imply that policies to improve conventional productivity (technical efficiency) are unimportant, it does have important implications for the interpretation of New Zealand's economic performance:

- Using historical GDP is likely to understate the income and wellbeing benefits of the changes in economic structure since the early-1990s.
- The income gain arising from a higher terms of trade is greater when policy settings enable resources to move into higher value production.
- The income gain provides more choices, both for consumption and investment.

Although the income gain is likely to be positive for individual wellbeing, two other effects are relevant:

- *Dynamic efficiency* – past terms of trade growth is not a guarantee for future income growth. The terms of trade could fall, for example if new supply or substitute products come on-stream (eg, New Zealand's experience with wool when synthetics were mass-produced). The fact that the economy has been able to reallocate resources provides some confidence that New Zealand can be resilient to these types of changes.
- *Social efficiency* – or whether externalities as well as private costs and benefits are taken into account in decisions. Improvements in allocative efficiency have resulted in the reallocation of resources within the agricultural sector (see below). While this is a rational response to past price signals it has created considerable pressure on our natural resources, such as water quality and biodiversity, as prices did not reflect externalities.

Understanding these two effects involves a more detailed analysis beyond the aggregate national income gains shown in Figures 4 and 5. Although such analysis is outside the scope of the present note, we have considered some of the evidence and possible further research:

- First, there is evidence of *reallocation within the agricultural sector*. For example, Drought and Mellor (2020) note that around 80 percent of New Zealand's primary sector land is pasture for dairy, beef, and sheep grazing. Although the total share of pasture-based farming has not changed, land used for dairy farming rose by 42 percent between 2002 and 2016 to match international demand, primarily through the conversion of land from sheep and beef farming. The number of dairy cows rose by 50 percent between 1999 and 2012, while sheep and beef cattle numbers fell 32 percent and 20 percent respectively.

- Second, there is some evidence on the relatively large and increasing role of *embodied services value-add in gross exports*, including for New Zealand's primary-related gross exports (see below). While this is suggestive of longer-lasting changes, analysis of the dairy industry indicates considerable variation. Barry and Pattullo (2020) note that several new and innovative firms have entered the dairy industry offering different products, with different business models, and different corporate strategies. Some firms, such as *Open Country Dairy*, have focused on producing and exporting base-ingredient cheese and milk powders. Other firms, such as *The a2 Milk Company* and *Synlait* have developed high-end brands and distribution channels. In contrast, Barry and Pattullo argue that *Fonterra* and *Westland* both attempted to move up the value chain into consumer brands, where this proved too costly, risky and capital intensive for either company to sustain. They conclude that the experience of the dairy industry over the last two decades illustrates that to prosper at a company-level and a national level it is not necessary to move up the so-called 'value chain'.[12]
- Third, a more complete understanding would benefit from an *update of earlier analysis*, including the decomposition of terms of trade changes (ie, Mellor, 2015).

Finally, changes in the terms of trade have a range of general equilibrium impacts on the economy. Steenkamp (2014) provides a fuller (albeit now dated) analysis for New Zealand covering exchange rates, sectoral effects, investment, and wages. An appreciated exchange rate is found to be a key mechanism for distributing some of the terms of trade improvement to consumers as imported goods and services become cheaper. This also tends to shift resources out of some segments of the tradable sector. This can be a helpful part of the adjustment if the terms of trade improvement is long-lasting. Steenkamp finds little evidence that commodity-related sectors placed upward pressure on economy-wide wages, or that there was a sustained boom in commodity-related investment. However, there was considerable reallocation of resources within the agricultural sector. Although overall productivity growth slowed since 2004, the observed structural shifts of resources within the economy associated with the higher terms of trade did not have a clear adverse effect on aggregate productivity growth.

Adjustments over and above the terms of trade

Adjustments for the terms of trade provide a wider perspective on productivity growth. Grimes and Wu (2021) take this further by calculating a measure of 'productivity' defined as the income available for consumption while maintaining the capital stock intact. They start with the World Bank's Adjusted Net National Income (ANNI), which includes three adjustments for: net investment income; depreciation, and resource depletion. The Grimes and Wu adjustment for the terms of trade differs somewhat from that used by others (see Annex).

Because of the positive welfare aspects of work for many (but not all) people, Grimes and Wu consider that measuring outcomes on a *per capita*, rather than on a per employee (or per hours worked) basis, is appropriate and reflects the voluntary choices that individuals make when maximising their own utility. Although this is true for wellbeing, we continue to see merit in employee or hours worked productivity measures derived using GDP.

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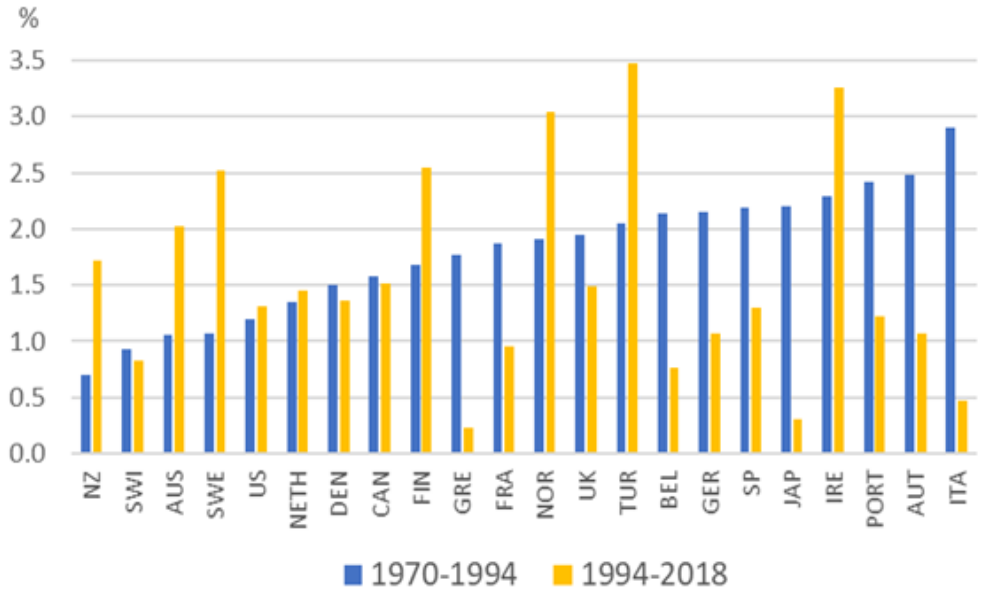
[12] The role of 'adding value' has a long history in the New Zealand economic development debate. See Bollard and McNaughton (1992) for a detailed industry analysis of value add and the role of technology, including an assessment of future prospects as seen from the early 1990s.

Figure 6 below plots per capita real ANNI (*pcRANNI*) growth rates across two sub-periods. The results have the feel of a 'game of two halves' – New Zealand played much better in the second half (1994-2018) where its *growth rate* was 7th out of the 22 countries. But in the first half (1970-1994) the opposition sides had already put lots of points on us.

Figure 6: Real ANNI per capita annual growth rate – 22 countries and two sub-periods



Source: Grimes and Wu (2021)

Grimes and Wu contrast developments in their *pcRANNI* series with per capita real GDP (expressed in PPP terms) over the period 1994-2018. At one extreme, Norway's cumulative growth in *pcRANNI* exceeded its real per capita GDP growth by 70 percentage points over this sub-period. In contrast, Ireland's cumulative *pcRANNI* growth was 66 percentage points lower than its real per capita GDP growth. Australia and New Zealand are ranked 4th and 8th respectively in terms of the deviation between the two measures. Australia's growth in sustainable consumption exceeded growth in its production measure while New Zealand had sustainable consumption growth approximately equal to production. For the majority of countries in the sample, *pcRANNI* grew more slowly than real per capita GDP.

The correlation coefficient between the growth rates of *pcRANNI* and real per capita GDP is 0.78, indicating that developments in a country's consumption possibilities are still related to its production growth. This comparison of *pcRANNI* and real per capita GDP growth rates raises two issues:

- First, analysis that adjusts only for trading gains (eg, OECD, Stats NZ, Kohli) indicates that New Zealand's real GDI per capita growth *exceeded* real GDP per capita growth in the post 1990 period. The Grimes and Wu method is also detecting a positive trading gain. This means that the other three adjustments are bringing New Zealand's *pcRANNI* and real per capita GDP closer together (see Annex).
- Second, Grimes and Wu conclude that when using real per capita GDP to assess productivity growth, New Zealand still ranks highly (6th highest of the 22 countries) over 1994-2018. However, the extent to which real per capita GDP growth is a proxy for labour productivity growth depends on changes in labour utilisation (ie, hours worked per capita). Our second finding (below) indicates an upward bias in hours worked and possibly it's growth rate.

As indicated in Figure 5 above (and Table 1 from Grimes and Wu), in 1970 the NZ/US GDP per capita ratio in current PPPs was around 75%. Neither the OECD levels analysis in Figure 5, nor the Grimes and Wu growth analysis summarised here indicate a restoration of past income relativities. That is, there has not been absolute (re)convergence.

5 Key finding two: Average annual hours worked in New Zealand relative to the OECD

One of the three points illustrated in Figure 5 above is that there has been a modest closure of the per capita output gaps between New Zealand and the United States. The standard explanation is that this reflects New Zealand's relatively high labour utilisation (hours worked per capita) as opposed to labour productivity.[13] High labour utilisation relative to an OECD average reflects New Zealand's relatively high rates of labour force participation and low rate of unemployment (high employment).

OECD analysis of average annual hours worked

The other component of labour utilisation is hours worked and this has been the subject of OECD analysis (Ward, Zinni and Marianna, 2018). In terms of productivity analysis, the 2008 SNA and the *Measuring Productivity OECD Manual* recommend the use of hours actually worked by all persons engaged in production (ie, employees and the self-employed). This measure captures variations in the share of part-time work, absences from work, and changes in normal working hours. Stats NZ defines a part-time worker as people who usually work fewer than 30 hours per week. Prior to COVID-19, around 20% of employed people worked part-time.

There are different ways to compile hours-worked data. The direct method annualises self-reported weekly hours actually-worked, typically sourced from a continuous labour force survey, and ideally for all weeks of the calendar year. The indirect (or component) method starts with data on usual, paid, or contractual hours from labour force and/or business surveys, but with a series of component adjustments applied.

The OECD data for New Zealand uses the direct method, supplied by Stats NZ and derived from the Household Labour Force Survey (HLFS), where *"…the continuous labour force survey sample design should avoid the need for adjustments for public holidays and other days lost".* New Zealand is one of a small number of countries that uses the direct method with no adjustments.

The 2018 OECD analysis argues that weekly *usual hours worked* is the more robust metric from survey data and can be used in a simplified component method. In this method, annual hours worked are calculated by multiplying weekly average (usual) hours by the number of annual weeks worked, where these have been adjusted for known holidays, sick, parental and other leave entitlements. The OECD apply this simplified component method to 26 OECD countries, excluding New Zealand.

[13] For example, Figure 6 in the Productivity Commission's *Productivity by the numbers 2021* compares New Zealand's GDP per capita, GDP hour worked, and hours worked per capita relative to countries in the top half of the OECD in terms of GDP per capita.

Their key finding was that: *"…countries making no adjustments to average hours worked measures extracted from the original source, such as self-reported hours actually worked, appear to systematically over-estimate labour input and, so, under-estimate labour productivity levels"*. For several countries, including the United Kingdom, the effect was in the order of 10%.

As a result, from early 2019, average actual hours worked data are replaced with estimates produced by the OECD using the simplified component method for 10 countries (Austria, Estonia, Finland, Greece, Latvia, Lithuania, Poland, Portugal, Sweden and the United Kingdom). This is intended to be a stop gap until these countries are able to align their estimates with the national accounts framework and correct for self-reporting bias.

The OECD note that the bias in international comparisons of productivity levels does not apply to the OECD comparisons of productivity growth rates. The time series takes average hours actually worked using the simplified component method in 2016 as a benchmark, and projects this forwards and backwards using national productivity growth rates. In this way, by definition, OECD labour productivity growth rates are not affected.

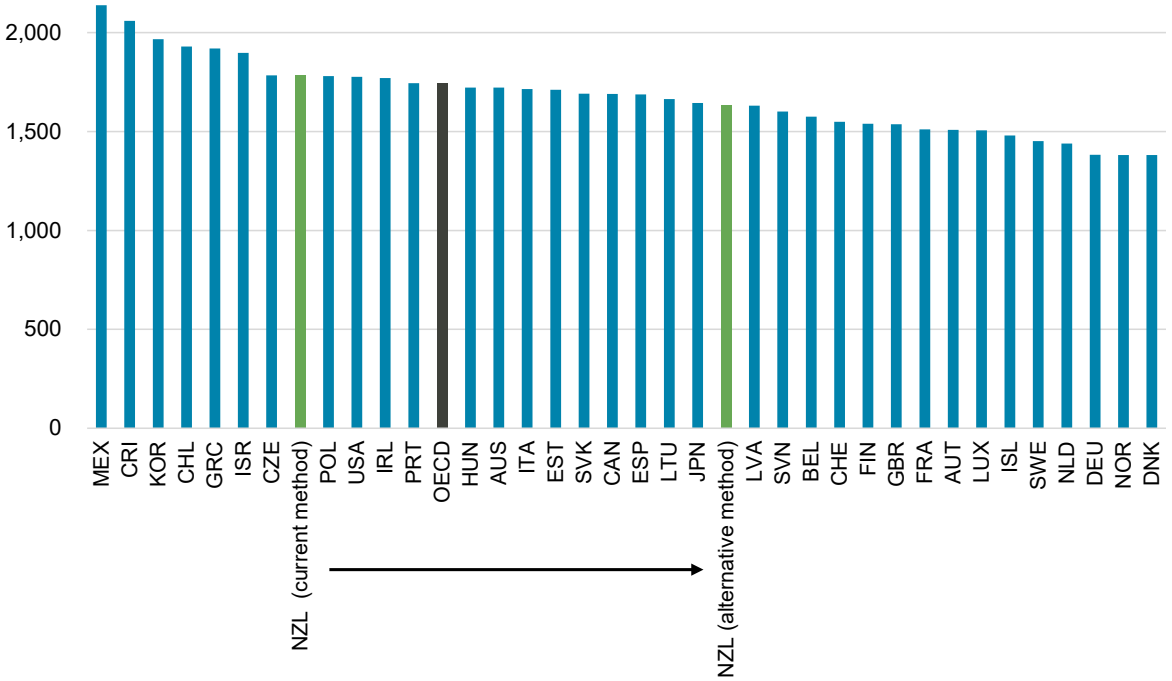
New Zealand analysis of average annual hours worked

In late 2019 the Treasury reviewed the labour productivity growth assumption used in various fiscal projections (The Treasury, 2019). As part of this review, the Treasury calculated a version of the OECD simplified component method for the post-1986 period. While this analysis suggests the difference was relatively small, the discrepancy was increasing over time, rising from about 3% in 1990 to a peak of about 6%. This would imply the growth rate as well as the level of productivity are too low.

Stats NZ have applied the OECD simplified component method for the years 2002 to 2021. This uses a combination of weekly usual hours worked from the HLFS, legislated annual leave and public holidays, and a doubling of HLFS sickness leave to adjust for under reporting. It is not complete replication because parental leave is also doubled by the OCED due to assumed under reporting. However, because it cannot be separated from other forms of family caregiving in the HLFS, it is only included once in the Stats NZ replication.

Figure 7 indicates an almost 10% decrease in shifting from the direct method (1,783 hours) to the simplified method (1,633 hours) in 2019. Stats NZ note that the simplified component approach makes assumptions about local attitudes towards taking leave and there are questions about the reliability of point-in-time measures of sick leave in comparison to those from a rolling quarterly survey like the HLFS. The simplified component approach assumes everyone in New Zealand is entitled to and using the same leave as permanent employees who have been continuously employed for 12 months (ie, assuming the average worker, including self-employed people, unpaid family workers, and contract or temporary workers, took 4 weeks annual leave and 2.2 weeks of public holiday days each year from 2008-2021).

Figure 7: Average annual hours worked per person in employment across the OECD

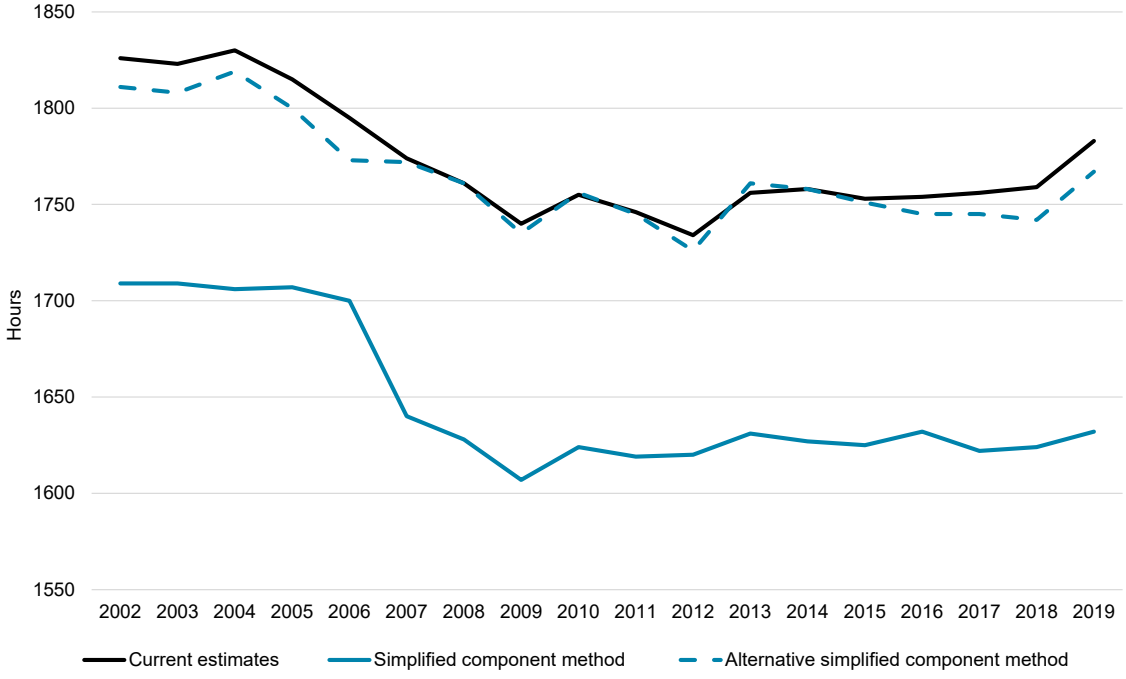


Note: 2019 is used to avoid the effects of the COVID-19 pandemic. For Austria, Estonia, Finland, Greece, Latvia, Lithuania, Poland, Portugal, Sweden and the United Kingdom, average actual hours worked data calculated in each country have been replaced with OECD estimates. For New Zealand, the simplified component method is explained in the main text.

Source: OECD and Stats NZ

Stats NZ have also calculated an alternative simplified component method that uses usual hours worked, together with annual leave, public holidays, and sickness leave as reported in the HLFS, without any adjustments (see Figure 8).

Figure 8: Average annual hours worked – alternative estimates for New Zealand



Source: Stats NZ

This measurement change would not affect overall GDP *per capita*. However, all else equal, it would alter the split in the sources of GDP *per capita* growth, in favour of labour productivity over labour utilisation and would also slightly change New Zealand's labour productivity ranking. All else equal the simplified component method increases New Zealand's labour productivity ranking in the OECD from 22 to 20 in 2019 (current PPP basis). The Treasury is currently working with Stats NZ and the OECD on this issue. Finally, New Zealand's relatively higher score on subjective wellbeing in the OECD BLI may be reflective of a work-life balance that is more consistent actual hours worked calculated under the simplified component approach.

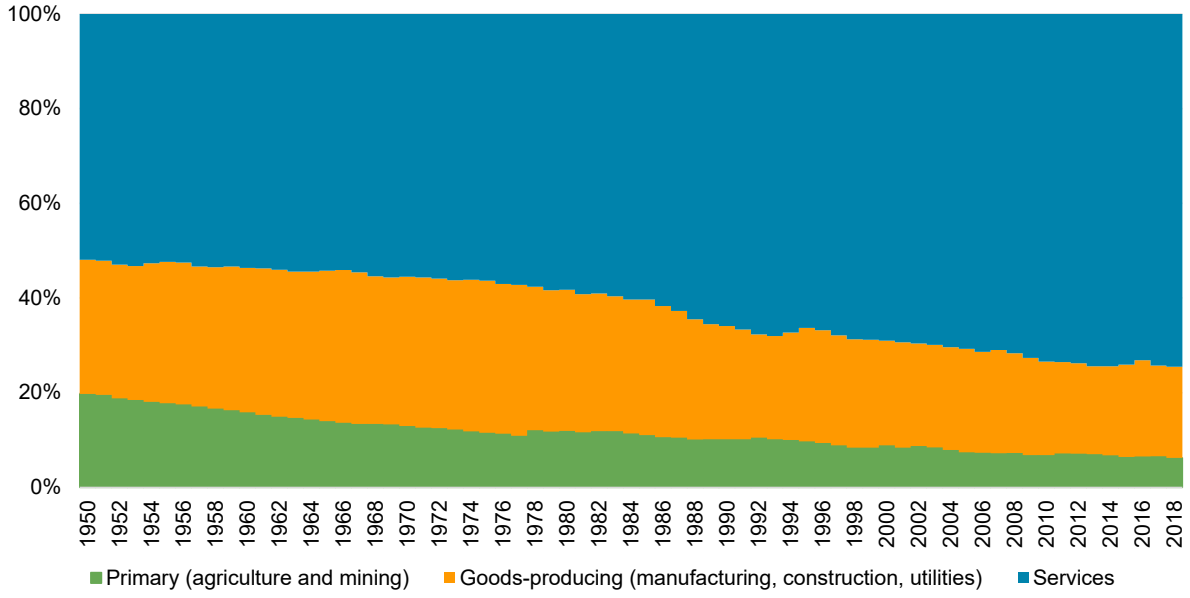
6 Key finding three: Implications of New Zealand being a service economy

In this section we examine the increasing role of services in the New Zealand economy and how this change intersects with two of the four explanations for New Zealand's productivity performance highlighted above, namely exports and capital intensity.

The increasing role of services in the New Zealand economy

Figure 9 indicates the shift in employment towards services in New Zealand and Figure 10 compares industry contributions to value add. New Zealand's services share is broadly in-line with the OECD average although New Zealand has a relatively larger primary sector. Figure 10 also indicates that the service sector comprises a wide range of industries.

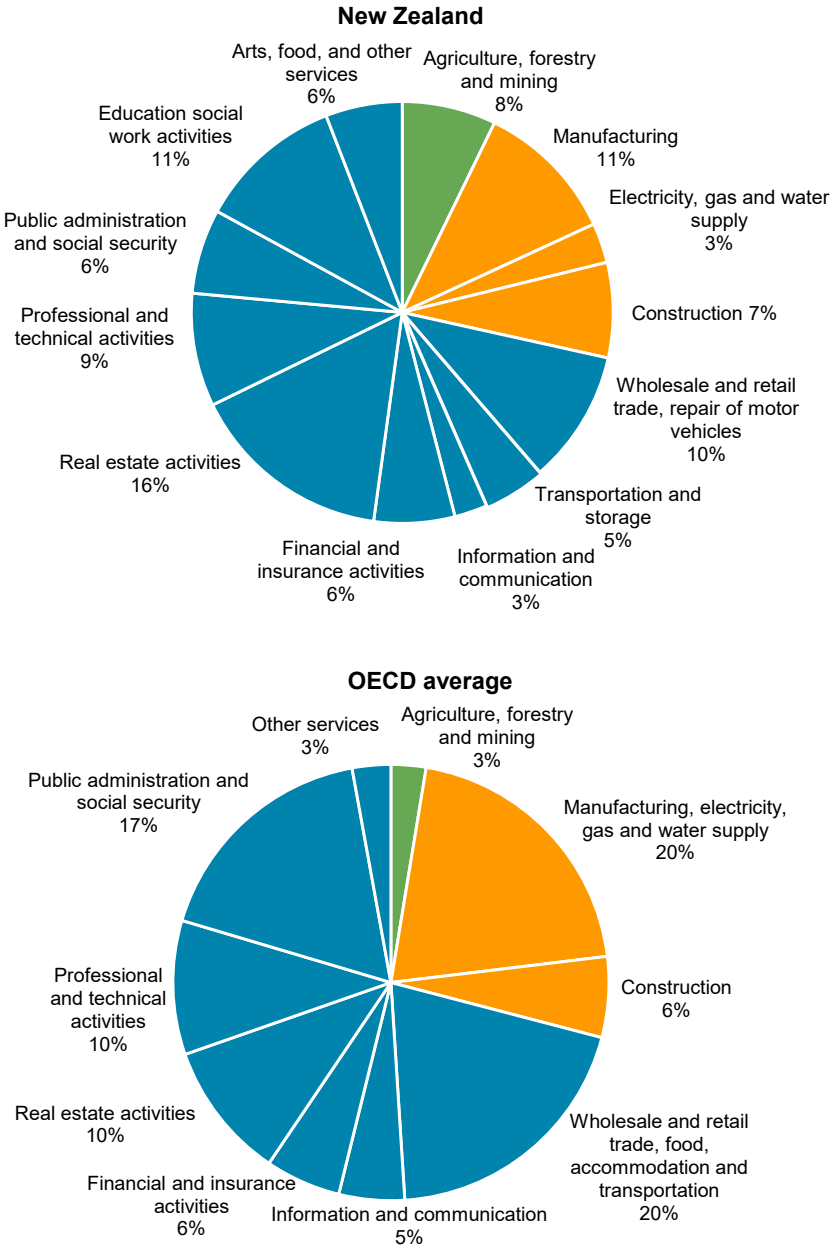
Figure 9: Employment by industry (1950 to 2018)



Note: A similar trend is evident in terms of GDP shares (see Figure 13, *Productivity by the numbers 2021*).

Source: NZIER, *data1850*

Figure 10: Contributions to value add – New Zealand and OECD average



Note: Industries shaded green comprise the primary sector, industries shaded orange comprise the goods-producing sector, and blue indicates services. Differences in *Real estate activities* are partly due to the treatment of owner-occupied housing, some OECD countries do not include it and others measure it differently.

Source: Stats NZ, OECD

There is some evidence that New Zealand made the transition to services earlier than other high-income countries. For example, Handle (2012) finds that the share of the workforce classified as ‘professional’ in New Zealand overtook the ‘production’ workforce share in 1994. This switch occurred in 2002 for Australia, 2007 for the United States, and 2008 for Canada. Although the data for European countries is more problematic, northern European countries transitioned in the early 2000s.

The implications of a growing service sector for economy-wide productivity performance are nuanced. The Australian Productivity Commission (2022) notes two effects. First, as economy-wide productivity increases, higher incomes allow more consumption of services compared with goods because demand for services is relatively responsive to income changes. Second, as productivity growth in goods-producing industries typically exceeds that of the service sector, the relative price of services increases. Because demand for many services is relatively unresponsive to price increases, overall spending on services increases relative to spending on goods. This phenomenon is often referred to as Baumol's 'cost disease' (Baumol, 1967). On the supply side, high productivity growth in some industries generates a shift of labour and other resources to industries with low productivity growth, which grow as a share of the economy overall. This in turn lowers the economy-wide rate of productivity growth. However, the services sector is diverse and cost disease does not affect all component industries. Some economists have argued that these are structural changes and are the expected consequence of rising technology and productivity growth in some sectors of the economy (see Turner, 2018; Vollrath, 2019).

Services embodied in exports

Although international connections are wider than trade, the role of exports is a key theme in many explanations of New Zealand's productivity performance. For example, the Productivity Commission's Frontier Firms report focuses on the importance of exporting specialised products at scale as a key driver of improving the productivity of frontier firms (New Zealand Productivity Commission, 2021). This in turn is likely to improve overall productivity levels through diffusion to non-frontier firms. The report concludes that New Zealand's low trade intensity, lack of diversification in exports, and low participation in global value chains is inhibiting the ability to connect internationally and therefore improve productivity.

Similarly, analysis by Verevis, Cribbens, Mellor and Brunt (2022) examines the characteristics of New Zealand's goods exporting firms, concluding that:

- New Zealand's goods exports are focused on primary-based products, predominantly from the manufacturing and wholesale trade industries. Almost half of all New Zealand's goods exports were to China, Australia, and the United States in 2018.
- Despite making up only 1% of the total number of exporters, large firms (those with more than 250 employees) were responsible for more than two-thirds of goods exports and employed more than half of all employees in goods exporting firms. Over half of exporting firms in the dataset exported to a single market but collectively represented only 4% of total goods exports, whereas only 13% of firms exported to more than five markets but were responsible for 82% of all goods exports.
- Exporting firms can be expected to have higher productivity levels than domestically focussed firms in part because exporting involves significant fixed costs that only larger and already more productive firms can overcome. Exporting allows firms to exploit economies of scale, provides them with greater exposure to competitive pressures, global knowledge and skills, and facilitates greater access to investment. Goods exporting firms had on average 89% higher output-per-worker than non-exporting firms, as well as three times' higher sales, four times' higher capital intensities, and significantly higher intermediate consumption. These differences were more pronounced in large firms, with the average productivity gap between exporters and non-exporters rising to 130% in firms with more than 250 employees.

Although exporting is a differentiating *characteristic* of frontier firms, the causal evidence is linked to other firm characteristics. For example, Fabling and Sanderson (2013) find that the superior productivity of exporters is a selection effect and firms expand on entry into new markets, which is likely to increase aggregate productivity through resource reallocation (see Fabling, 2021).

As noted above, it is possible that the higher export prices driving a rising terms of trade may be indicative of an increasing role of embodied services in goods exports and so reflective of a 'move up the value chain'. Rajanayagam (2016) sets out the evidence on the so-called 'servicification' of New Zealand's exports. Services can be traded directly, or as:

- *Embedded services exports*, which are services bundled with goods, such as customer care.
- *Embodied services exports*, which are services used to produce goods for export, for example communications, transport, energy, R&D, and insurance.

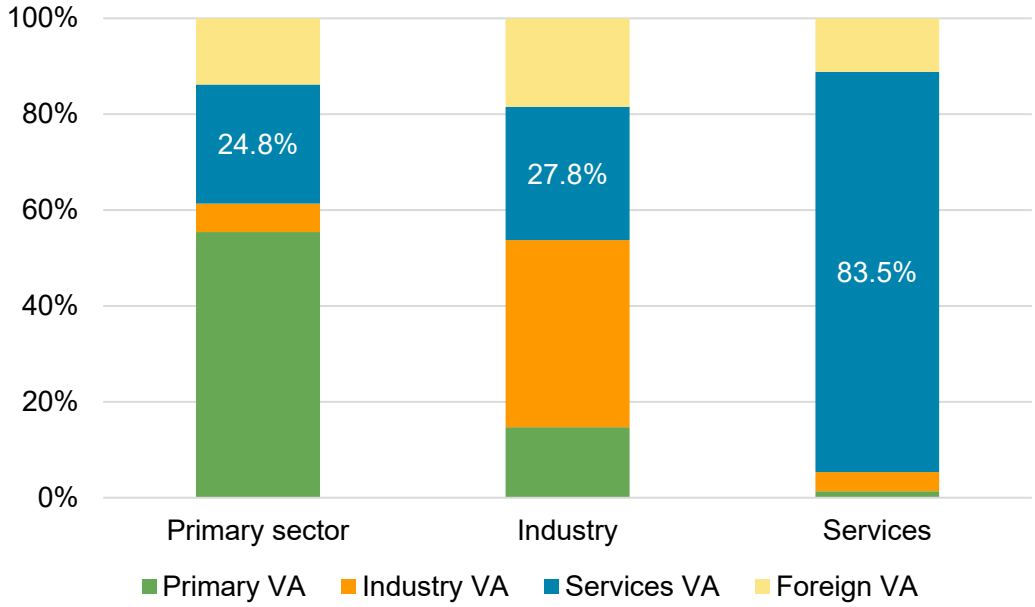
Servicification can involve either domestic sourcing or international sourcing of services inputs. Under the General Agreement on Trade in Services (GATS), Mode 5 is defined as 'domestic intermediate services inputs that are incorporated in a country's merchandise exports'. The other modes are: Mode 1: Cross-border supply; Mode 2: Consumption abroad; Mode 3: Commercial presence abroad; and Mode 4: Presence of natural persons abroad.

Traditionally, data on services trade are drawn from Balance of Payments statistics and typically includes Modes 1, 2 and 4 only. The joint OECD-WTO Trade in Value-added (TiVA) database addresses the statistical shortcomings of gross trade flows (Guilhoto, Webb and Yamano, 2022). The TiVA database measures the value added by each country in the production of goods and services by combining different national input-output tables. One key indicator is the degree to which a *country uses foreign inputs (imported intermediate inputs) in its gross exports* (ie, the intermediate import content of gross exports). The counterpart of this indicator is the domestic value added content of gross exports.

In terms of the services value added content of gross exports, the service industries in the TiVA indicator include: *Construction*; *Wholesale and retail*; *Accommodation and food services*; *Transportation services*; *Information and communications*; *Financial and insurance*; *Real estate; Professional, scientific and technical services; Administrative and support services; Public Administration; Health*; *Education;* and *Personal services.*

Figure 11 shows the share of sector value add embodied in New Zealand's gross exports by sector in 2018.

Figure 11: Sector value add in gross exports by sector (2018, %)



Note: 'Industry' includes mining, manufactures, and utilities. 'Services' includes Construction.

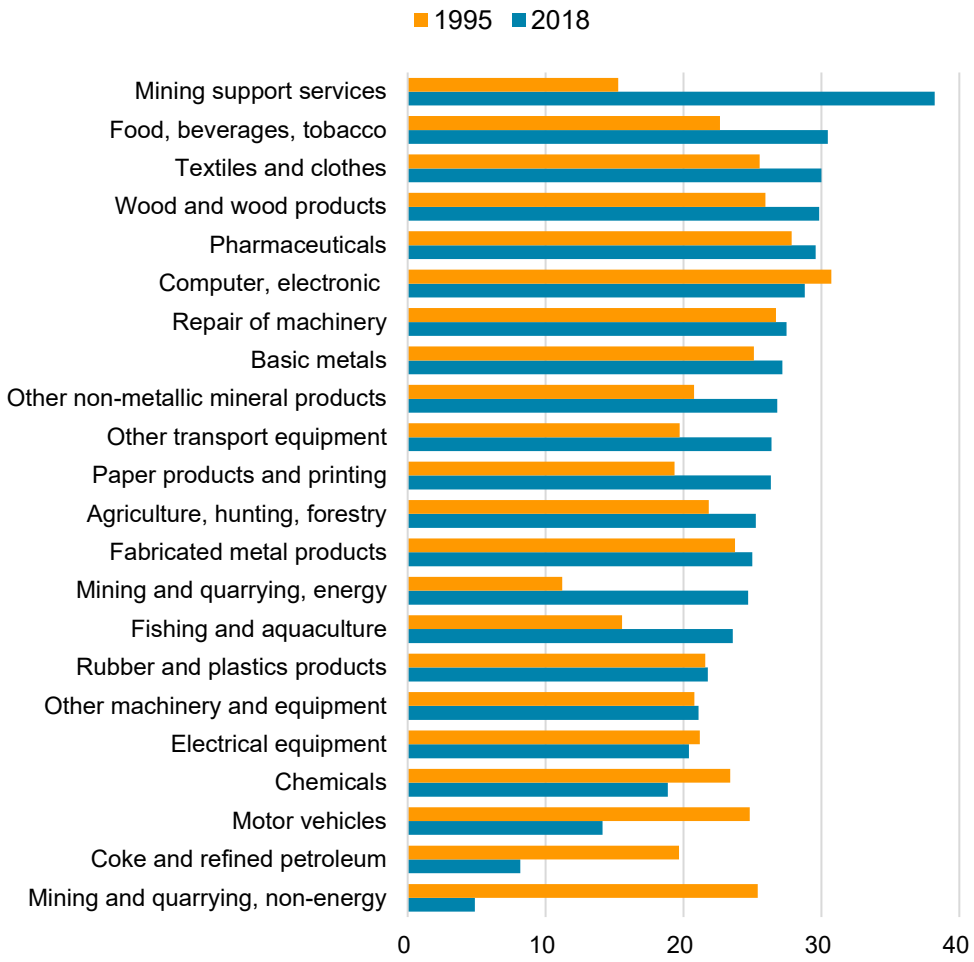
Source: OECD, TiVA database

Around one quarter of Primary sector gross exports are domestic services value add. For the 'Industry' sector, around 28% of gross exports is domestic services value add and just under 20% is foreign value add (only a part of which is foreign *services* value added). As expected, the majority of Service sector gross exports are embodied services value add. Across all exports, the domestic services value added share of gross exports was 43.7% in 1995 and 50.3% in 2018.

We have examined the composition of changes in services embodied in agriculture and manufacturing to assess the extent of any outsourcing of what was previously work internal to the industry. Between 1995 and 2018 there were three industries in the service sector that increased their contribution to the value add of agricultural exports: Other professional services (from 7 to 9%); Financial and insurance services (from 4 to 5%); and Construction (from 0.6 to 1.4%). The rise of embodied service input into manufacturing exports has been widespread, but the areas with the most growth are again in business services. Both outsourcing and new services are likely to have contributed to the increased share of services embodied in gross exports, but the larger proportion is from greater use of services that were more likely to have traditionally been external to the industry.

The Primary sector has a lower *direct* gross export share than manufacturing. This is because a large share of the sectors gross output is an intermediate input into manufacturing (eg, milk into dairy processing). While this increases the *ultimate* exports of the Primary sector it means that a more detailed industry perspective is needed to ascertain the services content of exports. Figure 12 shows the level and change in embodied services in the gross exports of primary and manufacturing industries. Between 1995 and 2018, embodied domestic services generally either remained the same or increased across these industries.

Figure 12: Domestic services content of New Zealand's gross exports, by industry (ranked by 2018 share)



Source: OECD, TiVA database

Rajanayagam (2016) notes that embodied services are both a necessary input into production and a cost. There is an incentive to reduce 'services costs' to improve the return on investment. Embodied services differ from embedded services in the sense that embedded services can be thought of as directly 'adding value' to a good, while embodied services can add value indirectly, but are often simply natural inputs to production (p.12). As a result, access to cost-efficient services inputs (both domestically sourced and imported) can play an important role in enhancing the export competitiveness of primary and manufacturing sectors. Edwards (2012) concludes that reducing services' inefficiencies is a more effective way of improving competitiveness, broadly defined, than a real exchange rate depreciation.

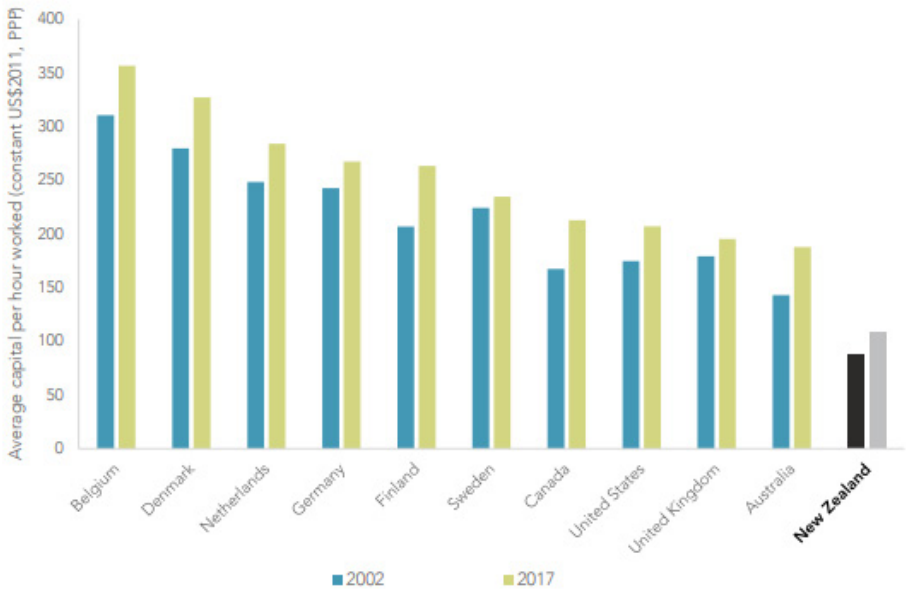
Capital intensity and intangible capital

As shown in Figure 1, the LSF includes financial and physical capital as one category of wealth. This wealth consists of three main subcategories: physical capital; financial capital, and intangible capital, also known as knowledge-based capital (KBC).

Capital intensity is the level of capital per unit of labour, and *capital deepening* refers to the growth of capital relative to the growth of labour. Low capital intensity (or capital shallowness) has been seen as one of the key explanations behind New Zealand's relatively weak labour productivity performance (see Janssen, 2018).

Recent research from the Productivity Commission's Frontier Firms report (New Zealand Productivity Commission, 2021) has shown that New Zealand's capital intensity is lower than selected international comparators (see Figure 13 below), although frontier firms in New Zealand are more capital intensive than non-frontier firms (see Figure 14 below).

Figure 13: Capital intensity – New Zealand and selected countries (2002 and 2017)



Source: Productivity Commission, Groningen Growth and Development Centre.

Figure 14: Key characteristics of New Zealand frontier and non-frontier firms (average 2005-2018)

Firm types	Firm age (years)	Capital intensity ($ of capital services per worker)	Exporter (% of total firms)	Exports (% share of sales)	Foreign Ownership (% of total firms)	Firm size (number of workers)	Value added per worker ($)
Frontier firms	11.8	58 980	17.5	8.4	13.7	24.1	282 635
Non-frontier firms	12.3	31 481	16.3	6.4	6.4	13.8	103 041

Source: Productivity Commission, Fabling (2021).

However, there are issues related to capital intensity that require further consideration.

First, low capital intensity has always been a nuanced explanation given that capital intensity and MFP are linked (see Hall and Scobie, 2005; Dupuy and Beard, 2008). The Australian Productivity Commission (2022) notes that the distinction between capital deepening and MFP is a simplification of a highly complex real-world process. For example, an increase in MFP means the profitability of new capital increases and so businesses invest more, leading to an increase in the capital to labour ratio. In this way, an increase in MFP encourages more capital deepening, making MFP growth a necessary condition for continued labour productivity growth as it pushes out the point of diminishing returns on new capital. Partly for this reason, growth and levels accounting is sometimes specified in terms of the *capital-output* ratio in order to reduce the induced effect of exogenous changes in MFP on capital accumulation and the capital-labour ratio.

Second, because depreciation must be reinvested to maintain living standards, net measures of national income are preferable. Grimes and Wu (2021) conclude that being capital shallow has the advantage, *ceteris paribus*, of having lower rates of depreciation. In their model, a reduction in the depreciation rate has similar effects to a rise in tradable goods prices. World Bank data indicates that New Zealand has a lower average depreciation rate, with around 2.6% of GNI being available for consumption that in the average OECD country would be used on depreciation. The *ceteris paribus* relates to the assumption that the current level of capital intensity is sufficient.

Third, the increasing role of the service sector may change the level and mix of capital. For example, Mason (2013) finds that although some service-sector industries have a relatively high capital intensity (eg, Information media and telecommunications), service-sector industries typically have a lower level of capital intensity. The rate of capital *deepening* in service industries is also typically lower than in primary and good-producing industries, although Retail trade, Information media and telecommunications, and Finance and insurance are exceptions (see Stats NZ measured productivity statistics).

In the SNA, investment is defined as the acquisition of fixed assets undertaken to enhance future production possibilities. According to SNA 1993, this includes physical assets such as machinery, equipment and buildings as well as a limited set of intangibles. In SNA 2008, the investment boundary was extended to also cover R&D. However, this still omits other intangible assets, such as brand equity and organisational capital (see Janssen, 2018).

Both growth and levels accounting indicate an important role for MFP (see Janssen, 2018). Improvements in the ways that firms combine inputs over time *ultimately* derive from the generation and accumulation of knowledge. As Hausmann puts it:

> *Fundamentally, technology is a way to transform 'the world as I found it' into 'the world as I want it to be' – from pastures to milk, from soybeans to chicken tenders, from silicon to smartphones. And it depends on three forms of knowledge:* ***embedded knowledge*** *in tools;* ***codified knowledge*** *in recipes, manuals, and protocols; and* ***tacit knowledge****, or knowhow, in brains.*[14]

With regard to the mix of capital, Haskel and Westlake (2017) investigate the reasons behind the increase in intangible capital relative to tangible capital, which include: the changing balance of manufacturing and services; globalisation; and developments in information technology. In many high-income economies, the service sector is now more intangible-intensive than was the case in the late 1990s. However, Haskel and Westlake also note that intangible investment is important in the manufacturing sector.

Earlier analysis for New Zealand by Crawford, Fabling, Grimes and Bonner (2007) concluded that once the effects of distance, scale, sectoral composition and firm size are accounted for, New Zealand was not a negative outlier for any of the three innovation variables examined (total R&D expenditure per capita; international patents per capita; proportion of total R&D funded by private industry). De Serres, Yashiro and Bouhol (2014) estimated that R&D intensity could account for up to 11 percentage points of New Zealand's 27 percentage point MFP gap with respect to the OECD average. Chappell and Jaffe (2016) examined the

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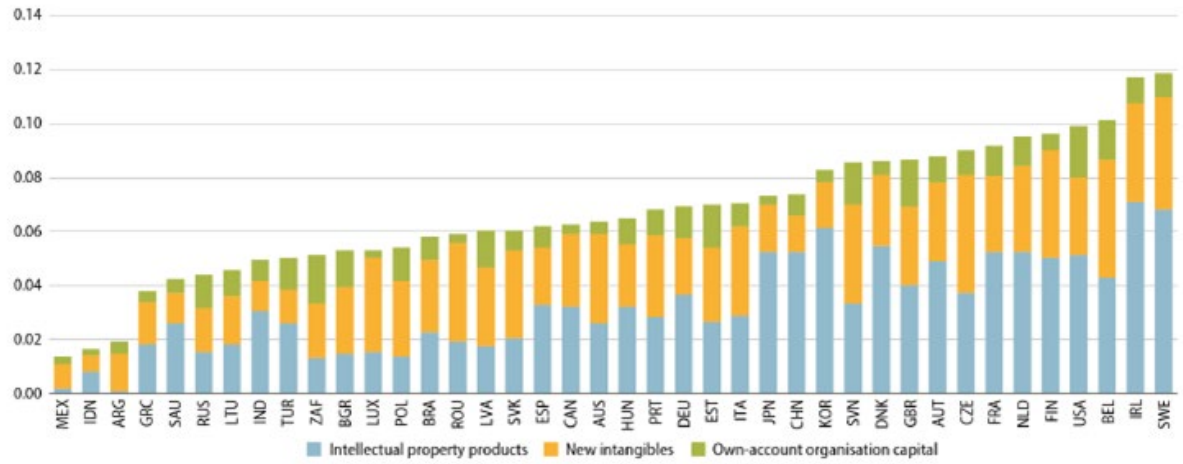
[14] See: https://www.project-syndicate.org/commentary/technology-future-of-work-by-ricardo-hausmann-2017-09

inter-relationships between firm characteristics, intangible investment, and firm performance over the period 2005-2013. Their data on intangibles was sourced from the Business Opinion Survey (BOS). While the survey questions align with the wider set of intangibles (eg, new business strategies; new management techniques; organisational restructuring; design; market research; employee training; and R&D), the survey responses do not measure 'true' intangible investment. While they do not estimate a causal model, their evidence suggests that intangible investment is associated with firm strategies related to growth and possibly to 'soft' performance objectives, but not to productivity or profitability. They caution that the weakness of the results, and their apparent inconsistency with theory, means it is hard to draw strong conclusions. The results may be driven by a (wide) range of factors.

In terms of cross-country evidence, the OECD (2017) found that New Zealand's rate of investment in KBC was just over 3% of GDP in 2015, slightly below the OECD average of around 3.5% of GDP. However, this includes only the national accounts categories and even then the New Zealand SNA does not include all of these.

The measurement of intangible investment at the country level is often constrained due to data availability. The OECD is developing a new methodology to extend its measurement to a wider range of countries (see Demmou and Franco, 2021). The new OECD measures encompass the 2011-2015 period and allow a distinction between investment in 'Intellectual Property Products' (IPP) from other types of intangible investment such as 'Design, Brand Equity and Purchased Organisational Capital' as well as 'Own Account Organisational Capital'. New Zealand is not included.

Figure 15: Intangible assets gross fixed capital formation OECD intangibles (2011-2015 average)



Note: The top panel shows the variation across countries of intangible assets' gross fixed capital formation (and its components) as a share of value added. Intangible assets' gross fixed capital formation is computed using a combination of data sources and a novel methodology described in Annex A; due to data availability, the training component of intangible investment is excluded. The bottom panel shows the evolution of intangible gross fixed capital formation as a share of value added for the United States and the European Union, using INTAN-Invest data and following the methodology proposed by Corrado et al. (2016). All the variables employed to build the ratios of interest are measured in constant 2015 prices.

Source: Demmou and Franco (2021).

Annex: The Grimes and Wu (2021) measure

The Grimes and Wu (2021) approach is summarised in the following equation:

$$pcRANNI_{it} = \frac{ANNI_{it} * ExchRate_{it}}{Population_{it} * CPI_{it}}$$

where:

- $ANNIit$ is the World Bank's series for country i's Adjusted Net National Income in current USD
- $ExchRateit$ is the nominal exchange rate for country i relative to the USD (which converts ANNI into domestic currency)
- $Populationit$ is country i's population, which converts the measure into per capita (*pc*) terms
- $CPIit$ is country i's consumer price index, which converts the measure into constant dollars.

There are three aspects of this approach that differ from the OECD analysis of TOT effects.

First, whereas the OECD focus on current PPPs as a way of incorporating TOT effects in a levels sense, Grimes and Wu convert ANNI in **current USD** to domestic currency using the nominal exchange rate rather than the current PPP.

The second difference is around the use of the CPI:

Traditionally, a measure such as GDP uses a different deflator to the CPI because it is a measure of production so has different weights to a consumer price measure. In our case, $pcRANNIit$ is designed to be a measure of real income available for consumption of a nation's residents once depreciation and resource depletion are accounted for. ***Since all this income is available for consumption (while holding the capital stock intact) a relevant measure of prices is country i's Consumer Price Index.***

The use of the CPI as a proxy for the domestic absorption deflator is subject to debate.

Third, the paper is focused on growth rates and not levels:

The resulting $pcRANNIit$ series does not take account of level differences in purchasing power across countries so is not a purchasing power parity (PPP) series. It does, however, account for changes in purchasing power over time within countries by virtue of using each country's CPI. Consequently, in the following analysis, we look only at changes in $pcRANNIit$ rather than comparing levels.

Using both OECD and World Bank data, we have decomposed, for New Zealand, the components of the Grimes and Wu measure over the period 1988 to 2019. The key results from this analysis are that:

- The difference between GDP and GNI – *net international investment income* – is negative and so GNI is lower, with the reduction fluctuating over time, peaking at just under 7% of GDP in 2006.

- The adjustment that generates the largest difference between GNI and ANNI is *consumption of fixed capital*. The net measure is below GDP although depreciation has been slowly declining since the early 1980s, from about 17% of GNI to just under 15%.

- All of the *resource depletion* adjustments are less than 1% of GNI, other than energy depletion which was high for a short period around 2010. Energy depletion has a trend upwards until 2010 which has offset some of the decline in the consumption of fixed capital.

- There is almost no adjustment for forest depletion (which is consistent with the trend towards a higher percentage of forested land). Although the World Bank includes the depletion of fisheries, the New Zealand value is consistently zero.

- As expected, using the CPI rather than the GDP deflator increases real ANNI, by around 13%. This adjustment displays a U-shape, declining over the 1988-2012 period, and then rising again. This is broadly consistent with the path of the terms of trade. Using the market exchange rate rather the PPP exchange rate creates an average 8.2% increase in real ANNI, but this varies from year to year.

For New Zealand, we have also applied the exchange rate and CPI steps to a measure of World Bank *GDP* per capita in current USD. This allows us to isolate the role of the bespoke terms of trade adjustment. Comparing this series to real GDP per capita (in New Zealand dollars) indicates a rising trading gain. However, the extent of the gain is sensitive to the choice of time period and differs to the approaches discussed above (ie, OECD, Stats NZ, Kohli) because of differences in the currency conversion and deflator.

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