Ministry for Primary Industries
Manatū Ahu Matua

Primary Sector Productivity

The measurement and meaning of primary sector productivity

MPI Technical Paper No: 2013/39

Prepared for the Ministry for Primary Industries
by NZIER

ISBN No: 2013/39
ISSN No: 2253/3923

Oct 2013

New Zealand Government

Growing and Protecting New Zealand

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The measurement and meaning of primary sector productivity

NZIER final report to Ministry for Primary Industries

29 July 2013

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice to clients in the public and private sectors, throughout New Zealand and Australia, and further afield.

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NZIER was established in 1958.

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Key points

Productivity is the path to higher living standards and efficient resource use...

Productivity is a measure of resource use efficiency, and of how current activities create value from available inputs. Raising productivity is crucial to maintaining New Zealand's competitiveness, contributing to the Export Double target and the wider Business Growth Agenda, and raising living standards.

...so understanding how it is measured and interpreted is important

Productivity can be measured by constructing ratios of outputs to inputs and observing their change over time or comparing differences between countries or industries. For consistency over time, they need to be converted from nominal to real terms, and translated into index numbers to control for compositional shifts in the mix of outputs and inputs.

Types of productivity measure most commonly encountered are:

- **Labour productivity**, a ratio of outputs per unit input of labour, measured as employee numbers, hours worked or some other measure
- **Capital productivity**, the ratio of outputs per unit input of capital, measured as a composite index reflecting the cost and differing effective lifetimes of different capital assets
- **Total Factor Productivity** (TFP), also known as **Multi-Factor Productivity** (MFP), which is the ratio of outputs per unit of combined index of inputs, and hence measures the productive value gain over and above (and not explained by) changes in other inputs like capital and labour, which could be due to technological change, better practices or smarter management in production processes.

Previous studies show that agriculture has performed relatively well...

There is a long history of productivity estimation in New Zealand, including the partial productivity measures of labour and capital productivity, and total factor productivity. These studies mostly examine the measured economy (excluding some service sectors) or the primary production sectors, with less attention paid to primary processing and distribution sectors.

Previous estimates vary with the methods used, time periods examined and the coverage of sectors. This is partly due to their serving different purposes. But there are some recurring themes from diverse studies, such as agriculture's productivity growing above the average for the New Zealand economy at large in recent years.

Productivity improvement is one of Government's stated aims for the Ministry for Primary Industries and aggregate productivity measures could be used to track progress against that aim. This can draw on previous studies and Statistics New Zealand's published estimates for productivity.

...but there is a lack of sector detail

Agriculture is not a homogenous sector. It has many sub-sectors, each with different growth drivers and mixes of inputs and outputs. Looking at an aggregate "agriculture" productivity measure is therefore not particularly helpful for thinking about what changes government, industries or individuals might consider in trying to boost productivity.

Working towards building a database of more detailed sub-sector level productivity – including upstream service and input sub-sectors, and downstream processing and distribution sub-sectors – is an important step in the Ministry getting a better understanding of the resource use and efficiency trends at a detailed sectoral level.

There is a trade-off between ease of computation and insights gained

However, the Ministry needs to be very clear on what it wants to achieve with any more detailed estimates of primary sector productivity. Calculating productivity in a robust way can be resource-intensive.

Labour productivity at a more detailed sectoral level is readily computed from available data and is easily understood by industry. Indeed, many of the best data sources for on-farm resource use will be industry bodies rather than Statistics New Zealand. This may be sufficient for basic monitoring and communication purposes.

However, computing outputs per unit of labour appears to ascribe all productivity gains (that may be due to capital deepening, better land use, etc.) to the labour factor. It is therefore not informative about where productivity gains come from.

Determining the drivers of productivity growth requires more in-depth analysis

Labour productivity acts largely as a "dial" indicator for considering *how much* productivity gain has been made. It has little diagnostic use in explaining *what causes* productivity gains and where to seek more.

If the Ministry wants to get a more fine-grained understanding of the drivers of growth in the primary sector, and its various sub-sectors, then more sophisticated analytical (econometric) techniques are required.

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1. Objectives

This report explains the measurement and interpretation of the productivity performance of New Zealand's primary industries. It also considers options for improving our understanding of primary sector productivity in the future.

Lifting primary sector productivity is consistent with:

- The government's goal of 'Building a more productive and competitive economy';
- The Business Growth Agenda themes of 'Export markets', 'Natural resources' and 'Building Innovation';
- The Ministry's 'Export Double' target.

Scope and definitions

This report is a high-level overview of productivity issues as they relate to the primary sector in New Zealand. It aims to spark further discussion on options for further research and analysis that might:

- Shine light on resource use trends at a more detailed sub-sector level
- Improve our understanding of what drives productivity growth in the primary industries.

Detailed data analysis is outside the scope of this project.

Your RFP poses a number of detailed questions. We have addressed these throughout the report in various places, and provided summary answers in Table 2 on page 19.

Because productivity is a widespread concern for modern governments and concerns sectors other than the primary industries, it is useful to view it in context with research into productivity measurement in other sectors and other countries. However, the focus of this report is on what implications can be drawn from these other measurements for assessing productivity in New Zealand's primary sectors.

For the purposes of this report the term primary industries covers industries engaged in the production of biological produce, such as agriculture, fishing and forestry, and also the processing industries associated with bringing them to market (such as food manufacture). It does not include the extraction industries of mining and quarrying.

2. What is productivity?

A simple concept...

Conceptually, productivity is simply a measure of the efficiency of resource use, a ratio of the value of outputs obtained from the inputs used to obtain them valued at opportunity cost. In essence productivity improves when more output is obtained from a given level of inputs, or the same output is obtained from reduced inputs.

...that is difficult to measure robustly

The practice of productivity measurement is more complicated than that, however. Choices have to be made on how to define outputs and inputs, to allow for the changing mix of both when comparing productivity changes over time, and to allow for temporary effects such as changes in output and input prices.

As productivity is simply a ratio, differences in the scope of the denominator and numerator give rise to different types of productivity. Principal variants are:

- **Labour productivity**: the value of output obtained per unit of labour input, which can be defined in terms of numbers employed, full-time equivalents, hours worked or other indicator of the level of labour input
- **Capital productivity**: the value of output obtained per unit of capital input, defined in terms of the composite value of capital employed, with due allowance for depreciation and ageing of plant and machinery
- **Total Factor Productivity** (TFP): the value of output obtained per unit of all inputs into the production process.

Productivity can be measured by looking at individual inputs, although these partial measures can be misleading

Labour productivity and capital productivity are what are termed partial factor productivity (PFP) measures, because of their focus on output relative to a single input. Labour productivity in particular is commonly used, because it is relatively simple to construct from available data and is understood well in a business context where costs are commonly accounted for on a per labour input basis.

However, by definition PFP measures do not account for all factors affecting output and need to be interpreted with care. Such measures effectively attribute to one factor of production the productivity gains that may be caused by some other factor.

In fact, labour productivity gains are commonly explained by what's termed "capital deepening", the application of more and better capital equipment per unit of labour. For example, consider a dairy farm where milking is newly automated rather than being done by hand. If we only consider the labour input required to produce any given amount of milk, then the farm appears to be showing massive labour productivity improvements. But the true gains have come from the capital investment and how that makes labour more efficient, not from labour being inherently more productive in and of itself.

In such circumstances how much of any marginal production gain is attributable to labour and capital can be open to debate.

TFP combines all inputs together but is more complicated to estimate

TFP is intended to overcome this limitation by examining output gains in relation to an index covering all the inputs into its production. However, this too is not a clear-cut measure, as it depends on what gets included as an input.

Most often the factor inputs are limited to labour and capital. But limiting inputs to just labour and capital isn't ideal for the primary sector, which at a minimum needs to also include land as a factor. Arguably other natural resources could also be considered, such as the availability of freshwater or environmental media for discharge and assimilation of wastes. So too conceivably could inputs of human capital (labour quality) and social capital (institutions and policy settings).

Recognition that TFP is a little less "total" than its name implies has led to widespread use of the term Multi-factor Productivity (MFP) in its stead. It is essentially the same as TFP. Whatever term is used, TFP or MFP accounts for effects on total output that cannot be explained by changes in the traditionally measured inputs, like labour or capital.

If all inputs are accounted for, MFP can be taken as an indicator of an economy's long-term technological change or technological dynamism in getting more from its resources than it previously did.

2.1. Why does productivity matter?

Productivity growth boosts living standards

In the long term, productivity improvement is a major driver of economic growth, and hence a contributor to improving living standards for New Zealanders. Economies can grow by using more resources – more people, more land and more capital – but they can also grow by creating more value from those resources, which is why productivity improvement is high on the list of most countries' priorities.

Comparison of productivity changes with that of competitor or trading partners could be used as a benchmark of relative performance. It is also indicative of a country's or industry's competitive position, and a pointer to future growth prospects. Other things held constant, productivity improvement lowers real output prices and enables a country or industry to compete more effectively in product markets.

Improved labour productivity allows for higher wages

Improving labour productivity, raising the output per unit of labour, is not just about increasing growth in the economy at large, but also has a direct link to incentivising individuals' contribution to productivity improvements. This is because at the margin, wage rates are based on the marginal value of labour. So understanding labour productivity improvements provides a link to wage levels and the standard of living and well-being of individual New Zealanders.

Getting more from less in a resource-constrained world

The primary sectors face a range of resource and environmental constraints, including land degradation, pests and diseases, climate change and competition for scarce inputs like water. As these constraints over time become tighter and resources

become scarcer and more costly, primary sectors need to improve efficiency in use of these constrained resources.

Productivity monitoring can assist with that search for efficiency, and provide clues as to whether capital deepening or shifts in the composition of activities will best assist in that aim.

3. How to measure productivity

Consistency of measurement is vital to allow comparisons

Measures of labour productivity or MFP provide an indicator of the ratio of outputs to inputs at a point in time. This is uninformative unless it can be compared with similar estimates from other industries, or with other estimates for the same sector at different points in time through a series of comparable measures. That is, productivity measures always need to be presented relative to something.

Consequently a lot of effort has been put into ensuring that estimates that are made are consistent across industries or time periods. There are a number of choices over how to do this when estimating productivity, with the result that there is some variability around the estimates in circulation.

The main choices, the reasons for them, and implications for interpretation are outlined below. We focus here on economywide measures, but the messages are very similar for considering productivity at the more disaggregated level.

3.1. Approaches to measuring productivity

The literature identifies three broad approaches to measuring productivity:

- **Econometric analysis** of production functions across a set of data to establish how outputs change with variation in key factor inputs, the marginal productivity of each factor being indicated by the coefficient on its independent variable
- The **growth accounting** approach, which computes MFP as a residual derived by subtracting from total output growth the separately evaluated contributions of specified input factors
- The **index number** approach, which measures productivity as the ratio of output and input quantity indexes, such that annual percentage growth in MFP is the difference between the percentage growth in outputs and percentage growth in inputs.

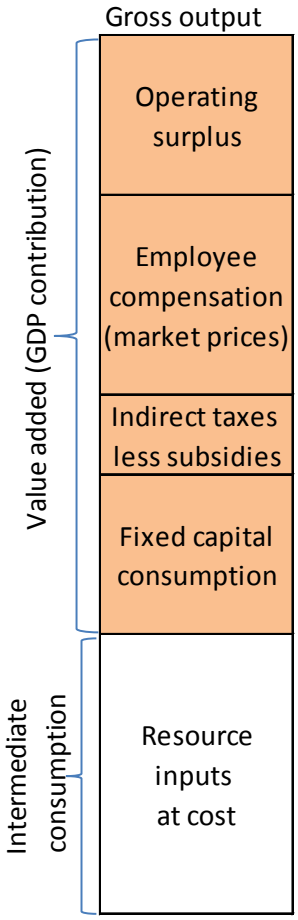
The simplest to construct and explain to industry, politicians and other stakeholders is the index number approach. Output per unit of input is relatively easy to construct and has a clear intuitive appeal. However, to ensure that the productivity measure is internally consistent and makes allowance for changes in input and output mix over time, a number of adjustments are required to the data used in the calculations.

Both the growth accounting and the index number approach depend on the framework of the system of national accounts (SNA), as employed by Statistics New Zealand and other national statistics agencies. This comprises a production approach, in which sectors' intermediate consumption of inputs is deducted from the value of their gross outputs to derive value added (or contribution to GDP). The SNA also calculates value added through an income approach, which adds up the returns to various production factors, namely: operating surplus (a profit or proprietors' return); compensation of employees (return to labour); fixed capital consumption (an estimate of the economic depreciation of capital equipment); and a small component of indirect taxes paid to government (net of subsidies received by the industry).

The relationship of the production and income approaches to national accounting is illustrated in Figure 1 below. Intermediate consumption of one sector comprises the gross outputs of all other sectors that supply it with inputs, so that across the economy aggregate value added does not double count sector outputs.

Figure 1 Sector output in the system of national accounts

Components in the production and income accounting structure



Source: NZIER

3.1.1. Choice of variables

Productivity measures work off aggregate measures of a sector's outputs or inputs.

Output measure is usually gross output, but value added also works

A first choice is whether the output aggregate should be gross output, value added or net value added (value added less depreciation)?

Most studies use a gross output figure, which is both pragmatic and theoretically grounded. A productivity ratio is implicitly expressing an underlying production function, and in practice production functions are not calculated off value added but

rather expressed in terms of gross outputs as a function of inputs such as capital, labour, energy, materials and services.

However, aside from this pragmatic reason, in principle there is no strong reason for preferring output over value added and the choice may come down to the purposes of particular study or the available data (OECD 2008).

If studying the productivity performance of a particular firm or industry, the gross output formulation has the advantage of being easy to explain to industry participants. But if analysing the productivity performance of an entire economy or an aggregate of industries, the gross or net value added is preferable in relating readily to the familiar GDP measures. Net value added is gross value added with depreciation deducted, leaving the dominant components of operating surplus and employee compensation. As households cannot consume depreciation, net value added is more readily related to the real incomes of households and businesses.

Input choice often affected by data availability

For the denominator, labour productivity measures offer the choice of using hours worked, numbers of employees, or some other quality adjusted measure of labour input. Recently, hours worked is being used with more frequency, because it now has long time series and offers greater confidence in aligning the inputs with the outputs obtained (SNZ 2010).

For capital productivity and MFP measures, the estimation of the capital component is more problematic as there is no universally accepted measure of capital input. Usually analysts resort to the construction of their own series, which involves a number of assumptions about the expected lifetime of the capital stock (which varies for different types of capital, such as plant, equipment and buildings) and also the appropriate discount rate to apply to it.

3.1.2. Standardising the data

Removing price effects is important; as is the choice of deflator

To examine productivity over time, a first adjustment is to convert the nominal figures into real values in constant dollar terms. This is either done by applying a deflator or by year-by-year chain linking of data, in which the nominal figures for one year are recalculated at the price of the previous year to arrive at a pure volume measure of change. So, for example, if gross output was the output variable being used to estimate deer sector productivity, then a deer price deflator would be applied to the nominal value of output.

The choice of deflator matters as it can affect results. For instance, applying an aggregate economy-wide deflator to a specific industry may not remove all of the price variability specific to that sector's produce.

There should be no price component in quarterly gross output for a sector if it is based on volume data (such as tonnes of a particular commodity). This is the current

practice with Statistics New Zealand's calculation of quarterly gross output for each farm type in its agricultural sector[1], which is in constant prices.

The gross output for the different farm types is summed to give total quarterly gross output. To get to value added, real intermediate consumption needs to be subtracted.

To do so, annual intermediate consumption is deflated by the Farm Expenses Price Index (FEPI). This gives a constant price annual intermediate consumption which can be subtracted from annual gross output to give annual value added. Quarterly gross output is then reconciled to annual value added to give the levels for quarterly value added.

The Farm Expenses Price Index is a Laspeyres index. It calculates prices for a fixed basket of goods. Laspeyres indexes tend to be slightly biased because of the substitution effect. If the price of one commodity increases, producers might substitute a cheaper alternative if possible.

The FEPI is divided into four farm types: Horticulture, Sheep and Beef farms, Dairy Farms, and Cropping and other farms. Within these farm types, several types of expenses are calculated, including electricity, fertiliser, and insurance premiums. The data is sourced from the commodity price survey, and the survey is representative of each commodity. The weights for the different expense categories are fixed, as are the commodities used for each expense type. Changes in the commodities used to calculate the FEPI only occur when a particular commodity is no longer available, in which case a replacement commodity as close to the original commodity as possible is used.

Inputs and outputs also need to be weighted

Because both outputs and inputs are variable and can change over time within a single industry, comparisons of raw output and input figures could give a distorted picture of effects over time or across industries. To counter this, both outputs and inputs need to be weighted to create an index that reflects price and quantities over time with compositional shifts removed.

For instance, unless allowance is made for changes in the proportional mix of sheep and beef output, or between pasture and supplementary feeds, productivity ratios could give misleading impression of real productivity changes.

There are four main indexes encountered in the literature (although others could potentially be used). These are the Laspeyres, Paasche, Fisher and Törnqvist indexes (see Black et al 2003 for formulations). The literature also describes two approaches to selecting an index for constructing productivity ratios.

- An economic approach chooses the index according to its fit with an assumed underlying function of production, cost, revenue or profit.

[1] Statistics New Zealand publishes real GDP annual values, 1989-2013, for the following primary industries: Agriculture; Forestry; Fishing, aquaculture and agriculture, forestry and fishing support services; and Mining; and in secondary processing sectors for Food, beverages and tobacco; Textiles, leather, clothing and footwear manufacturing; Wood and paper products manufacturing; and Printing.
http://www.stats.govt.nz/browse_for_stats/economic_indicators/GDP/GrossDomesticProduct_HOTPMar13qtr.aspx

- Alternatively an axiomatic approach bases choice of an index number formula on the properties exhibited by the index, compared against the axioms for an ideal index.

The literature on productivity measures favours the use of a Fisher index (which is a combination of Laspeyre and Paasche indexes) or the Törnqvist index, which are regarded as having a stronger axiomatic case than the Laspeyre or Paasche indexes (Black et al 2003).

That literature indicates that use of a Fisher index generally shows lower productivity than applying Laspeyre indexes alone to the same data (OECD 2003); also that using the Fisher index or the Törnqvist index produce similar results (Diewert & Lawrence 1999). While recent empirical estimates in New Zealand have predominantly used the Fisher index, the Törnqvist index was recommended by the OECD (2001) and is now used by Statistics New Zealand in its productivity estimates.

3.2. Limitations and challenges to current measures

Partial measures only provide partial information

As indicated above labour productivity is more often used as the proxy measure for productivity: the requisite information is readily available and it is more easily understood than the alternatives of capital productivity and MFP. However, it can be misleading if the labour productivity figure reflects the influence of other inputs (like capital) that affect productivity but are omitted.

By under-accounting for inputs that contribute to productivity growth, the productivity assessment is allowing a “free lunch” that can bias results (and any policy design based on those results).

Position in business cycle can affect estimates

Output per person is also subject to fluctuations in the business cycle, which can lead to misleading results in labour productivity estimates. When an economy starts to recover, firms may work their employees harder rather than hire new staff, raising the level of productivity which then falls later when the recovery is sustained long enough to give firms confidence in hiring new labour.

The interpretative risks have become apparent in the global financial crisis, with different countries recording productivity impacts which at first sight appear counter-intuitive. Apparent productivity gains may arise in a faltering economy in which fewer people are engaged in work, whereas productivity may fall during recovery as more labour is hired. This is just the result of the arithmetic in the productivity ratio.

Sectoral detail is limited

A significant limitation of productivity estimates to date is their coverage. Historically, many of the analyses focused on a “measured economy” comprising primary and

manufacturing sectors but excluding many of the harder to measure services industries.[2]

For instance, they omit some public sector and non-priced service sectors (such as central and local government services) on grounds that national accounting records their output value at cost rather than value people's willingness to pay, so there is no true output value to relate to input cost. As service industries have accounted for an increasing share of employment in developed countries in recent decades, this – historically at least – has created a rather large hole in productivity measurement that limits the conclusions to be drawn about the efficiency of resource use across the economy.

In New Zealand, as the next section discusses, the level of sectoral detail has been gradually increasing over time, but remains fairly aggregated. This limits the use of existing estimates for policy analysis at a sectoral level.

Challenges remain in using data available

The OECD Manual (2001) on productivity measurement identifies four particular challenges for statisticians in compiling productivity measures:

- Price indices used for output measures by industry
- Measurement of hours worked by industry
- Weak empirical basis of existing measures of capital inputs
- Need for institutional, historical and case study material to explore the underlying causes of apparent productivity improvements that appear in the productivity measures.

Some of these issues remain apparent in recent empirical studies, as described in the next section.

[2] Although it should be noted that Statistics New Zealand now produces productivity statistics for most services sectors, including the education and health sectors.

4. Current knowledge of productivity in New Zealand

There have been a number of labour productivity and MFP estimates undertaken in New Zealand, both from an economy-wide perspective and specific to the primary sectors. The 1990s in particular saw an increase in the number of studies being undertaken, with long time series for productivity being constructed to examine the effect of the structural changes and economic policy reforms implemented in the mid-1980s.

Although these studies have used different estimation methods, data series and periods for examination, some common themes emerge about labour productivity in New Zealand at large, and in the primary sectors in particular. These are summarised below.

4.1. Economy-wide productivity

In recent years, New Zealand's productivity, particularly labour productivity, has come under increased scrutiny, to find out why it remains low – in both level and growth – by OECD standards. Much of this has been driven by comparison with Australia, and the link between labour productivity and wages and incomes that is believed to be a major attraction for the trans-Tasman migration of workers from New Zealand.

Diewert and Lawrence set the standard...

A landmark study for recent economy-wide productivity in New Zealand was that by Diewert & Lawrence (1999), who were commissioned by the Treasury and the Reserve Bank to examine productivity and the discernible effects of reforms in the New Zealand economy. Diewert & Lawrence constructed their own data series to measure productivity over time, conducted comparable analysis using an official database available to New Zealand officials, and also comparable analysis with a data series allowing comparison with productivity work undertaken by the Australian Bureau of Statistics (ABS). They also performed a range of sensitivity analyses to illustrate the robustness of their estimates to changes in key assumptions in their calculation.

Diewert and Lawrence used the Fisher index and hours worked to measure labour input, and included land as an input in one of their variants, although its inclusion or exclusion did not have much effect on their results. They focused on TFP, with some consideration of labour and capital productivity, spanning the period 1978-1998.

...and showed considerable variability in New Zealand's TFP over time

Drawing on their various results and a review of previous literature in New Zealand, Diewert & Lawrence suggest a consistent picture emerges from these diverse sources: New Zealand's national productivity was poor in the 1970s, strongly improved in the early 1980s but then flattened off in the years to 1993 (a period

coinciding with industry restructuring and laying off of staff) and resumed a surge into the later 1990s.

Comparisons with Australia then started to become more common

Treasury followed up with its own estimation of productivity using a Fisher index to measure aggregate and industry productivity over the period 1988-2002 (Black et al 2003). The paper found that labour productivity growth since 1994 had been higher in Australia than in New Zealand, whereas capital productivity growth had been higher in New Zealand than in Australia, because of a lower rate of capital accumulation in New Zealand.

This illustrates a limitation of the partial productivity measures as arithmetic constructs that simply attribute productivity gain to a factor from change in level of other inputs used with it: adding capital to labour raises labour productivity, while restricting capital for labour (or adding labour to capital) raises capital productivity.

There are circumstances in which adding labour to capital can be a beneficial course, for instance creating jobs for the un- or under-employed which raises their productivity above what it would otherwise be. Productivity measures by themselves are not illuminative of why particular relativities emerge between industries or nations, but they certainly highlight the comparisons and fuel anxieties.

New Zealand and Australia experienced similar multifactor productivity growth after 1998, but Australia achieved much more impressive growth in labour productivity. In 2004 New Zealand's labour productivity, measured in terms of output per hour, was 76 per cent of Australia's.

This raises the question of why labour productivity in New Zealand has been lower than that in Australia? There are several suggested causes and contributing factors, but the literature to date identifies two in particular:

- small scale and geographical isolation; and
- low capital intensity.

Small scale and geographical isolation are prime suspects behind our relatively poor performance

In 2005, the Treasury (Davis & Ewing 2005) explored a number of potential sources of this difference in labour productivity – regulatory policy, level of education, research and development intensities and the interaction of productivity with labour force participation – but found the most promising explanation to be the impact of:

- location relative to global economic activity;
- internal geography; and
- population density.

Australia has advantages over New Zealand in these three areas. Its greater ability to capture increasing returns to spatial concentration from knowledge spillovers, thick labour markets and supplier proximity to customers may explain its higher labour productivity.

Analysis by the International Monetary Fund (IMF 2004) estimated New Zealand's distance from major markets accounted for over half of its economic under-

performance relative to other OECD countries since 1970. The IMF attributes the remainder to high initial incomes and historically low savings rates and high inflation rates, together with a relatively low rate of capital accumulation. In contrast, Australia's greater labour productivity growth has been driven by higher investment. This brings us to the second possible area of explanation.

Along with low capital intensity

Since the early 1990s New Zealand's rate of physical capital accumulation has been slower than the OECD average, resulting in a lower level of capital per hour worked, known as "capital intensity".

In a paper for the Treasury, Hall & Scobie (2005) identified that capital intensity has been increasing more slowly in New Zealand than in Australia for nearly 25 years. They estimated that 70 per cent of the difference in output per hour worked over 1995 to 2002 could be explained by New Zealand's lower capital intensity.

Lower capital intensity may stem from a lower cost of labour relative to capital, which encourages the adoption of less capital intensive production methods, and/or different underlying production methods. Whilst the cost of labour relative to capital has been rising in Australia, in New Zealand it declined by 20 per cent between 1987 and 2002. As a result, it fell from around parity with Australia in the late 1980s to 60 per cent of Australia's in 2002. Hall & Scobie also found some evidence of differences in production technologies between New Zealand and Australia, reflected in New Zealand's lower responsiveness of capital intensity to changes in the wage rate relative to the return on capital.

High participation rates may drive down labour productivity; with TFP being pulled down by low uptake of ICT and R&D

New Zealand's increase in labour participation (employment rates and hours worked), which fuelled New Zealand's recent improvement in economic growth and is now high relative to other countries, may have had some effect in driving down average labour productivity. Work at the Australian Productivity Commission suggests that periods of labour expansion, prompted by labour market reforms reducing the real wage, should be excluded from national productivity comparisons (Parham & Roberts 2004).

With this exclusion, Parnham & Roberts consider the explanation for New Zealand's poorer labour productivity to lie less in lower capital intensity than in lower overall levels of efficiency of resource use as measured by multifactor productivity. This, in turn, it suggests may be due to a gap in uptake of information and communications technology and low investment in research and development.

In another Treasury paper, Janssen & McLoughlin (2008) take up the refrain of why New Zealand's labour productivity remains relatively low in comparison to other developed countries. This paper notes that productivity measurement in New Zealand has improved with official productivity data being issued for the measured sector. Those data suggest that while productivity growth in New Zealand's measured sectors has been on a par with that of Australia over the past two decades, it dropped off in the years after 2000.

It considers explanations relating to employment growth, changes in labour quality and industry and sector developments. It finds that recent growth in output has been driven by rising participation in the labour force and falling unemployment, by improved labour utilisation rather than labour productivity.

Changes in measurement techniques can affect cross-country estimates

Continuing the theme of trans-Tasman comparison, Statistics New Zealand and Treasury issued a report in 2010 entitled provocatively "Taking on the West Island" (SNZ 2010). Using the same industrial classification system and similar methodologies for measuring productivity, it compares Australia and New Zealand across 12 broadly defined industries that comprise the "measured sectors" and accounted for 60% or more of each country's economies.

Looking at the period 1978-2008 across the whole economy of each country, this paper found that the Australian average annual labour productivity grew at an average of 1.7% per annum compared to 1.4% per annum for the corresponding estimate in New Zealand. But in the measured sectors New Zealand labour productivity grew at 2.2% per annum, slightly higher than the corresponding sectors in Australia (2.0% per annum).

The paper tactfully suggests that the difference in results may be due to the difficulty in measuring the mainly government service sectors outside the measured economy, rather than leaping to the conclusion that those sectors have low productivity that drags down the better performing measured sectors in the economy-wide estimate.

Warmke et al (2011) examine results from the labour productivity, capital productivity and MFP estimates that have been published by Statistics New Zealand since 2006. These estimates are for the measured sectors only, in which agriculture, forestry and fisheries are combined into a single primary sector.

The paper finds that industries recording higher average growth in labour input tend to have lower average labour productivity. The highest productivity performance has been in the communication services sector, but the primary sector is one of 4 sectors recording a better than average improvement in productivity. The paper raises the paradox that application of ICT investment does not always translate to higher productivity, as declining MFP offsets the capital injection boost.

The relatively strong performance of agricultural sectors is noted in other studies (NZIER 2011).

4.2. Primary sector productivity

The Ministry for Primary Industries' website currently states that from 1984-2007, productivity grew by 3.3% per annum in the agricultural sector and by 1.6% per annum in the forestry sector. That period covers the aftermath of the major reform of agricultural policy settings, with widespread implications for productivity.

Early studies used varying approaches, limiting comparability

There has been a long history of studies of New Zealand agricultural productivity dating back to the 1950s, as listed in Johnson & Forbes (2000). These early studies derived volume data series from the national accounts using the double deflation

method, whereby outputs and inputs are deflated separately and the difference between the two is the real factor income. The resulting index depends on the base year chosen, which adds to the variation in results of these studies caused by their methodological differences.

More recent studies have used methods more aligned with the economy-wide productivity studies, although not following exactly the same methodology. Some studies, for instance, have used the Törnqvist rather than Fisher index weighting to overcome biases caused by changes in the components of a given volume index (Johnson & Forbes 2000, Cao & Forbes 2007).

Johnson & Forbes (2000) estimated productivity from national income data for the agriculture and forestry sectors prepared by Statistics New Zealand, drawing comparisons with the corresponding sector results from Diewert & Lawrence and also comparing the results prepared with a Törnqvist and a Laspeyre index. This shows the Törnqvist indexes tend to lower the factor income and productivity growth rates, compared to calculations using the Laspeyre index.

International comparisons show mixed results for agriculture

Mullen et al (2006) estimate productivity growth and rates of research activity in a comparison of the performance of agriculture in New Zealand and Australia and some other countries. They estimate MFP for the composite primary sector of agriculture, forestry, hunting and fishing grew at an annual rate of 1.5% from 1988 to 2004. They also found that over the period 1970 to 1987 agricultural sectors had higher rates of productivity growth than other sectors in a number of developed countries, but that the New Zealand primary sector had not performed relatively as well as that in Australia, UK or USA.

That relatively poor result from Mullen et al is inconsistent with that of Diewert & Lawrence (1999), who found TFP growth in agriculture over the 1978-1998 period to be three times that of the economy-wide TFP growth. But it is not necessarily inconsistent with Johnson & Forbes (2000), who calculate TFP growth of 1.8% in the 1972-1984 period and 4.0% in the 1985-1998 period. They estimated a similar change between periods in the forestry sector (from 1.5% to 4.6%), suggesting that both sectors improved their productivity performance after the policy reforms in the mid-1980s.

Productivity performance varies between sub-sectors, and over time

Cao & Forbes (2007) present updated estimates of TFP in both primary production and downstream processing sectors. The results showed agriculture having the highest annual productivity growth, and a negative productivity in wood products, a sector which will have seen a lot of capital removal with widespread closure and rationalisation of smaller sawmilling plant.

They also estimated that agriculture's labour productivity grew faster than capital productivity after 2003, following years of similar growth, which could be explained by increased capital investment with conversion of pastoral farms to dairying. The comparison of results with other estimates is presented in Table 1 below.

Table 1 Productivity estimates for primary sectors

Annual average per cent change in Multi-Factor Productivity

Sector	Diewert & Lawrence 1999	Mullen et al 2006	Cao & Forbes 2007
	1978-98	1988-2004	1988-2006
Agriculture	3.9	1.5% (ag/fish/for)	2.7
Fishing	0.3		
Forestry	6.3		1.5
Food & beverages	0.7		1.1
Wood products	0.3		-0.1
Pulp & Paper	1.3		

Source: Diewert & Lawrence 1999, Cao & Forbes 2007, Mullen et al 2006

Recent MPI release focuses on partial measures

In 2012 the Ministry for Primary Industries issued a study of Pastoral Input Trends in New Zealand, which included some time series on intensification and productivity. This drew from the Linked Employer and Employee (LEED) longitudinal dataset developed by Statistics New Zealand which provides a measure of total on-farm labour use, including employees and farm owners.

The report presents results for labour per kilogram of milk solids and per unit of beef or lamb produced, showing declining labour intensity per unit output over the period 2002-2009. It also presents similar series on farm inputs of Nitrogen, Potassium and Phosphorus per kilogram of farm output, and also of debt per unit output.

These measures indicate productivity, with output measured in physical rather than value terms. They are readily understood and provide some indication to farmers of what has been achieved.

However, they are more measures of intensity with respect to input use than productivity measures, and they sit a little to one side of the tradition of productivity studies done in New Zealand to date. As physical measures they are not directly comparable with other sectors, although they could be converted to a form more comparable with other productivity estimates.

They do provide some insight into labour use and productivity. Further matters relating to labour productivity are addressed in Table 2 below.

Statistics New Zealand figures allow comparison across the primary sector, but at a relatively high level only

Statistics New Zealand has been publishing productivity measures since 2006, using series that date back in some cases to 1978 (see Appendix B). These measures are at a fairly high level of aggregation. In the primary sector there are (in descending order of aggregation) separate indexes for:

- Primary industries (which includes mining)
  - Agriculture, forestry and fishing

- Agriculture
- Forestry, fishing, and services to agriculture, forestry, and fishing.

There are also indexes for the 'Food, beverages and tobacco manufacturing' and 'Wood and paper product manufacturing' sectors.

Apart from their relatively high level of aggregation, some characteristics of the Statistics New Zealand measures for comparison with earlier estimates include:

- They construct their indexes using the Törnqvist formulation, in accordance with the recommendations of the OECD's Productivity Manual (OECD 2001)
- They deflate GDP series with chain linking (Statistics New Zealand 2013a)
- They use – for the aggregate 'measured economy', but not any specific industries – a quality adjusted labour input index, which reduces the multi-factor productivity attributable to variables such as technology change and technical efficiency improvements.

They use a standard labour input index for the industry specific measures, based on a Tornqvist index which weights each industry's labour hours with its marginal product of labour. This implicitly reflects quality if skills are picked up in wages. However, it has noticeably less effect on the labour input measure than the explicitly quality adjusted labour input series, which reflects differences in skills and experience.

The effect of this quality adjustment, at the aggregate level, is illustrated in Figure 2. Apart from an obvious drop after the global financial crisis in 2008, the figure shows the quality adjusted labour input series growing at an annual average rate of 1.3% per annum, faster than and diverging from the standard Labour Input index (1.0% per annum) and hours paid (0.9% per annum). Hours paid grew faster than labour supply during buoyant growth until 2005 but have declined since then.

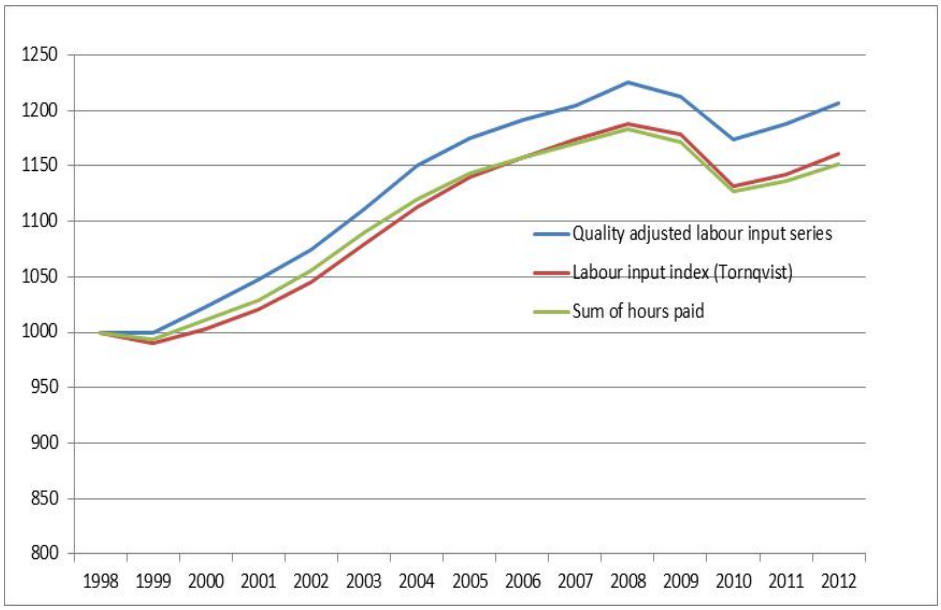
An implication is that the multi-factor productivity attributed to factors other than labour quality has declined from what it would have been had labour quality not been growing faster than hours worked.

Statistics New Zealand calculates this quality adjusted index by adjusting the unweighted labour volume index with movements in proxies for skill, educational attainment and estimated work experience. This adjustment process uses the Household Labour Force Survey and the New Zealand Income Survey to identify relative incomes of the different categories of employment. Average wages are calculated with an OLS regression, with experience, qualifications, and dummy variables for urban/rural and full-time/other included in the model. This method accounts, for example, for demographic change as the underlying sample data retains representativeness to the demographic structure of the population. So as the number of older workers increases then there will be a more experienced workforce, and this will be reflected.[3]

[3] Further information on the methods for accounting for compositional change is available in on pages 7-11 in: http://www.stats.govt.nz/browse_for_stats/income-and-work/employment_and_unemployment/accounting-changes-labour-composition-measurement-labour-productivity.aspx

Figure 2 Effect of quality adjustment on the labour input index

All sectors New Zealand, 1998-2012



Source: Statistics New Zealand

Does growth in contracting affect these measures?

There could be a range of effects from a significant growth in contracting in an industry.

If the contractors were also classified as being within the same industry (e.g. within the 'Agriculture, Forestry and Fishing Support Services' sub-sector, which falls under the 'Agriculture' sector), then in theory value added and labour productivity should remain unchanged, as contracting out should increase both output and intermediate consumption.

This might not be the case, however, if the contractors were genuinely more productive than the other agricultural workers who they replaced, in which case output should increase by more than intermediate consumption.

If the contractors were from another industry, then labour productivity for the industry contracting out may increase (assuming value added was unchanged) but the effect on the industry providing the contractors is unknown as its labour input would increase as well as value added through additional gross output. So, overall productivity might be boosted by some reallocation effects across the contractor using and contractor providing sectors.

In practice, the effect of growing contracting is likely to be very small in Statistics New Zealand's existing productivity statistics because they include services to agriculture in the broader agriculture sector definition. The effects would become more apparent if disaggregated labour productivity measures for sub-sectors were constructed, revealing cross-sub-sector allocation effects.

Key questions on measuring primary sector labour productivity

You have posed a number of questions that have arisen in the course of your previous work on productivity. We cover a number of these topics in the report, but provide brief responses here for completeness.

Table 2 Answering your questions

Question	Response
What are the various ways of measuring labour productivity, and how should these measures be interpreted?	See section 3.1.It is usually a ratio of an activity's production (gross output, value added etc.) to its labour inputs (employees, hours worked etc.), but can also be calculated in physical output units.
What are the drivers of labour productivity, e.g. climate, output prices and capital deepening?	There are numerous drivers, such as skills, capital deepening, interaction with other factors of production (energy, soils). Variable climate and environmental factors (e.g. drought) affect short term productivity, which may be dampened over the long term with investment in irrigation and other improvements. Output prices should not directly enter productivity calculations as all inputs and output should be deflated, but this depends on an appropriate deflator being applied to convert nominal output into real volume terms (see section 3.1.2).
Can the impact of skills be measured?	Conceptually yes, although there are some estimation challenges. Quality-adjusted measures of labour input are calculated by Statistics New Zealand for broad industry categories (see end of section 4.2). Data sets exist on levels of qualifications of workers in the primary sector, although they may reside with industry organisations rather than Statistics New Zealand.
How robust are the official productivity statistics?	We have no reason to doubt their robustness. The question of how useful they are to the Ministry is another matter: the high level of aggregation limits their value.
Can the statistics be further disaggregated to get a clearer picture of different industries?	Yes. Labour productivity estimates should be easy to calculate for sub-sectors within the primary industries. TFP estimates would take more effort due to the need to get detailed capital stock data, but it should be feasible.
Would a gross output measure be better than the value-added series and how feasible would it be to produce this?	It should certainly be feasible – Statistics New Zealand produce gross output figures. Both gross output and value added can be obtained for disaggregated sectors from input output tables, although these do not provide continuous time series. Which is better depends what you want to measure and why. (see section 3.1.1)
How robust are the labour per unit of output measures in MPI's 2012 report? Can similar measures be created for other industries?	They appear robust, but their meaning is limited as we don't know what other inputs (with which labour interacts) are doing (see section 2, page 2). Few other industries (e.g. all of the services sector – some 70% of the economy) have similar commodity-type outputs that can sensibly be measured in terms

	of their weight, so comparisons will be very limited and largely meaningless.
Does forestry have measurement issues given their relatively long production cycles?	Definitely. This highlights the need to separate forestry out from aggregated measures, and for Statistics New Zealand to continue working with other international statistics organisations to ensure best practice estimation techniques are being used. However, productivity is not the same as profitability and the long lead times need not affect productivity measured for specific activities within forestry. For instance, if logging output and labour input can be separated from other forestry activities of planting and tending, labour productivity can be estimated for logging without regard to the age of the trees.
How can we benchmark New Zealand's performance? Who should we compare ourselves against?	Ideally you need internationally-prepared estimates from independent bodies such as the OECD. Comparators might include New Zealand's competitors in each market to check where New Zealand stands in competitiveness terms. But more diagnostic tools will be required to provide an indication of *why* New Zealand's productivity might be different from other countries.

Source: NZIER

5. Where next for primary sector productivity estimates?

5.1. Pulling it together

Key themes emerge from the New Zealand literature

Numerous productivity studies have been done to date, with diverse purposes, methods, sector coverage and results. Despite differences, there are recurring themes for the primary industries, including:

- Most studies to date concentrate on primary production, with fewer giving attention to primary processing
- Most studies also focus on a high level of industry aggregation, in some cases combining agriculture, forestry and fishery into a single sector, and never disaggregating processing beyond the composite food and beverage sector
- Some studies have been prepared specific to agriculture, and to a lesser extent forestry, but fishing appears most in economy-wide studies or included in a composite sector with agriculture and forestry
- Most productivity estimates show New Zealand agriculture exhibiting higher productivity growth than the New Zealand economy at large in recent years, although there are exceptions and studies hinting at that growth tailing off
- Most MFP studies have limited coverage of input factors, usually only capital and labour, and rarely consider the influence of land or other natural resource inputs or the qualities of labour and management
- Some indicate that agriculture has exhibited productivity improvement since the policy reforms of the 1980s.

Choice of measure to analyse depends on the purpose of the analysis

Most studies focus on MFP, the residual gain in value after allowing for changes in other inputs such as capital and labour, which is attributable to other factors such as technology improvements, best practice adoption, or managerial skills. But labour productivity which relates output to labour input is still commonly encountered as it is simple to construct from readily available data, avoids the difficulties of having to value capital or other inputs like land, and is easily understood.

Productivity as described in the literature is an indicator of resource use efficiency. Indicators can be divided according to their uses into “dials” which act as warning devices for changes in condition, or “can-openers” that operate more as diagnostic tools for identifying the cause of such changes.

Labour productivity and capital productivity are partial productivity measures that act more as dials than can-openers. That is, they are indicators of broad trends rather

than a means of pin-pointing their causes. MFP has more diagnostic uses in that it identifies the residual gain and does not (mis)attribute it to single input factors, but it too is more of a dial than a can opener.

More detailed diagnostics require econometric analysis that can examine the role of multiple factors in output changes, but this is data-intensive. For instance, it is possible to decompose MFP by regressing it over time against indexes reflecting technological change, technical efficiency and other influential variables to indicate the relative importance of each to output growth, as has been done in the study of productivity growth in China's dairy farms (Ma, Liu & Oxley 2012). A similar attempt to decompose TFP for New Zealand agriculture and regions was attempted by Rae et al (2008), but this concluded that the empirical results were too uncertain to suggest policy recommendations other than the need to improve available data.

Therefore, it is critical to decide what you want to measure and understand before committing resources to potentially expensive research studies:

- If you want to monitor labour use, then simple measures of labour productivity will suffice. But these will tell you little about why productivity is going up or down.
- If you want to compare between sectors to gauge shifts in resources, then you may be better off just looking at employment or Business Demographics data.
- If you want to compare between countries to see if New Zealand's competitors are catching up or moving ahead of domestic producers, then you should draw on estimates produced by international organisations like the OECD. These will be robust and consistently estimated but have the downside of being at a fairly high level of sectoral detail.
- If you want to know why output – either in absolute or relative terms – has been increasing or decreasing, then you need to use techniques that have more diagnostic power, such as econometrics or other statistical methods.

5.2. A focus for MPI: getting beyond the headline numbers

Statistics New Zealand has been publishing productivity statistics since 2006, so the Ministry for Primary Industries can complement that effort by concentrating on interpreting those statistics for primary sectors and supplementing them by addressing matters that are not covered by the statistics.

Disaggregation should be a priority in order to tell a richer story

Statistics New Zealand's productivity measures are at a high level of aggregation that often combines agriculture, forestry and fishing into a single sector, or only distinguishes total agriculture from other biological-based primary activities. MPI may want to disaggregate them into the separate industries, maybe even distinguish agriculture from horticulture or dairying from other agriculture, and split out dairy processing and meat processing from the broad food and beverage sector. This could aim for something similar to what ABARES is doing in Australia (Dahl et al 2013).

Another option would be to look at the level of disaggregation in the New Zealand input-output tables as a guide.[4] This provides a more detailed breakdown of the primary sector, and indicates that Statistics New Zealand are likely to have the necessary input data to at least prepare some cross-sector comparisons at one point in time. Sectors in the input-output table include:

- Horticulture and fruit growing
- Sheep, beef cattle and grain farming
- Dairy cattle farming
- Poultry, deer and other livestock farming
- Forestry and logging
- Fishing and aquaculture
- Agriculture, forestry and fishing support services[5]
- Meat and meat product manufacturing
- Seafood processing
- Dairy product manufacturing
- Fruit, oil, cereal and other food product manufacturing
- Beverage and tobacco product manufacturing
- Textile and leather manufacturing
- Wood product manufacturing
- Pulp, paper and converted paper product manufacturing.

Further development of productivity measures depends on the purposes for which productivity indicators are required, and the feasibility of making worthwhile improvement in the measures without entailing excessive cost.

5.3. Addressing current weaknesses

The Ministry for Primary Industries has stated objectives of improving sector productivity to maximise export opportunities, and increasing sustainable resource use. These involve improving understanding of the primary sectors' role in achieving wider economic benefit, which include raising economic growth and re-balancing the economy from debt-fuelled consumption towards more productive sources of growth.

Productivity measures can be used as dials in gauging progress towards these ends, but this does require that the measures are reliable and believable. That in turn suggests there could be value in addressing weaknesses in current estimates.

The review of current knowledge of productivity estimates in New Zealand above reveals a number of weaknesses that could be addressed in future commissioning or use of productivity measures.

Most of the studies done to date concentrate on the primary production sectors only, and few enable a link to be explicitly drawn with downstream processing

[4] See http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/input-output%20tables.aspx

[5] Looking at this sector in more detail may provide some insights into MPI's questions about the extent and effects of contracting out.

industries that convert primary produce into value added products. Even then the downstream industries were presented at an aggregated level which may conceal productivity improvements in particular sub-sectors of the primary industries.

As suggested above, to improve understanding of how productivity adds value to primary production, estimating productivity on a consistent basis across the value chain – production, processing, marketing and distribution – for different products – agricultural, horticultural, seafood or forestry – could provide a richer picture of strengths and weaknesses of the current production structure and practices.

For instance, if productivity improvement is seen as a way for forestalling expected labour shortages – by improving efficient use of labour and raising wages and attraction of labour into the industry – disaggregation into different components would be more informative than the current broad sectoral productivity measures.

Diewert & Lawrence (1999) identified the two most important areas of further work were in improving labour data (better dealing with the self-employed and casual and part time staff) and better measurement of the outputs and inputs of service sectors. Improving labour data is particularly pertinent to the primary sectors, given the relatively high proportion of working proprietors among the total labour force, and the difficulty of observing hours worked on the farm by family members. The Linked Employer Employee Dataset (LEED) provides a rich source of information covering both employees and working proprietors that could eliminate some of the past issues in measuring labour input into the pastoral sectors.

Another source of variability in current estimates is controlling for seasonality and one-off events like drought. The Ministry could consider working with Statistics New Zealand and other agencies with particular interest in seasonality, such as tourism bodies, on resolving methodological issues.

5.4. Building on the current base

Beyond addressing the weaknesses of current estimates, there is potential to build on base of current studies in various ways. This might be done to address various questions:

- What is the geographical variation in the pattern of productivity? If there is significant variation in productivity between regions, this could be caused by differences in industry composition, environmental factors, or institutional characteristics such as the planning and resource management system. Establishing what geographical variation in productivity exists is a first step in moving from dial to diagnostic indicators.
- What is the source of productivity gain? This requires unbundling the gains in MFP to particular sources, which has already been examined in part with respect to research and development activity but could be extended with respect to such variables as natural resource inputs like water, labour quality or managerial qualifications.
- How does productivity affect profits and investment? Current estimates note that productivity gains in the post 1985 period have not been matched by gains in farm income, which on the contrary have fallen relative to non-farm incomes over that period. Establishing the relationship between productivity

measures and farm incomes would help to identify where improvements in the two measures align, and better incentivise industry players in targeting their investments and achieving national productivity aims.

5.5. Conclusion

There are many ways in which productivity measures for the primary industries could be developed further. This could include greater disaggregation of sectors, further attention to what's causing productivity improvement and identifying measures to achieve sustained productivity improvement. But to ensure you get value for money from resources pointed in this direction, the first step is to be clear on what you want to look at and why.

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Appendix B Statistics New Zealand productivity measures

Statistics New Zealand issues a range of productivity estimates and data on labour and capital inputs and outputs on which productivity is based (Statistics New Zealand 2013a). These include productivity data for the total economy and the 25 industries that make up the "measured sectors" (i.e. excluding government and non-profit services, where it is difficult to determine output value for productivity measures).

Data are available for each of the 25 industries, along with three aggregates, three sectors, and the measured (and former measured) sector. The series currently cover the years 1978 to 2011, and are consistent with the level of detail available at the industry level. These statistics are based on the Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC06).

Principal data sets available on Statistics New Zealand's website[6] are:

- Productivity by industry, annual per cent changes averaged across each growth cycle (Tables 1.01, 1.02,1.03), including:
  - Separate indexes for 'Primary industries' (includes mining); Agriculture, Forestry & Fishing sector (excluding mining); and further disaggregated to Agriculture sub-sector and 'Forestry, fishing, and services to agriculture, forestry, and fishing' sub-sector
  - Also 'Goods-producing industries', with 9 sub-sectors including Food, beverages and tobacco manufacture and wood and paper products manufacture
  - Period covered 1978-2011
  - Also 'Service industries' and 11 sub-sectors
- Productivity inputs and outputs indexes and percentage changes, including labour, capital and multifactor productivity indexes (Tables 2.01-2.17)
  - Labour, capital and multi-factor productivity
  - For 'Primary industries' (includes mining) and subdivided into; Agriculture, Forestry & Fishing sector and separate Mining sector
  - For Goods Producing Industries, no series on primary sector processing
  - Period covered 1978-2011
- Unit labour cost statistics: nominal and real for the total economy and measured sectors, covering 2000-2011 (or 2012 for some series) (Tables 3.01-3.09)
  - Covering the total economy, measured sectors, measured sectors excluding agriculture, goods-producing industries and service industries
  - No series specific to agriculture, forestry or fishing sectors or associated processing and distribution activities.

[6] http://www.stats.govt.nz/browse_for_stats/economic_indicators/productivity/IndustryProductivityStatistics_HOTP78-11.aspx