THE TREASURY
Kaitohutohu Kaupapa Rawa

The Start of a Conversation on the Value of New Zealand's Financial/Physical Capital

John Janssen

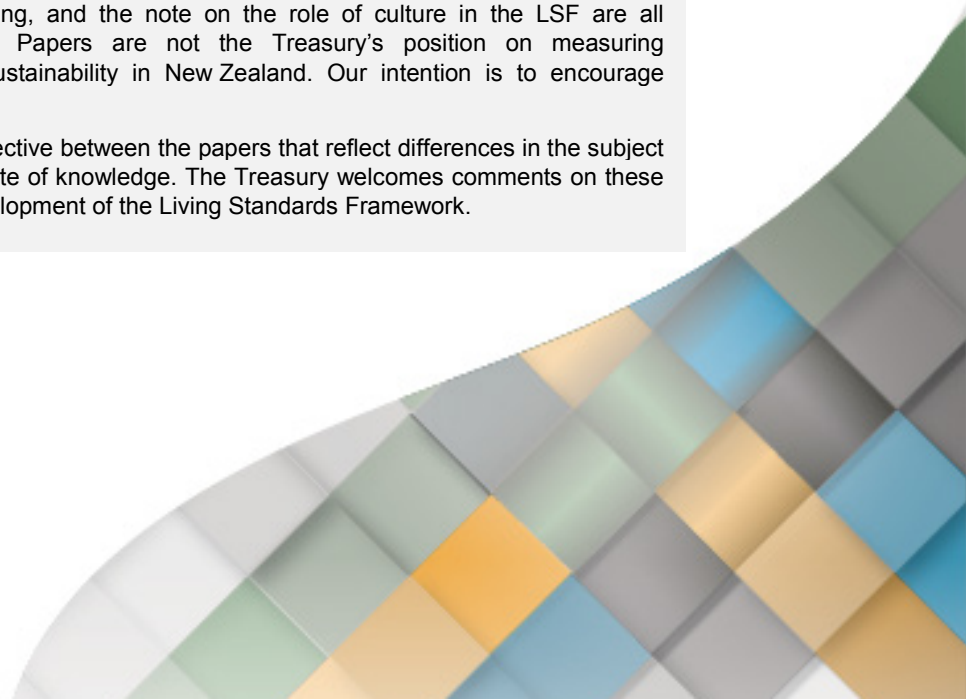
Living Standards Series: Discussion Paper 18/07

July 2018

DISCLAIMER

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

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



New Zealand Government

LIVING STANDARDS SERIES: DISCUSSION PAPER 18/07

The Start of a Conversation on the Value of New Zealand's Financial/Physical Capital

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Summary

This discussion paper adds to the set of Living Standards Discussion Papers released in February 2018. Compared to the capitals covered in the February papers – human, natural and social – financial/physical capital is relatively more straight-forward given existing measurement frameworks such as the national accounts. The objective of the paper is to explain and assess the various indicators of financial/physical capital for the purposes of a *Living Standards Dashboard*.

The paper looks at alternative definitions of financial and physical capital, the gaps relative to indicators proposed by the Organisation for Economic Cooperation and Development (OECD), and the measurement of capital. The most appropriate measure of capital depends on the purpose of the analysis, the required coverage, and the availability of data. For example, the capital measures used in a national balance sheet are not the same as the measures used in the analysis of productivity.

The paper provides detail on the potential indicators for a dashboard using two broad perspectives. First, aggregate balance sheet information is part of the full suite of national accounts and helps relate economic growth to the accumulation of assets and how shocks affect the economy. A theme of the OECD and Treasury frameworks is that the capitals contribute in various ways to wellbeing. So the second perspective relates financial/physical capital to the production of goods and services and hence material living standards. The paper assesses the relevance and reliability of alternative indicators for New Zealand. From the balance sheet perspective we note the distribution of household net worth and the asset base of the Māori economy and Pacific peoples. From the economic growth perspective we note the important role of productivity.

The paper acknowledges the increasing role of intangible capital and challenges around output measurement. These challenges have motivated calls for amendments to existing measurement frameworks and/or placing more weight on a set of capital stocks. The applicability of these measurement challenges to New Zealand is still to be fully assessed. By design, the Treasury's Living Standards approach considers a wide range of capitals. The extent to which the national accounts should be expanded to include a wider set of capitals would need to assess the primary purpose of the accounts, and whether estimates like Gross Domestic Product (GDP) would be affected.

Information from the New Zealand national accounts and other sources suggests it is feasible to generate the OECD indicators for this capital. However, the analysis in Smith (2018) and this discussion paper concludes that a somewhat different set of financial/physical capital indicators is appropriate for the *Living Standards Dashboard*. The proposed set is drawn from the national accounts and includes: aggregate household net worth; the net international investment position; fixed and intangible assets; investment, including in research and development (R&D); and multifactor productivity.

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Part 1 – Introduction

> *Capital (I am not the first to discover) is a very large subject, with many aspects; wherever one starts it is hard to bring more than a few of them into view. It is just as if one were making pictures of a building; though it is the same building it looks quite different from different angles.*
>
> John Hicks, *Capital and Time: A Neo-Austrian Theory*, Clarendon Press, Oxford, 1973 (page v)
>
> *But the little yellow digger stayed to finish off the drain. It helped to make a driveway that would stay hard in the rain.*
>
> Betty and Alan Gilderdale, *The Little Yellow Digger*, Ashton Scholastic, 1993 edition (page 30)

The first quote was made by an authority on capital. The second is from a popular New Zealand children's book that provides an early introduction to the importance of physical capital. The two quotes are related in that the measurement of capital needs to allow for the fact that not all diggers are created equal. And diggers are different from trucks. Hicks' analogy about the different perspectives on capital is a central theme of this discussion paper. The most appropriate measure of capital depends on the purpose of the analysis, the required coverage, and the availability of data. For example, the capital measures in a national balance sheet are not the same as measures used in productivity analysis. In addition, since the Hicks quote, the relative role of physical capital compared to other forms of capital has changed.

The present paper adds to the set of Living Standards Discussion Papers released in February 2018.[1] Compared to the capitals discussed in the February papers – human, natural, and social – financial/physical capital is relatively more straight-forward given the advanced development of GDP and other information. The System of National Accounts (SNA), of which GDP is a part, is the framework that is utilised for this capital. However, although relatively more advanced, there are still a number of issues and questions regarding the measurement of financial/physical capital.

Financial and physical capital plays various roles in the living standards approach. Physical capital includes the buildings, machines, and equipment that contribute to the production of the goods and services that support people's material living conditions. Some goods, such as private cars and household appliances are classified as consumer durables and typically excluded from statistical measures of physical capital. This is because they are not used in market-based production but rather, by households directly (see Part 2).[2] Land-related assets feature in natural capital and also play a role in the New Zealand economy.

Housing is a major contributor to current wellbeing. Three of the current well-being indicators used by the OECD relate to housing and it is the dominant asset in household net worth. The financial assets of households provide resilience to unexpected life events as well as income for retirement.

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1 See https://treasury.govt.nz/information-and-services/nz-economy/living-standards/most-recent-papers

2 More generally, cars can contribute to measured sector activity (ie, taxis and rentals). And technology is changing the boundaries and utilisation of these assets (eg, Uber for cars, Airbnb for housing).

The Government's own physical capital stock in schools, roads, and hospitals delivers public services and supports the wider capital stock in generating GDP. The Government's net financial assets provide a buffer to the economic cycle and shocks, and partially prefund some future expenses (eg, New Zealand Superannuation).

The OECD (2015) uses a wide definition of "economic capital" that includes intangible assets such as knowledge-based capital (see Table 1 below). This definition is consistent with what is used in the national accounts.

Table 1 – Indicators of OECD economic capital

Indicators relevant to both current and future well-being	Indicators of the "stock" of capital	"Flow" indicators (investment in, and depletion of, capital stocks)	Other risk factors
Net wealth of households	Net fixed assets per capita	Gross fixed capital formation	Indebtedness of the private (household) sector
Net financial wealth of households	Knowledge capital per capita	Investment in R&D	Financial net worth of general government
	Financial net worth of the total economy per capita		Leverage of the banking sector

Source: Adapted from OECD (2015) Table 3.1, Box 2.1 (for the two indicators in the first column), and Box 3.5 (for the illustrative indicators in the remaining columns).

The objective of this discussion paper is to explain and assess various indicators for the purposes of a *Living Standards Dashboard*. The paper does not provide:

- extensive detail on methodology
- a detailed narrative around trends in the indicators
- a comprehensive assessment of the challenges and opportunities associated with financial/physical capital.

Part 2 of the paper looks at alternative definitions of financial and physical capital, the gaps relative to the indicators in Table 1 and the measurement of capital.

Parts 3 and 4 provide more detail on the potential indicators and the New Zealand evidence using two broad perspectives. First, Part 3 takes a balance sheet perspective. Aggregate balance sheet information is part of the full suite of national accounts and helps relate economic growth to the accumulation of assets and how shocks affect the productive economy (Statistics New Zealand, 2017). Second, Part 4 takes an economic growth and productivity perspective, which links more closely to the generation of goods and services. This part includes a consideration of knowledge-based capital. In both parts we assess the relevance and reliability of alternative indicators for New Zealand. For example, in the balance sheet part we note the distribution of household net worth. In Part 4 we note the importance of productivity in explaining the growth in the flow of goods and services.

Part 5 concludes by revisiting the OECD illustrative indicators and proposing a set of indicators for a *Living Standards Dashboard*.

Part 2 – Definitions and measurement

Definitions of capital

The Treasury Living Standards papers released in February advocate the use of the wellbeing framework developed by the OECD, with adaptations and extensions for the New Zealand circumstance. The OECD framework defines economic capital as follows:

> *Economic capital plays a direct role in supporting people's material living conditions (eg, housing, jobs and earnings) and a much wider role in determining the goods and services that people can afford to consume in pursuit of their well-being today and in the future. Crucially, economic capital also provides a store of value, providing a buffer against income shocks and enabling people, firms and governments to plan for the future. Economic capital refers to both* ***produced capital*** *(tangible assets, such as buildings, machinery, transport infrastructure, inventories; knowledge assets, such as computer software, capitalised research and development (R&D) outputs, and entertainment, literary and artistic originals); and* ***financial capital*** *(which can include various financial assets such as currency and deposits, and liabilities in the form of loans and debt securities, and which may represent claims on produced* capital). (OECD, 2015, p. 129)

There are alternative frameworks and definitions for capital. For example, Hamilton and Hepburn (2014) propose a six capitals framework (bolded text indicates those capitals most relevant to this discussion paper):[3]

(i) ***physical or produced capital***, which includes physical infrastructure, buildings, machinery and so on
(ii) *human capital*, which incorporates the education and stock of knowledge embodied in human beings within a country
(iii) *natural capital*, which includes the underground assets (minerals, fossil fuels), commercial land, fish stocks and natural land including the ecosystem services that it provides
(iv) ***intellectual property***, which includes the value of contracts, leases, patents, software, databases and other intangible property
(v) *social/institutional capital* incorporates intangible factors such as the quality of institutions, the rule of law and various forms of social capital that enable goods and services to be produced
(vi) ***net financial assets***, the measure of the net holdings of financial assets across national borders. Within national borders, financial assets and liabilities cancel.

In terms of the Living Standards framework and Dashboard, Smith (2018) makes the following recommendations regarding financial and physical capital:

- Change "physical and financial capital" to "produced capital" to cover a wider class of assets such as **intangibles**.

- Retain indicators such as net fixed assets per capita and household net worth (for distributional analysis). But also include an expanded definition of net assets that includes **consumer durables**.

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3 See also: http://integratedreporting.org/resource/international-ir-framework/

- Although conventional economic growth models are relatively narrow, the "economic production process" is a missing element in both the OECD and Treasury frameworks. The efficiency of the capitals and not just their levels is important. As a result, Smith argues for a consideration of **multifactor productivity**.

- Because domestic assets and liabilities cancel each other out, it is important to consider the **net foreign asset position** with respect to the rest of the world. This indicates the degree to which New Zealand has a claim over other countries' capital stocks or other countries have a claim on New Zealand's capital stocks.

Smith argues against the inclusion of knowledge-based capital as a fifth capital because it is difficult to measure, with much of it being freely available. As such, most knowledge capital is not owned, and is essentially a public good. Where knowledge capital is not a public good it is already reflected either as an element of produced capital (intellectual property) or embodied in a person's skills and knowledge (human capital) (Smith, 2018, p. 34). Nonetheless, intangible assets such as "brands" are measured and used in decision-making. For some businesses, a comparison of net tangible assets and share market capitalisation (where the difference can be assumed to be intangibles) indicates that intangibles can be significant.

Consumer durables, such as private cars, provide consumption services over a long period and also act as a store of value. The purchase of a private car would be reflected in household consumption expenditure. The difference is in the timing of when the contribution to material living standards is recorded as being received rather than it not being captured. The timing of the contribution to living standards changes in switching from household consumption to a capital treatment. Statistics New Zealand has suggested that the inclusion of consumer durables could provide a step towards an improved understanding of the contribution of consumer surplus to wellbeing. For example, developments in the digital economy such as "free" online services might be a factor behind differences in measured productivity and the experience of technological change in people's personal lives (see Part 4 below). The SNA framework, while providing the basis for most capital indicators in this paper, does not cover consumer surplus. Although the consumer surplus perspective is wider than just consumer durables, durables would likely be an important input.

Smith's notion of multifactor productivity emphasises the efficiency of all the capital stocks in relation to flows of consumption, both market and non-market. But even for produced capital, existing analytical and measurement frameworks face challenges and choices. For example, non-market assets in schools, roads and hospitals contribute to wider living standards. However, because of measurement challenges, productivity analysis often focuses on narrower definitions of output and capital, with the role of other assets subsumed elsewhere (ie, in multifactor productivity).

Overall, for this discussion paper we retain the terminology of "financial/physical" capital rather than "economic" or "produced" capital. This is in part because of the links to risk and resilience (see below). The paper includes a wide set of produced assets, including intangibles in Part 4. The February Treasury paper argued that having intangibles included somewhere was more important than which specific capital it was grouped under. The paper also discusses the role of multifactor productivity, albeit in a narrower sense than Smith (2018), and the net foreign asset position.

In terms of actual financial/physical capital indicators, the OECD *How's Life?* indicators listed in Table 1 provide "a starter for ten". In the November 2017 release of the Better Life Initiative (BLI), "Household net wealth" replaces "Household net financial wealth". We consider both measures because the data are available. In some cases the BLI uses slightly different labels for the indicators. For consistency we generally retain the terms used in Table 1.

The OECD (2015) acknowledges that:

- The indicators in Table 1 do not comprehensively represent the complete picture of economic capital, nor financial or economic stability, and that there are important gaps in the data, largely caused by limitations in data availability. The OECD also notes that in order to allow for a holistic analysis of financial or economy stability, a much greater set of indicators would need to be adopted, which take into account a variety of flow and risk factors.

- Economic capital, like the other three capitals, is heterogeneous, which makes their measurement challenging. It is difficult to settle on a set of illustrative indicators for each capital because there is a choice between indicators that measure current wellbeing outcomes and those that allow monitoring of wellbeing outcomes in the future. However, there is also significant potential for the indicators to overlap so that the same indicators that are used for monitoring current well-being also inform well-being over time.

The OECD indicators draw extensively on SNA information. The most recent OECD reporting for New Zealand includes three of the indicators in Table 1: household net wealth; gross fixed capital formation; and investment in R&D. The accompanying note states there are no data available on produced assets, financial net worth of the total economy, intellectual property, household debt, financial net worth of the government and banking sector leverage. In contrast, the OECD reports nine indicators for Australia.[4]

Despite the small number of economic capital indicators that are included in *How's Life in New Zealand?* there appears to be sufficient domestically produced data to fill the gaps. The absence of New Zealand data is in part owing to government agencies not being able to provide accurate data by the time the OECD report was compiled. Statistics New Zealand considers that future OECD questionnaires are likely to capture these data, although perhaps not to the same extent as the Australian case. Statistics New Zealand expects its Annual Balance Sheets, first produced in 2017, to feed into future OECD reports. These estimates will have some historic coverage, starting from March 2007.

4 See www.oecd.org/statistics/Better-Life-Initiative-2017-country-notes-data.xlsx

Measures of capital

The detailed methodology around the calculation of capital stocks is beyond the scope of this discussion paper (see OECD 2017a; Schreyer, 2005; Statistics New Zealand, 2014a). Statistics New Zealand suggests that the development of capital stock measures for the New Zealand economy was motivated by two different facets of economic analysis:

- the need to measure national wealth, with the calculation of **net capital stock** statistics for use in balance sheets being the first step in this process[5]
- the need to understand and explain economic growth. This requires statistics of **productive capital stock** from which the flow of capital services used in production can be derived.

These two facets are also displayed in the debate around *Capital in the Twenty-First Century* (Piketty, 2014). Capital is defined by Piketty as the total market value of everything owned by the residents and government of a given country at a given point in time, provided that it can be traded on some market. Among the items included in this are the structures, equipment and infrastructure that make up more conventional definitions of physical capital; land (both underlying residential real estate and farmland); mineral deposits; precious objects; and the value of intellectual property, brand recognition and market power that are captured in market valuations of corporate equity (see Weil, 2014).

Weil lists a number of advantages to Piketty's approach, including that: market valuations capture past value-creating expenditures that are not measured as part of investment in the national accounts, market valuations also incorporate the effects of technological change, price changes or other shocks that may have rendered past investment more or less productive; it allows for consistent measurement over time and across countries; and the privately owned part of capital corresponds to things that could be taxed. But overall, Weil concludes that Piketty's definition "*is both problematic as a measure of the quantity of physical capital in the economy and incomplete as a measure of wealth*" (Weil, 2014, p. 16) and that *"capital is the stuff that is used in producing output and wealth comprises claims that are convertible into consumption now or in the future"* (Weil, 2015).

An assessment of Piketty's analysis is well beyond the scope of this paper and would bring in a wide range of considerations such as the role of housing, asset revaluations, the substitutability of labour and capital, and differences between gross and net saving (see for example, Krusell and Smith, 2015; Obregon, 2015; Rognlie, 2015). However, the debate does highlight that the measurement of capital matters. The following two sub-sections provide a high-level description of how key capital stocks are derived.

Net capital stocks

Produced assets are those generated as outputs from processes that fall within the production boundary of the SNA. Produced non-financial assets comprise fixed assets, inventories and valuables. Fixed assets are those that are used repeatedly in processes of production for more than one period. Fixed assets are broken down further into tangible or intangible fixed assets.

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5 The gross capital stock represents accumulated investment less the accumulated value of assets no longer in use. Statistics New Zealand notes that it is of limited value as an economic variable and is generally only produced as an intermediate step in deriving the net capital stock.

Non-produced assets are needed for production but have not themselves been produced. They can be split into tangible or intangible non-produced assets. Tangible non-produced assets include land, sub-soil assets, water resources and certain uncultivated biological resources. Intangible non-produced assets entitle the owners to engage in certain specific activities or to produce certain specific goods or services and exclude other institutional units.

The ideal measure for balance sheet assets and liabilities is market values. However, where the services produced by the asset are not priced in markets, as with roads, schools and hospitals, market values for the assets are not likely to be available. Where market values are not available, net capital stock is the common approximation for assets. Conceptually, the net capital stock is forward-looking and reflects the discounted value of the flow of services that assets in existence can produce over the remainder of their service lives. In perfectly competitive markets, economic theory would suggest that this is how the market value of traded fixed assets is determined. The net capital stock is often described as a "wealth stock" (see Schreyer, 2005).

In practice, the net capital stock is the sum of the written-down values of the fixed assets still in use, valued at current replacement cost. The written-down value of a fixed asset is equal to the actual or estimated price of a new asset of the same type, less the cumulative value of the consumption of fixed capital. Empirically, the stock is obtained by cumulating investment flows of a particular type of asset, and correcting them for asset retirement and depreciation.

Productive capital stocks

In the case of production and productivity, the appropriate stock measure is the productive capital stock. Empirically, the productive stock is obtained by cumulating investment flows of a particular type of asset, and correcting them for the loss in productive efficiency owing to ageing and asset retirement. For example, a 10-year-old digger would be given a lower weight compared with a new digger when past purchases of diggers are added up to construct a measure of today's productive stock of diggers. And because diggers are scrapped after a certain number of years, at some point old investments do not enter today's productive stock.

Unlike the net capital stock, *aggregate* measures of productive capital stock weight different types of assets by valuing each type of asset with its user cost. This weighting is designed to capture the marginal productivity of different assets. For details on the construction of user costs for New Zealand productivity statistics, see MacGibbon (2010).

Net capital stock measures will equal productive stock measures at the level of individual types of assets under certain conditions. This is not the case at higher levels of aggregation because the implicit weighting for different assets in wealth stocks is based on market prices. However, changes in the relative productivity of the different assets are not necessarily consistent with changes in the relative price of the assets. For productivity analysis it is the weighting of different asset types that is relevant. The flow of capital services from an asset are a key input into productivity measures and are typically taken as a proportion of the productive stock of the same asset, where the *productive stock* reflects the productive capacity of capital (see Schreyer, 2005).

Although net capital stock and productive capital stock are different, they are derived from the same underlying data using a Perpetual Inventory Method (PIM) (see Statistics New Zealand, 2014a). Gross fixed capital formation (GFCF) is a key input to the PIM. GFCF is defined as the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period, plus certain additions to the value of non-produced assets as a result of productive activity of institutional units (such as land improvements).

GFCF, net capital stocks and the consumption of fixed capital are published in current prices. Only GFCF and net capital stocks are published in volumes (or constant prices). Valuation at current prices is sometimes referred to as current replacement cost. This differs from market value, which depends on many other factors, such as the demand for final product, in addition to the cost of production. A point-in-time summary of New Zealand's GFCF and net capital stocks, by asset type, is provided in Table 2 below. With the implementation of SNA 2008, GFCF includes R&D for most sectors and this flows through into the intangible component of capital stocks (see Statistics New Zealand, 2014a; and Part 4 below). The productive capital stock is not included in Table 2 because it is the flow of capital services that matters for productivity measures.

Table 2 – GFCF and net capital stock ($billions, current prices, March 2016)

Asset type – all industries	**GFCF**	**Net capital stock**
Residential buildings	18	346
Non-residential buildings	7	142
Other construction	7	135
Land improvement	1	
Transport equipment	6	22
Weapons systems	< 1	1
Plant, machinery and equipment	12	63
Intangible assets	9	33
Totals	**59**	**742**

Note: Expenditures on land improvements are treated as GFCF but do not lead to tangible assets in balance sheets that are separate from the land itself. Rather, they represent a net (capital formation less depreciation) addition to a non-produced asset.

Source: Statistics New Zealand

Part 3 – Balance sheets

About half of the OECD starter for ten indicators in Table 1 relate to national balance sheets. In March 2017, Statistics New Zealand published its first set of Annual Balance Sheets (ABS) for the period 2007 to 2015. These balance sheets are produced within the New Zealand System of National Accounts (NZSNA) and so based on the internationally agreed standards of the SNA 2008. A primary purpose of the ABS is to bring together various data sources with partial coverage into a more coherent picture of the assets and liabilities of the total economy. A second release of balance sheet statistics in December 2017 included revisions and estimates to 2016.[6] In June 2018, Statistics New Zealand published accumulation accounts that explain the movement in values from one balance sheet to the next in terms of transactions, price movements (revaluations) and unanticipated volume changes (eg, loss of assets in a natural disaster).

Total economy and sectors

The balance sheet estimates are compiled from a number of sources including: the Annual Enterprise Survey (AES); Reserve Bank of New Zealand (RBNZ) surveys; the Crown Financial Information System (CFISnet); the Local Authority Census (LAC); and the International Investment Position (IIP). The household sector is sourced from RBNZ's quarterly household balance sheet statistics (see below) and uses the March quarter data for year-end values.[7]

RBNZ has been publishing its household balance sheet statistics since 2000. In addition, measures relating to government balance sheets are published by the Treasury using Generally Accepted Accounting Practice (GAAP)[8] and by Statistics New Zealand using Government Finance Statistics (GFS). Data for many of these areas are more frequent and timely than the ABS data. The relatively longer lag for the ABS reflects the availability of other inputs, particularly related to the business sector.

Statistics New Zealand notes that the quality of individual balance sheet estimates is improved by the process of bringing them into an integrated system which confronts them with other corresponding data. However, in some cases, this process raises issues about data quality that cannot be resolved or will require further work. Future analysis will result in further improvements being made, resulting in revisions to the latest published estimates. Hence the ABS are currently termed "provisional".

From a business accounting perspective, group financial controllers preparing a consolidated balance sheet can require subordinate entities to agree or reconcile balances with other subordinate entities. This process is not open to statisticians who must work with the information with which they are provided, and use their best judgements to adjust reported balances, or leave unknown residual amounts in their reports. These residual amounts are typically attributed to the household sector as this is the sector with the least direct (and therefore likely the least robust) data. This is a common situation internationally and means

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6 This section draws on the detailed explanation available at: http://datainfoplus.stats.govt.nz/item/nz.govt.stats/a53f7405-f072-4532-8085-db8efd3b1493/26#/nz.govt.stats/392ae1b1-aa98-4959-b865-427dee903589/24

7 For details see: https://www.rbnz.govt.nz/statistics/c22

8 In GAAP, the New Zealand public benefit entity (PBE) international financial reporting standard (IFRS) came into place in 2007 with an update in 2014 to base PBE standards on the International Public Sector Accounting Standards, called PBE IPSAS.

that inaccurate underlying data or methods are acknowledged to impact adversely on the household sector.

Table 3 below sets out the assets, liabilities and net positions for the 16 sectors of the total New Zealand economy. Additional information on total economy assets by type is also included. Businesses and financial institutions have large holdings of assets but also liabilities. As noted above, produced non-financial assets comprise fixed assets, inventories and valuables. Non-produced non-financial assets include land. Financial assets comprise cash, deposits, equity and loans. The liabilities in Table 3 include loans and the equity of owners. For corporate business enterprises and registered banks, the "net worth" estimate is a residual calculation that accumulates errors and omissions. It is therefore best considered as a balancing item. For sectors that do not have equity liabilities to other parties – government, non-profit institutions serving households, and households – the term "net worth" is considered equivalent to the concept of "net wealth". In Table 3, the information for these sectors is shaded.

Table 3 – Assets and liabilities ($billions, as at March 2016)

	Assets	**Liabilities**	**Net worth**
By sector:			
Corporate business enterprises	787	798	-11
Non-corporate enterprises	437	437	0
Central bank	25	25	0
Registered banks	501	520	-19
Other depository organisations	4	4	0
Investment funds	94	94	0
Other financial intermediaries	86	86	-1
Insurance companies	29	30	-1
Pension funds	76	76	0
Financial auxiliaries	10	10	0
Captive financial institutions	317	326	-9
Central government institutions	210	121	89
Funded social insurance schemes	38	4	34
Local government institutions	130	17	113
Non-profit institutions serving households	32	2	30
Households	1495	184	1312
Total economy	**4272**	**2735**	**1537**
Rest of the world	399	240	159
By asset type:			
Produced non-financial assets	833		
Non-produced non-financial assets	864		
Financial assets	2575		
Total	**4272**		
Net capital stock (current prices)	742		

Note: Captive financial institutions comprise institutional units that provide financial services but where most assets and liabilities are not transacted in open markets (eg, holding companies). Shading indicates sectors where "net worth" can be equated with net wealth.

Source: Statistics New Zealand: Annual Balance Sheets; National Accounts (Industry Production and Investment); Accumulation Accounts

Most of the difference between produced non-financial assets in Table 3 and net capital stocks from Table 2 is owing to the inclusion of inventories in produced non-financial assets. There is

some further difference owing to use of non-PIM sources. The fixed assets component of produced non-financial assets for most sectors in Table 3 is estimated by the PIM model. Central government, local government, central bank and funded social insurance schemes use alternative sources.

Because one person's liability is another's asset, most sectors in Table 3 can be consolidated out so that households become the ultimate owners, supplying capital in the form of debt and equity. In this sense, financial assets represent claims to a combination of real and intellectual assets and their earnings. This is one motivation for focusing on produced assets, as proposed by Smith (2018).

Because some produced assets are funded from overseas (and vice versa) it is also useful to consider *net* financial claims with the rest of the world. Table 3 indicates that the rest of the world has claims on New Zealand assets to the value of $399 billion (distributed across the 16 sectors). The rest of the world has $240 billion of liabilities with respect to New Zealand (ie, New Zealanders own overseas assets). Overall, New Zealand's net international investment position is a net liability of $159 billion. This can also be expressed as total economy net *financial* worth (the difference between financial assets of $2,575 billion and financial liabilities of $2,735 billion).

Some general points emerge from this analysis:

- The produced assets of businesses and financial institutions comprise a wide range of asset types, as described in Table 2 above. How these assets combine with other inputs, and their associated productivity, is discussed in Part 4 below.

- Ultimately, households own most of the net wealth in the economy. As discussed above, this reflects that, for most other sectors, the equity that households hold is reflected as a liability to the sector. And ultimately the net worth of government represents taxpayer equity.

- Central government holds more assets than local government but also has considerably more liabilities and therefore a lower net worth.

- At around $90 billion, the net worth of central government is in-line with that reported in the Financial Statements of the Government (FSG). However, the *levels* of both assets and liabilities differ considerably across the two reporting formats, being higher in the FSG which includes government corporate and financial institutions.

- The degree of risk associated with debt levels is influenced by its distribution. With the ABS data being at the sector level it provides no insights as to the extent to which debt is concentrated within particular sub-groups.

Households

In the SNA, when households own rental properties the operation is treated as a business regardless of whether the business is incorporated (see Reserve Bank of New Zealand, 2015). SNA guidelines require that rental properties and associated mortgage debt be recorded on the business sector balance sheet, and not that of the household sector. Therefore, the household row in Table 3 excludes rental properties. Instead, rental property assets, debt and equity are allocated to the appropriate corporate or unincorporated business sectors, with the net equity allocated back to households as a financial asset. In Table 4 below this net equity is included in the row labelled "Equity and investment fund shares". In effect, the household

balance sheet shows gross housing assets and liabilities for non-rental (owner-occupied) dwellings. In addition, many unincorporated and unlisted incorporated businesses are owned by the household sector, and their equity is recorded on the household balance sheet.

In terms of housing and land, residential property data are sourced from published RBNZ estimates and are divided into land and buildings. Residential buildings are reconciled to PIM estimates. To maintain consistency with published totals for "land and housing", land is the residual (see Statistics New Zealand, 2018). The previously suppressed split between produced and non-produced non-financial assets is now published with the accumulation accounts release.

Table 4 – Household assets and liabilities ($billions, as at March 2016)

		Including rentals
Non-financial assets (housing and land)	680	905
Equity and investment fund shares	*573*	
Insurance, pensions, and standardised guarantee schemes	*82*	
Other financial assets	*159*	
Financial assets	815	
Total assets	**1495**	
Housing loans	*154*	
Housing loans including rentals		*215*
Other liabilities	*30*	
Total liabilities	**184**	
Net worth	**1312**	
Housing and land components:		
Produced non-financial assets	245	
Non-produced non-financial assets	435	

Sources: Statistics New Zealand, Annual Balance Sheets, with "Other financial assets" and "Other liabilities" as residuals; Reserve Bank of New Zealand (Table C22) for housing loans and rental property data. Produced non-financial assets and non-produced non-financial are from Statistics New Zealand Accumulation Accounts.

The newer data indicate that New Zealand households have more diversified balance sheets than previously thought (or at least was measured). For example, the share of housing assets as a share of total assets is around 45%, acknowledging that net equity in rental properties (around $164 billion) is included as a financial asset.

Finally, some asset and liability items are still missing from the household balance sheet. These include household assets held overseas directly by individuals, and consumer durables.

Government

As noted above, the Treasury publishes government balance sheet information, including in its regular economic and fiscal updates, the FSG and the Investment Statement. However, while these include measures of financial and physical capital, they are not directly comparable to either the central government balance sheet perspective presented above or the productivity perspective discussed below.

In the ABS, the central government sector includes all core Crown departments and most Crown entities. State-owned enterprises (SOEs) are public non-financial corporations and are included in the corporate business enterprises sector. However, the equity of market-operating Crown entities and SOEs is included as an asset of central government. The central

government sector is itself divided into two sub-sectors: central government institutions excluding funded social insurance schemes; and funded social insurance schemes (eg, the Accident Compensation Corporation (ACC) and the Earthquake Commission (EQC)).

Statistics New Zealand also presents government balance sheet information using the Government Finance Statistics (GFS) Manual, and the Treasury also presents some GFS based information as part of its economic and fiscal updates (ie, on a forecast basis). The classification of assets and liabilities in the SNA and GFS are fully consistent. However, financial assets and liabilities can differ owing to different approaches to consolidation.

In the ABS, the data for units within the central government institution sub-sector are consolidated. However, transactions between sub-sectors are presented on a deconsolidated basis. For example, funded social security schemes' holdings of New Zealand government debt securities in the national balance sheet is an asset of funded social security schemes and a liability of central government. In the FSG and GFS, these positions are netted out, so direct comparison with the ABS will show differences.

There are other differences across the reporting frameworks. For example, the reference period for the ABS is March years. The FSG and GFS are on a June year basis, so there will be differences in asset and liability values. In addition, a number of valuation methods are used in valuing assets and liabilities of government and funded social insurance schemes. The value of non-financial assets of central government units is based on their latest valuation or available benchmark valuations.

Distribution and ownership

Because households ultimately own most of the net wealth in the economy, the distribution of household wealth provides additional information that can be important from a living standards perspective.

The OECD starter for ten indicators in Table 1 do not provide information on the distribution of financial and physical capital. The OECD (2015) notes that data on household net financial wealth per capita (from national accounts sources) and total household wealth (as measured in micro data) suggest large differences across OECD countries in both the level and the distribution of household wealth (p. 129).

Household net worth

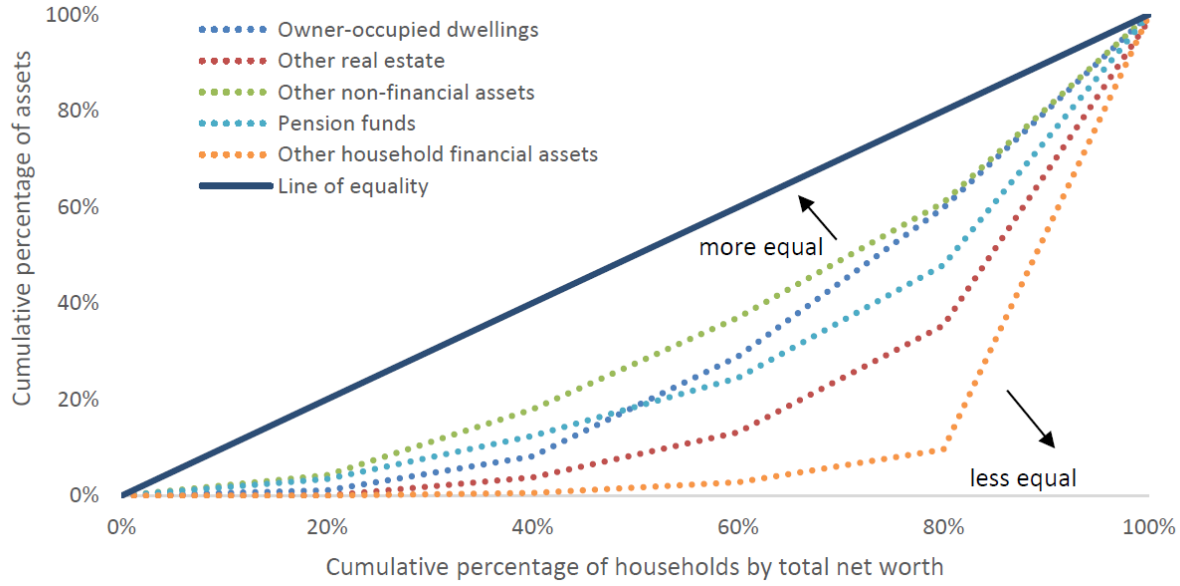
In June 2016, Statistics New Zealand published Household Net Worth (HNW) statistics for the year ended June 2015 (see Statistics New Zealand, 2016a). This is a sample survey of household financial positions that will be conducted every three years. Although the HNW survey has some limitations, it has the potential to provide another data source for validation and missing items in the aggregate balance sheets. This is particularly the case for data relating to trusts and the value of mortgages for both owner-occupied and rental properties. The survey also provides insights into other items missing from the current household balance sheet (eg, valuables, consumer durables).

The HNW analysis of distribution is undertaken by: income and wealth; asset type; age; and ethnicity. A background paper prepared for the Tax Working Group has made use of the HNW analysis and presents the results in more detail.[9] By way of example, Figure 1 below shows the concentration (or Lorenz) curves for different types of household assets. This figure plots

9 *Distributional analysis: Background Paper for Session 5 of the Tax Working Group March 2018.*

the cumulative percentage of assets held by households by level of net worth. The 45 degree line indicates perfect equality – where 20% of the population would hold 20% of the wealth. Curves that are further away from the 45 degree line indicate greater inequality of the distribution. Table 4 above indicates that housing is the dominant asset in the aggregate household sector balance sheet. Figure 1 suggests that owner-occupied dwellings and consumer durables are more equally distributed than investment property and financial assets.

Figure 1 – Concentration curves for household assets (2015)



Note: Other household non-financial assets include consumer durables and valuables. Other household financial assets include: bonds and other debt securities; equity in own unincorporated enterprises; shares and other equity; mutual funds and other investment funds; life insurance funds and annuities; and other household financial assets. Quintiles are formed by dividing the population into five groups and ranking households by their net worth. The analysis includes a small number of households with no assets or liabilities.
Sources: The Treasury, Statistics New Zealand

Asset base of the Māori economy and Pacific peoples

Te Puni Kōkiri has commissioned research into the *asset* base of the Māori economy (Business and Economic Research Limited (BERL), 2015).[10] As with the balance sheet analysis above, this research considers a range of assets including cash, investments (including fishing quota), land, property and buildings, and machinery and equipment. Land, property and buildings includes farm and forestry land, marae, health service facilities, farm, office and retail buildings, as well as residential property including papakāinga and kaumātua housing. Machinery and equipment ranges from irrigation systems to transport equipment.

For Māori entities (trusts, incorporations and iwi holding companies), BERL obtained asset valuations from annual reports, Māori Land Court data, Te Puni Kōkiri data and research, as well as data from Charities Services information. These data were balanced and improved with additional information that BERL collected from research on the Māori asset base in the Bay of Plenty, Taranaki, Northland and Waikato regions. For the businesses of Māori employers and self-employed Māori, BERL used Census 2013 data to deduce average business size (in terms of employees per employer), and AES data to deduce average assets per employee ratios. Combining these factors (at the disaggregated industry level) generated estimates of

10 See: https://www.tpk.govt.nz/en/a-matou-mohiotanga/business-and-economics/maori-economy-report-2013

asset values. Given the assumptions involved, the estimates for businesses of Māori employers and self-employed Māori are subject to more uncertainty.

The 2013 Māori economy asset base was estimated to be $42.6 billion. This figure comprises three categories:

- $23.4 billion in businesses of Māori employers
- $6.6 billion in businesses of self-employed Māori
- $12.5 billion in Māori trusts, incorporations, and other collectively-owned enterprises.

Assets held by Māori enterprises in the primary sector (ie, agriculture, forestry and fishing) made up over 26% of the total asset base, followed by the property service sector with just over 19% of the total asset base. At a regional level, the Māori asset base is dominated by $11.4 billion held in Te Puku o Te Ika, with $8.9 billion in Tāmaki Makaurau and $7.9 billion in Te Waipounamu.

As noted by BERL, these estimates are not directly comparable with capital stock estimates published by Statistics New Zealand. BERL calculated that the 2013 estimate of $42.6 billion represented 6.1% of a similarly calculated total New Zealand asset base. In terms of the ABS discussed above, the estimate of $42.6 billion is around 4.1% of the combined assets of the corporate and non-corporate sectors (in 2013).[11]

In addition, *Tatauranga Umanga Māori 2016* (Statistics New Zealand, 2016b) provides a summary of statistics on Māori authorities using AES data collected by Statistics New Zealand. The analysis focuses on collectively managed assets and broadly aligns with BERL's category three above. For the year ended March 2013, Māori authority assets (across all industries) were $13 billion, slightly higher than the BERL category. Māori authority assets rose to $15 billion in the year ended March 2014.

Tatauranga Umanga Māori 2014 included information on Māori authority asset composition and financing. For example, Māori authorities were found to hold a higher proportion of fixed tangible assets than other businesses. Fixed tangible assets account for 49% of Māori authorities' total assets, compared with 28% for all industries. In terms of financing, shareholder funds or owners' equity account for 70% of Māori authorities' total equity and liabilities. This compares to 37% for all industries, which tend to use a more even distribution of finance sources between shareholder funds or owners' equity, and current and non-current liabilities.

The Treasury, in collaboration with the Pacific Business Trust, has commenced a Pacific Economic Research Project. This project will, for the first time, provide reliable and comprehensive data on the range and description of capital and activities that comprise the Pacific collective wealth and its real and potential contribution to the New Zealand economy. This information will enable a consideration of appropriate policy and operational benchmarks for improving and sustaining Pacific economic performance in the longer term. Unlike other economic research projects, attention will be given to the less visible aspects of the economy such as the total contribution families make to churches as well as the value of Pacific-owned church assets and its role within the Pacific economy.

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11 These are the two sectors that would most likely include the entities in the three BERL categories. Because the BERL estimate is a composite of various assets it cannot be directly compared to produced, or non-produced, non-financial assets.

Risk and resilience

Three of the OECD starter for ten indicators in Table 1 relate to "risk factors" (ie, indebtedness of the household sector; government financial net worth; and leverage of the banking sector). An accompanying discussion paper covers risk and resilience in more detail, including a qualitative assessment for financial and physical capital (Frieling and Warren, 2018).

Table 5 – Overview of risk and resilience factors for financial/physical capital

RISKS	
Financial capital • Delayed action towards a low-carbon future • High income and wealth inequality • Price shocks • Cyber risk	**Physical capital** • Affordability constraints for maintenance and renewing of infrastructure • Natural disasters and extreme weather events leading to infrastructure failure

RESILIENCE	
Financial capital **Absorption** • Adequate steps towards a climate resilient economy • Inclusive growth • Strong cyber security **Adaptation** • Trade diversification • Well-functioning insurance markets	**Physical capital** **Absorption** • Robustness of physical capital • Redundancy and flexibility of critical physical capital **Adaptation** • Capacity and level of collaboration within New Zealand's construction industry.

Source: Frieling and Warren (2018)

The reporting and analysis of macro, fiscal and financial risks is undertaken by a number of agencies, in a variety of reports, and using a wide range of indicators. For example, the Treasury includes risks and scenarios in its economic and fiscal updates, and assesses longer-term fiscal sustainability in the statement on the long-term fiscal position. The resilience of the Crown balance sheet was featured in the Treasury's most recent Investment Statement. Financial and macro stability is also assessed in the six-monthly Reserve Bank *Financial Stability Report* and the annual Article IV report by the International Monetary Fund (IMF).

As Frieling and Warren (2018) note, the OECD has released a set of more than 70 vulnerability indicators for OECD countries to assess their economic resilience. The indicators are grouped into five domestic areas: i) financial sector imbalances; ii) non-financial sector imbalances; iii) asset market imbalances; iv) public sector imbalances; and v) external sector imbalances. An additional international "spill-overs, contagion and global risks" category aims to capture vulnerabilities that could transmit from one country to another through financial, trade or confidence channels.

Policy advice on macroeconomic risk tolerances and desired levels of resilience will require assessments of the current exposures to risks (their likelihood and consequences for each of the capitals and the interactions between those capitals), a view on the impact of risk trends and an understanding of the absorption capacity and adaptive capacity of each capital and the impact of interventions to change those settings. It is not the purpose of the *Living Standards Dashboard* to provide the information for that analysis, and so it is not proposed to report financial/physical capital risk indicators separately in the *Dashboard*.

Part 4 – Growth and productivity

Four of the OECD starter for ten indicators in Table 1 link to GDP growth (ie, net fixed assets; gross fixed capital formation; knowledge capital; and investment in R&D). Some link directly because their acquisition (either domestically in the case of, say, buildings, or via importation in the case of diggers) is the investment component of GDP (alongside private and public consumption, other imports and exports). Investment contributes to the capital stock. In turn, the capital stock, when combined with other inputs such as labour, generates goods and services. This provides the link to economic growth and productivity.

Measures of productivity

Labour productivity, the more common measure of productivity, can change as a result of technological change or additional capital. This means it is a *partial* measure that attributes to one factor of production – in this case labour – changes attributable to other factors. Capital productivity is also a partial measure, and in general we are more interested in investing in capital to raise the productivity of each worker rather than adding more people to raise the productivity of capital. In contrast, multifactor productivity (MFP) takes into account both labour and capital inputs.[12]

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). However, *measured* MFP growth will also include a range of effects including input and output innovation, management skills, deviations from perfect competition, model misspecification, errors in the measurement of the variables, adjustment costs and unobserved changes in capacity utilisation.

New Zealand's official productivity statistics are calculated for the measured sector, which covers all industries in the primary and goods-producing sectors plus selected service industries. The 16 industries in the measured sector account for approximately 80% of GDP (see Statistics New Zealand, 2014b). Central government, local government, health, and education are excluded from the measured sector. Statistics New Zealand produces productivity measures for health and education.[13] These are official measures for these industries although the different approach means that they are excluded from the "measured sector" estimates.

Cross-country comparisons of productivity are challenging because of differences in the coverage of industries, data sources and methods. This can result in a trade-off between what is judged most appropriate for national productivity statistics and what is needed for consistent cross-country comparisons. For example, comparisons across the full set of OECD countries are generally made on an economy-wide basis. The Treasury also uses economy-wide measures in its forecasts in order to provide an outlook for the whole economy.

Although conceptually preferable to labour productivity, MFP is more challenging to calculate, especially in a cross-country context where differences in the measurement of capital can be significant. Warmke and Janssen (2012) find that that cross-country differences in the

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12 The relationship between productivity, wages, and factor income shares for New Zealand is examined by Conway, Meehan, and Parham (2015) and Fraser (2018). For an OECD perspective see Schwellnus, Kappeler, and Pionnier (2017) and Cho, Hwang, and Schreyer (2017).

13 For an analysis of state sector productivity, see the New Zealand Productivity Commission inquiry: https://www.productivity.govt.nz/inquiry-content/3253?stage=3

measurement of capital fall into three broad categories: asset coverage; industry coverage; and compilation methodology. For example, in terms of industry coverage, both the OECD and the Australian Bureau of Statistics exclude residential buildings from their productivity measures. The Australian Bureau of Statistics does this because private rentals are included with owner-occupied dwellings in the ownership of dwellings industry, which is outside the market sector. In New Zealand, private rentals are included in the measured sector.

In addition, capital services in New Zealand's measured sector productivity statistics are both narrower and wider than the productive capital stocks discussed in Part 2 above. First, because the measured sector excludes central government and local government, it excludes the assets of these industries (eg, roads, schools, and hospitals). Rather, their existence enhances other factor inputs and so their contribution to measured sector output growth is reflected in the MFP residual. Relatedly, R&D by universities is in the education industry and so outside the scope of measured sector intangible assets. In contrast, Crown Research Institutes are mostly classified in the business services industry and so within the measured sector. Second, measured sector capital services are estimated for a number of land-related assets including: agricultural and forestry; residential; commercial; industrial; mining; and other non-agricultural land (see Annex). These are all excluded from OECD MFP estimates.

Productivity performance

Table 6 sets out the components of growth accounting for New Zealand's measured sector. MFP growth is the residual of measured sector output growth and growth in labour and capital, both weighted by their share of income. In addition to the full 1996 to 2017 period, the analysis is undertaken for growth cycles. A growth cycle is defined as the years between the peak of one cycle and the peak of the following cycle. The current cycle (2008 to 2017) is incomplete. The use of growth cycles helps allow for factors that vary within a cycle, such as capacity utilisation of the capital stock.

Table 6 – Growth accounting for New Zealand's measured sector (average annual growth rates)

	Output	Labour input	Capital input	Labour productivity	Capital productivity	MFP
Growth cycle:						
1997–2000	2.9	0.1	2.4	2.9	0.5	1.9
2000–2008	3.4	2.1	3.9	1.3	-0.4	0.5
2008–2017	2.0	0.8	2.0	1.1	0.0	0.6
Full sample:						
1996–2017	2.8	1.3	2.8	1.5	-0.1	0.8

Note: Years ended March. Each growth cycle excludes the change for the first year (eg, the 1997 to 2000 average annual growth rate does not include 1997).

Source: Statistics New Zealand: https://www.stats.govt.nz/information-releases/productivity-statistics-19782017

For the period 1996 to 2017, average annual growth in labour productivity for the measured sector was 1.5%. Capital deepening (the difference between growth in capital inputs and labour inputs) averaged 1.6% per year over the same period. Growth in capital input was in-line with growth in output, indicating a stable capital to output ratio and low capital productivity growth. Low capital productivity growth can accompany reasonable rates of return, noting that the rate of return equals capital's marginal product. When the return on capital is high there is not necessarily a need to improve capital's average productivity until the rate of return goes down. Only when faced with declining returns do firms take action to utilise capital more

efficiently. As such, there is a distinction between capital's ability to generate a reasonable return with its performance in terms of average capital productivity growth.[14]

New Zealand's productivity performance, using a range of measures and comparator countries, has been assessed in a number of reports including: *Holding on and Letting go* (The Treasury, 2014); *He Tirohanga Mokopuna* (The Treasury, 2016); the Productivity Commission's report on *Achieving New Zealand's Productivity Potential* (Conway, 2016); MBIE's report on *What we Know (and Don't Know) About Economic Growth* (Ministry of Business, Innovation and Employment (MBIE), 2016); the OECD economic survey of New Zealand (OECD, 2017b); and Conway (2018).

Although these reports cover a number of possible explanations, the role of capital (and hence MFP) is typically a feature and so is relevant for the present paper.

In the growth accounting of Table 6, the growth of MFP is a *residual rate of growth*. It is possible, although more challenging, to compare *levels* of productivity and factor inputs across countries. In levels accounting, MFP is a *residual ratio* relative to a benchmark country, with the other ratios derived using data for output, capital and labour. Cross-country levels accounting suggests that differences in total factor productivity (TFP) are the largest contributor to income differences (see Jones, 2015). In the poorest countries of the world, well over 80% of the difference in GDP per worker relative to the United States is owing to TFP differences. For the richest countries as a whole, TFP contributes around 50% of the difference. Differences in capital intensity and educational attainment account for the balance of the difference.[15]

A number of papers have examined capital intensity in the New Zealand economy, particularly from a cross-country perspective. The Annex sets out (now somewhat dated) levels accounting estimates for New Zealand relative to Australia, the United Kingdom and selected OECD countries.

The overall finding of these levels accounting exercises is that the gap in New Zealand's labour productivity is mainly owing to differences in MFP and capital intensity, while skill differences make a smaller contribution. Nonetheless, Hall and Scobie (2005) concluded that changes in the coverage and method of computing estimates of the capital stock altered their conclusions. For example, whether New Zealand is capital shallow relative to Australia may well hinge on whether land and inventories are adequately measured and incorporated in a more comprehensive concept of capital (see Annex).

Dupuy and Beard (2008) emphasise that a relatively low level of labour productivity can be associated with both low relative capital intensity and low relative MFP. As a result, New Zealand's low capital intensity can be thought of at least partly as a by-product of New Zealand's low MFP. Their analysis examines the various impediments that might push New Zealand's cost of capital upward and so drive the capital stock below the level that would be justified by New Zealand's MFP.

There is some evidence challenging the capital shallowness hypothesis. For example, Steenkamp (2016) estimates aggregate and industry production functions for the period 1996

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14 See Aulin-Ahmavaara and Jalava (2003) for an analysis of capital productivity in Finland that emphasises these distinctions.

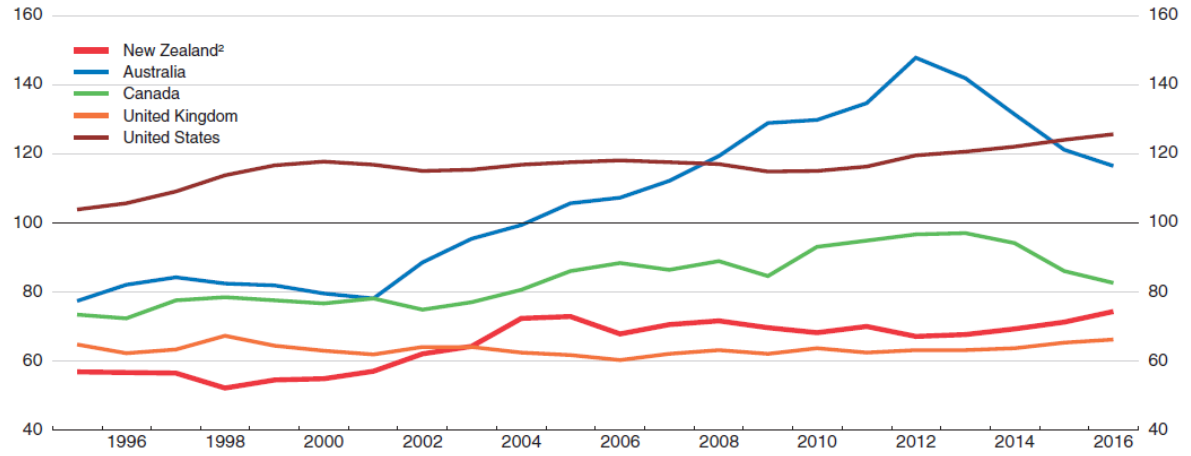
15 The levels accounting studies cited by Jones typically focus on the capital-output ratio in order to reduce the induced effect of exogenous changes in MFP on capital accumulation and hence the capital-labour ratio. See also Klenow and Rodriguez-Clare (1997), Hall and Jones (1999), Hsieh and Klenow (2010) and Weil (2014).

to 2012, allowing for different specifications of technology. Steenkamp finds evidence of capital regress for many industries. He lists a number of possible explanations, including: misallocation owing to a high proportion of small, owner-run firms with weak links to global value chains, poor management practices and under-investment in intangibles; mismeasurement; a shift away from expenditure on physical capital towards pay-as-you-go services; and that a fall in the relative price of equipment and ICT may have accelerated obsolescence and so productive capital stock figures may be overstated. Data limitations prevent a detailed assessment of these factors.

More recently, the OECD (2017b) concluded that:

> *While recent sluggish labour productivity growth is due primarily to slow MFP growth, persistent softness in investment is also a factor in New Zealand's low level of labour productivity. Non-residential capital formation per capita was below 60% of the OECD average in the late 1990s and remains below 75% of the OECD average. Although it is difficult to compare capital stocks across countries directly due to different measurement approaches, sustained weak investment suggests that capital stocks are low in New Zealand compared with OECD peers. Strong growth in NZ employment over recent years means that investment would need to be even higher than elsewhere in order to achieve the same trajectory of the capital-labour ratio. Weak investment and MFP are linked, as low MFP reduces the incentive to invest and improvements in technology are often embodied in capital goods. (p. 79)*

Figure 2 – Gross fixed non-residential capital formation (per person in the labour force, OECD = 100)[1,2]



1. Data for gross non-residential capital formation are in current prices and were converted into a common currency using 2010 purchasing power parity exchange rates. The labour force includes only people aged 15-64. Data for the OECD exclude Chile, the Czech Republic, Estonia, Greece, Hungary, Iceland, Israel, Latvia, Luxembourg, Mexico, Norway, the Slovak Republic, Slovenia and Turkey.
2. Excluding investment related to the Canterbury earthquake rebuild.

Source: OECD, *Economic Outlook and Labour Force Statistics Databases*; A. Wood et al. (2016), "The Canterbury Rebuild Five Years on from the Christchurch Earthquake", *RBNZ Bulletin*, Vol. 79, No. 3, February.

StatLink http://dx.doi.org/10.1787/888933497246

Given that New Zealand's investment rate is around the OECD average while output per worker is below the OECD average, investment *per worker* is lower than the OECD average. This assessment is consistent with previous OECD findings by Guillemette (2009), who concluded that the impediments to capital deepening and to MFP growth in New Zealand overlap to a large degree.

Broader measures of capital and multifactor productivity

A theme of the OECD and Treasury frameworks is that the capitals contribute in various ways to wellbeing. Smith (2018) suggests that most existing measures of MFP face limitations in terms of incorporating the impact of social capital, most of natural capital and much of the qualitative impact of human capital (p. 34). However, some aspects of human capital and natural capital have been incorporated into MFP estimates.

Human capital

Statistics New Zealand has released composition-adjusted productivity measures that account for the impact of changes in the skill composition of workers. As a result, output growth can also be explained by changes in labour composition, thereby reducing the contribution of the MFP residual. Composition-adjusted labour is calculated by adjusting labour input using movements in a labour composition index, which estimates changes in skill composition using proxies for skill (eg, education attainment and work experience). This index is calculated using the Household Labour Force Survey (HLFS) to estimate the proportions of each skill category of worker, and the New Zealand Income Survey (NZIS) to compile income shares for each group.[16]

For a sample of OECD countries, Égert (2017) tests the sensitivity of aggregate MFP estimates to human capital, capital stock assumptions, cross-country price adjustments and labour inputs. Égert concludes that whether or not human capital is included as a factor input makes a significant difference for the level and dynamics of MFP. At the same time, MFP measures are less sensitive to other parameters. New Zealand is not included in this analysis.

Natural capital

OECD research indicates that the direction of adjustments to traditional MFP growth estimates depends on the rate of change of natural capital extraction *relative* to the rate of change of other factor inputs (Brandt, Schreyer, and Zipperer, 2013). The adjustment factor can change over time, especially when periods of resource scarcity follow resource abundance.

Brandt et al. find a larger adjustment factor for countries with significant natural capital endowments, such as Norway, Russia, Chile and Mexico and, to a lesser extent, the United Kingdom, Australia, Canada and the Netherlands. In Australia, Denmark, Norway, Finland and New Zealand they find that the adjustment factor is negative, as natural capital grew faster on average over the sample period (1986 to 2008) than the traditional input index. In Australia, this was owing to a strong generalised increase in minerals production, in Denmark and Norway to oil production, and in New Zealand mainly to oil and gas production. For New Zealand, unadjusted MFP growth averaged 0.68% per year, compared to 0.66% when natural capital is included. Natural capital grew by an average of 2.11% compared to 1.78% for traditional inputs. The share of resource rents in total costs was 1.41%.

Overall, the changes to MFP are judged as small, partly reflecting the fact that the natural capital data used in the analysis is relatively narrow, consisting of oil, gas and various minerals. Soil, water, and wild fish stocks are not included. The various services that forest and other ecosystems provide are also not captured, although this is the “very basis of any

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16 In its 2018 productivity release, Statistics New Zealand did not release composition-adjusted productivity as the measured sector data did not meet quality standards for publication. The absence of these data does not affect any other data published in the release.

economic activity" (Brandt et al., 2013, p. 19). The authors note that adjustment factors could change as more encompassing data become available.

Knowledge-based capital

For this discussion paper we focus on the role of knowledge-based capital (KBC) as it is not explicitly covered in the other Living Standards capitals. In addition, two of the OECD starter for ten indicators in Table 1 relate to KBC. Both growth and levels accounting indicate an important role for MFP. Improvements in the ways that firms combine inputs over time (or point-in-time differences across countries) *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.* (See: https://www.project-syndicate.org/commentary/technology-future-of-work-by-ricardo-hausmann-2017-09)

Romer highlights the two-way link between codified knowledge ("A") and human capital ("H"). Whereas H is almost perfectly excludable, codified knowledge produced by human capital is generally non-rival. So people can use it to produce better human capital. As Romer puts it: "There is a lot of human history tied up in our successful efforts at scaling up the H → A → H round trip."[17]

KBC is an important factor in both the OECD *Future of Productivity* work and the New Zealand Productivity Commission's narrative (Conway, 2016). De Serres, Yashiro, and Boulhol (2014) describe KBC as encompassing a wide range of assets (or activities aimed at creating such assets) including branding, database development, product design, inter-firm networks, R&D, and organisational know-how. These assets can be classified under three broad categories: computerised information; innovative property; and economic competencies. For each type of asset, a distinction can be made between the input flow that goes into the creation of the asset and the value or capital stock generated. Not all of these investments and assets are included in the national accounts (see Table 7 below).

The 2017 OECD Economic Survey of New Zealand includes a more up-to-date comparison of KBC drawing on SNA information (see Figure 3). At just over 3% of GDP, the KBC investment rate for New Zealand is consistent with intangible investment cited in Table 2 above. To the extent that intangible assets are reflected in measured sector capital services, then they will not be included in the estimated MFP residual. Nonetheless, MFP will include spill-overs from knowledge-based capital.

Importantly, intangible investment is broader than R&D, which, using the SNA definition, is itself just over 1% of GDP in New Zealand. Differences between the SNA definition of R&D and alternative measures (eg, Gross Expenditure on R&D in the Frasacti Manual) are set out in Ker and Galindo-Rueda (2017). The *stocks* of produced non-financial assets in the government sectors of the ABS do not currently include the capitalisation of R&D. This is expected to be incorporated in the December 2018 release of the ABS, following implementation of the most recent version of the GFS manual.

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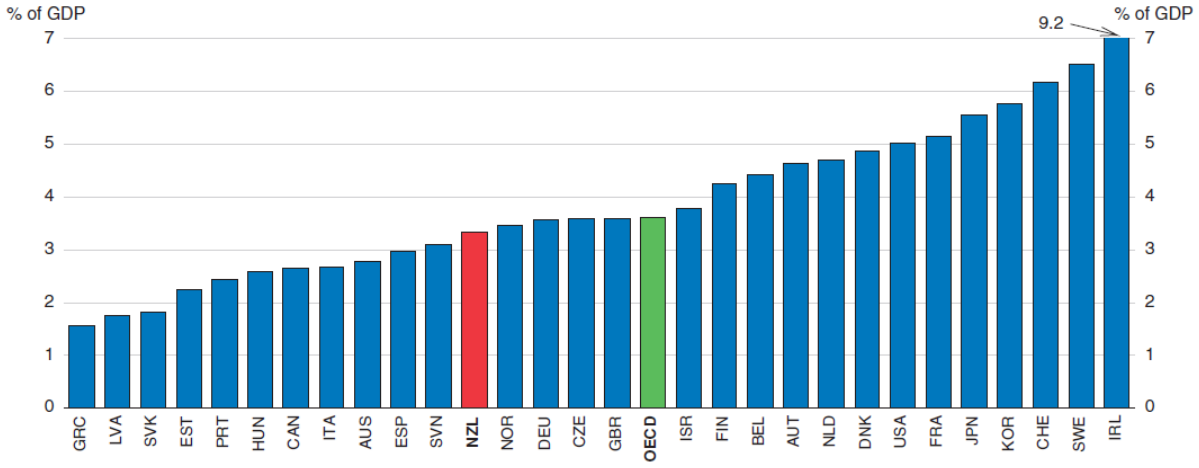
17 See: https://paulromer.net/human-capital-and-knowledge/

Figure 3 – Investment in knowledge-based capital (2015)[1,2]



1. Includes R&D, mineral exploration and evaluation, computer software and databases, entertainment, literary and artistic originals, and other intellectual property products.
2. Or latest year available.

Source: OECD, National Accounts Database.

StatLink http://dx.doi.org/10.1787/888933497580

The New Zealand SNA does not include an explicit estimate for computer databases. However, the approach for measuring software development done on own account will include some estimate of databases. There are no estimates for entertainment and literary and artistic originals because of the difficulty in obtaining information.

In their book on *Capitalism Without Capital*, Haskel and Westlake (2017) address the measurement of intangible capital within the context of the SNA and beyond. Haskel and Westlake use the case of commercial gyms, and in particular, the New Zealand example of Les Mills, to highlight the changing role of intangible capital. So, while the physical capital of commercial gyms has changed somewhat over time, there have been large changes in the underlying business model. For example, in the late 1990s Les Mills began codifying routines that combined music with the use of gym equipment. By 2005 classes based on these codified routines were being offered in 55 countries with an estimated 6 million participants per week. This combination of branding, music, course design, and training represents significant intellectual property for Les Mills, protected by copyrights and trademarks.[18]

Haskel and Westlake set out the three steps researchers have used to estimate an expanded version of intangible capital. The first step is to estimate nominal spending on intangibles in a way that captures activity outside normal investment surveys (eg, training and market research). In addition, information from labour force surveys is combined with industry consultation to generate an estimate of in-house intangible investment. The second step also involves consultation with industry to establish how much of the intangible spending will last for more than a year. The third, and non-trivial step, is to adjust for inflation and quality. Estimates for the US and a sample of EU countries suggest that intangible investment overtook tangible investment around the time of the global financial crisis.

18 See also: https://interactives.stuff.co.nz/2018/06/muscle/

Table 7 – Categories of intangible investment

Broad category	Type of investment	Type of legal property that might be created	Treatment in SNA
Computerised information	Software development	Patent, copyright, design IPR, trademark, other	Yes, since early 2000s
	Database development	Copyright, other	Recommended in SNA 1993 but OECD suggests uneven implementation
Innovative property	R&D	Patents, design IPR	Yes, recommended in SNA 2008, introduced gradually since then
	Mineral exploration	Patents, other	Yes
	Creating entertainment and artistic originals	Copyright, design IPR	In the EU and US
	Design and other product development costs	*Copyright, design IPR, trademark*	*No*
Economic competencies	*Training*	*Other*	*No*
	Market research and branding	*Copyright, trademark*	*No*
	Business process re-engineering	*Patent, copyright, other*	*No*

Note: IPR = Intellectual Property Right. In the column headed "Treatment in SNA", the dates refer to when the standard was changed. When the changes are implemented they are generally applied to the whole time series. "Uneven implementation" highlights the difficulty of applying new concepts.

Source: Adapted from Table 3.1 in Haskel and Westlake (2017)

Corrado, Haskel, and Jona-Lasinio (2017) find that when an expanded view of investment is included in a sources-of-growth analysis, intangible capital is found to account for one-fifth to one-third of labour productivity growth in the market sector of the US and EU economies. More specifically, they find that the marginal impact of ICT capital is higher when it is complemented with intangible capital, and that non-R&D intangible capital has a higher estimated output elasticity than its conventionally calculated factor share. These findings suggest investments in KBC generate productivity growth spill-overs via mechanisms beyond those previously established for R&D.

Finally, the increasing role of intangibles and challenges around output measurement have motivated calls for amendments to GDP and/or placing more weight on a set of capital stocks (see, for example, Corrado, Fox, Goodridge, Haskel, Jona-Lasinio, Sichel, and Westlake, 2017; Coyle and Mitra-Khan, 2017;). Analysis of measurement challenges arising from issues like digital transformation and their applicability to New Zealand is outside the scope of this discussion paper (for more information see Pells, 2018). By design, the Treasury's Living Standards approach considers a wide range of capitals. The extent to which the SNA itself should be expanded to include a wider set of capitals would need to assess the primary purpose of the national accounts, and whether estimates like GDP would be affected.

Part 5 – Conclusions

Information from the New Zealand SNA and other sources (eg, fiscal and financial data) suggests it is feasible to generate the OECD indicators of economic capital in Table 1.[19] However, the analysis in Smith (2018) and this discussion paper suggests a somewhat different set of indicators for the *Living Standards Dashboard*.

Table 8 presents a proposed set of dashboard indicators for financial/physical capital. The table groups the indicators in terms of balance sheets and growth and productivity. Overall, the indicators are drawn from the SNA. Some of the indicators could be presented in per capita terms, while others would be expressed relative to GDP. The proposed set:

- includes aggregate household net worth (with the distribution assessed via the HNW)
- includes the net international investment position (the financial net worth of the total economy)
- splits produced non-financial assets into fixed and intangible assets, and includes R&D investment
- replaces (growth in real) GFCF with one of three alternatives. This reflects that capital stocks are challenging to measure in a cross-country setting and that the type of investment is relevant
- does not include indicators on risk. As noted in Part 3, the reporting and analysis of macro, fiscal and financial risks is already undertaken by a number of agencies, in a variety of reports, and using a wide range of indicators
- does not include measures of KBC beyond those currently included in the SNA
- includes measured sector MFP growth. However, if cross-country comparability is important then economy-wide measures of MFP would likely be needed
- does not include human capital or natural capital adjusted MFP given data limitations.

Table 8 – Proposed indicators of financial and physical capital

<table>
<tr><th colspan="2">Balance sheets</th><th colspan="2">Growth and productivity</th></tr>
<tr><td rowspan="3">Household net worth</td><td rowspan="3">Net international investment position</td><td>Net fixed assets</td><td>Gross fixed capital formation (one of):
Total investment
Total non-residential investment
Business non-residential investment</td></tr>
<tr><td rowspan="2">Intangible assets</td><td>R&D investment</td></tr>
<tr><td>Measured sector MFP growth</td></tr>
</table>

19 The OECD BLI converts some of these indicators into a common currency using Purchasing Power Parities (PPPs) and expresses some indicators in per capita terms.

Annex – Productivity measurement

Levels accounting

New Zealand:Australia (=1.00)

Study	Method	Y/L	K/L	Human capital	MFP
IMF (2002)	Market sector. Productive capital stock with five assets (including land). Specific expenditure-based PPPs for output and capital (adjusted for margins and indirect taxes). Year of comparison is 1999.	0.73	0.83	1.01	0.86
Hall & Scobie (2005)	Total economy. Net capital stock, excludes land but includes housing. Conversion via GDP(E) PPP. Year of comparison is 2002.	0.77	0.72	-	0.83
Mason (2013)	Market sector. Net capital stock: Structures (non-residential and other) and land improvement; Plant, machinery & equipment; Transport equipment, Intangibles (excluding R&D). Specific PPPs for industry output and investment goods by asset types. Year of comparison is 2009.	0.62	0.62	0.97	0.78
New Zealand:United Kingdom (= 1.00)					
Mason & Osborne (2007)	Market sector. Net capital stock: Structures (non-residential buildings and other); vehicles; computers; other plant and machinery; intangibles (principally software). Specific PPPs for industry output and for investment goods by asset types. Year of comparison is 2002.	0.77	0.69	1.07	0.87

Note: See individual studies for details on methodology. IMF (2002) sources the stock of land used for productive purposes from Diewert and Lawrence (1999). To improve comparability with Australia, Mason (2013) adjusts "Rental, hiring and real estate services" to remove the value of private rental dwellings from output (there is no corresponding labour input and residential buildings are excluded from Mason's capital stock).

Selected OECD economies in 2002 (USA = 100)

	Y/L	Y/K	K/L	MFP
New Zealand	61.1	125.5	48.6	72.8
Australia	79.7	102.6	77.7	85.0
United Kingdom	85.9	137.3	62.6	97.2
Canada	81.7	110.0	74.3	88.0
France	108.3	93.7	115.6	103.5
Japan	70.9	53.2	133.3	65.5

Note: As per the *OECD Productivity Database,* the estimates are for total economy. Capital is on a productive capital stock basis and excludes residential assets and land. PPPs are for specific investment goods.

Source: Schreyer (2005) Tables 2 and 3

Land and productivity

The table above indicates that the treatment of 'Land' varies across productivity studies. While earlier studies (eg, Diewert and Lawrence, 1999; IMF, 2002) included land, subsequent studies such as Schreyer (2005) and Mason (2013) exclude land. Official productivity *growth* statistics for Australia and New Zealand include the flow of capital services from land assets. In contrast, the OECD excludes land from its productivity growth statistics.

Hall and Scobie (2005) note that land is often excluded because the quantity of land in use is seen to remain relatively constant over time, and hence can be treated as a fixed, unchanging factor. Diewert and Lawrence (1999) argue that even though the quantity of land may remain constant, the price of land is generally increasing over time. When constructing a price weighted quantity index of input growth for the economy, the fixed quantity of land for many economies will receive a higher price weighting over time, leading to a lower growth of aggregate input and hence leading to a higher measure of productivity growth. For New Zealand, Diewert and Lawrence find that excluding land has a negligible impact on their estimates. This is because land has a relatively small (*ex post*) user cost and consequently has a small weight in forming the overall total inputs index. The main reason for land's relatively small user cost is that it does not include a depreciation component. It is assumed that maintenance activities are captured elsewhere and so the quality of land is constant. Furthermore, increases in the observed price of land have led to significant capital gains which have largely offset (and in some years exceeded) the interest cost associated with holding land. This has led to land having a negative (*ex post*) user cost in some years. Where this occurs, land effectively becomes an output instead of an input to the production process.

For its measured sector productivity statistics, Statistics New Zealand measures the capital services from land using a similar approach to that applied to other assets, the core difference being the source of the estimates of the stock of land. These are obtained from Quotable Value for the total stock of land and value of land by 12 broad categories and by 77 sub-categories. Some sub-categories can be directly allocated to a specific industry (eg, Mining). More difficult to allocate land types are proportionately allocated to each industry that is likely to use that land type. This allocation is based on the proportion each industry has of the total book value of land from the AES. User costs and capital services are calculated in essentially the same way as for all other assets, the key difference being that there is no depreciation term for land.

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