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Productivity Statistics: 1978-2008

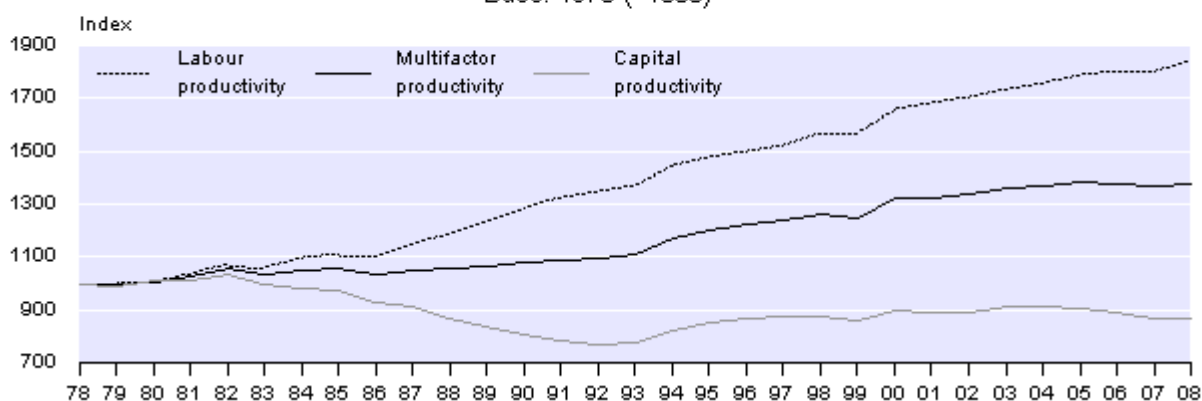
Highlights

- Average annual labour productivity grew 1.3 percent over the 2000–08 period, compared with annual growth of 2.0 percent from 1978–2008.
- Average annual multifactor productivity fell 0.4 percent over the 2000–08 period, compared with an annual fall of 0.5 percent from 1978–2008.
- Average annual multifactor productivity grew 0.6 percent over the 2000–08 period, compared with growth of 1.1 percent from 1978-2008.
- New in this release is a composition-adjusted productivity series, which accounts for differences in the skill composition of workers. From 1998–2008 composition-adjusted labour productivity averaged 1.2 percent growth annually.

Measured Sector Productivity Indexes

Year ended March, 1978–2008

Base: 1978 (=1000)



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See also [Productivity Statistics: 1978–2008 – Media release](#).

Commentary

Annual productivity series for the measured sector from 1978–2008 have been released in this publication. In 2005, the latest year for which current price industry value added data are available, the measured sector covered approximately 73 percent of the economy. It excludes the following industries: government administration and defence, health, education, ownership of owner-occupied dwellings and property services. From 1996 onwards business services, and personal and other community services are included in the measured sector.

The supplementary tables include data for the former measured sector from 1978–2008. This data maintains the previously released time series and maintains comparability with Australia, whose official productivity statistics have the same industrial coverage as Statistics NZ's former measured sector. See 'Industry coverage – the measured sector' in the Technical notes for more detail on the coverage of the measured sector and former measured sector.

Unless otherwise stated, all references to average movements are annual geometric mean movements relating to the measured sector.

Productivity estimates are subject to capacity utilisation rates over the period of a business cycle, making interpretation of annual movements difficult. The series are of most value when analysed as average growth rates from the peak of one growth cycle to the peak of another. Statistics NZ has estimated growth cycles in the data to assist users in interpreting the results of the productivity series. Please note that the latest period (2000–08) is not a complete cycle. The economic picture within this period is assessed as each new data point becomes available. The assessment determines whether a more recent peak has occurred within the series, and therefore whether a new growth cycle has begun. Caution is advised when comparing the latest period with other cycles. For more information, see 'Estimating growth cycles' in the Technical notes.

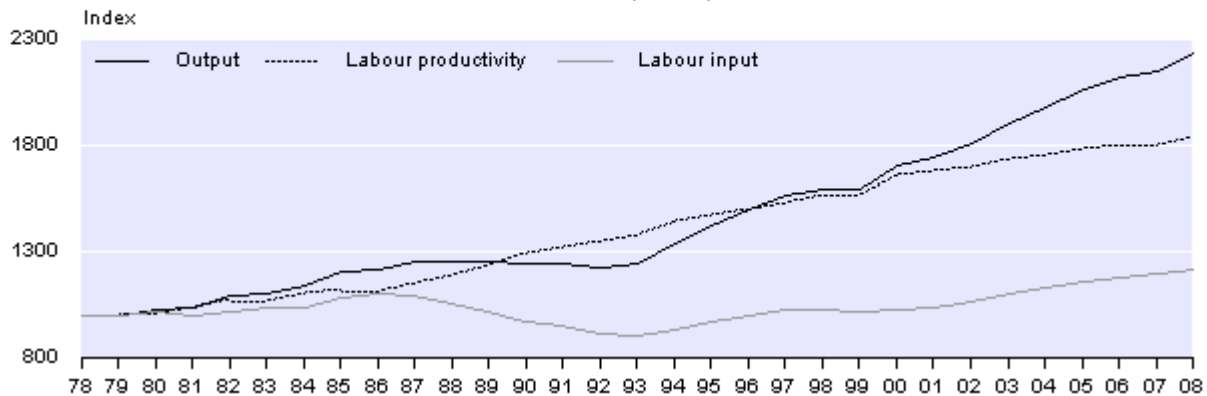
New to this release

Supplementary tables containing an annual composition-adjusted series from 1998–2008 are now available in this release. The 1998 to 2008 period reflects the availability of datasets needed to compositionally adjust the labour input index. The series provides a more in-depth measure of labour and can provide insight into the effects that changes in labour composition have on productivity. For more information, see 'Composition-adjusted labour input' in the Technical notes.

The measured sector, and former measured sector, productivity series now have an expression base of year ended March 1978=1000 (year ended March 1996=1000 was used in the previous releases). The composition-adjusted productivity series have an expression base year ended March 1998=1000.

Labour productivity

Measured Sector Labour and Output Indexes
Year ended March, 1978–2008
 Base: 1978 (=1000)



Labour productivity is measured as a ratio of output to labour input. In the year ended March 2008, labour productivity increased by 2.0 percent, due to labour input (up 1.6 percent) increasing by less than the growth in output of 3.6 percent. The continued strength of the labour market was highlighted by a record low unemployment rate of 3.6 percent for the year ended March 2008 (lower than the previous year's rate of 3.7 percent) and a labour force participation rate of 68.3 percent (down slightly on the previous year's record rate of 68.4 percent).

The growth in labour productivity in 2008 is largely attributable to capital deepening (ie an increase of capital input relative to labour input) which contributed 1.1 percent, with multifactor productivity increasing 0.9 percent. See 'Growth accounting for labour productivity' for more details on these components.

The following table presents the average annual growth in labour productivity for the growth cycles identified within the series.

Labour Productivity Average Annual Growth Rates⁽¹⁾⁽²⁾ <i>Year ended 31 March</i>			
Cycle	Output	Labour input	Labour productivity
	Percent ⁽³⁾		
1978–82	2.1	0.4	1.7
1982–85	3.4	2.0	1.4
1985–90	0.7	-2.1	2.9
1990–97	3.3	0.8	2.5
1997–2000	3.0	0.1	2.9
2000–08	3.4	2.1	1.3
1978–2008	2.7	0.7	2.0

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.
 (2) Business services, and personal and other community services are included in the measured sector from 1996 onwards.
 (3) Percentage changes are calculated on unrounded index numbers.

Growth in labour productivity of 2.0 percent for the 2008 year is above the average annual growth rate for the 2000–08 period of 1.3 percent. The growth rate over this latest period is lower than any of the previous cycles. However, caution should be exercised in this comparison as the 2000–08 period is not a complete cycle.

Labour input growth, averaging 2.1 percent annually over the 2000–08 period, is higher than any of the previous cycles. In this latest period, labour input growth peaked in 2003 at 3.2 percent and then dropped back over the subsequent years to grow at a rate of 1.5 percent in 2007. In 2008 labour input grew 1.6 percent. The growth in labour input over this period is consistent with the low (arithmetic) average unemployment rate of 4.4 percent. The unemployment rate is for the whole economy, an unemployment rate that covers only the measured sector is not available.

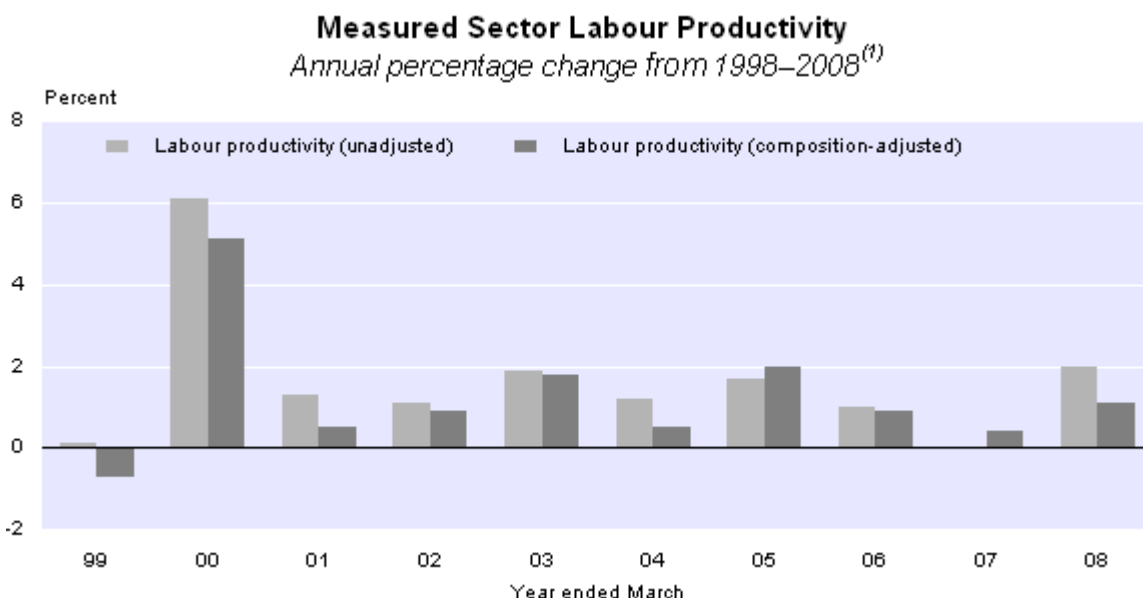
Over the entire time series (1978–2008), average annual growth in labour productivity was 2.0 percent, due to labour input (up 0.7 percent) increasing by less than the growth in output of 2.7 percent.

Composition-adjusted labour productivity

In measuring labour productivity, a labour composition-adjusted series (often referred to as a ‘quality-adjusted’ series) is generally considered to provide the most representative measure of labour input. The rationale for adjusting an input series for changes in labour composition is that workers are not homogenous, and as such, have different skill levels. This adjustment provides a more in-depth measure of labour, and an insight into the effects that changes in labour composition have on productivity.

In the year ended March 2008, adjusted labour productivity increased by 1.1 percent. This was due to adjusted labour input (up 2.5 percent) increasing by less than the growth in output of 3.6 percent.

The following graph indicates that on an annual basis, growth in adjusted labour productivity is lower than the growth in the headline (unadjusted) measure of labour productivity, except in the 2005 and 2007 years.



(1) The series begins in 1998, meaning annual percentage changes can only be calculated from 1999 onwards.

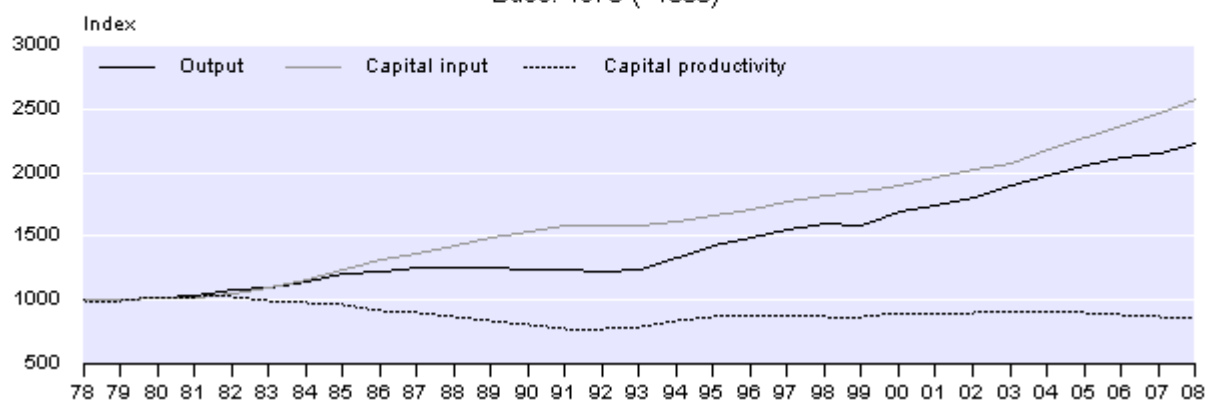
Adjusted labour input growth, averaging 2.2 percent annually from 1998–2008, is higher than the corresponding annual growth rate of 1.8 percent for the unadjusted labour input series. This implies that the average skill level of the workforce has increased over the period. The differences in the labour input measures have caused the annual average growth in the adjusted labour productivity series of 1.2 percent to be lower, than the unadjusted labour productivity series (up 1.6 percent) from 1998–2008.

Capital productivity

Measured Sector Capital and Output Indexes

Year ended March, 1978–2008

Base: 1978 (=1000)



Capital productivity is measured as a ratio of output to capital input. In the year to March 2008, capital productivity fell 0.5 percent, due to the continued growth in capital inputs (up 4.1 percent) increasing by more than output growth of 3.6 percent.

The following table presents the annual average growth in capital productivity for the growth cycles identified within the series.

Capital Productivity Average Annual Growth Rates ⁽¹⁾⁽²⁾			
Year ended 31 March			
Cycle	Output	Capital input	Capital productivity
	Percent ⁽³⁾		
1978–82	2.1	1.3	0.8
1982–85	3.4	5.4	-1.9
1985–90	0.7	4.5	-3.7
1990–97	3.3	2.1	1.1
1997–2000	3.0	2.1	0.9
2000–08	3.4	3.9	-0.4
1978–2008	2.7	3.2	-0.5

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.

(2) Business services, and personal and other community services are included in the measured sector from 1996 onwards.

(3) Percentage changes are calculated on unrounded index numbers.

The decline in capital productivity over the 2000–08 period can be explained by the increase in capital input of 3.9 percent due to strong business investment in fixed assets. This was particularly evident in the construction industry, where the investment supported the strong economic activity that peaked in 2006 and has slowed down in recent years. A decline in capital productivity is seen in three of the six cycles. However, caution should be exercised in this comparison as the 2000–08 period is not a complete cycle.

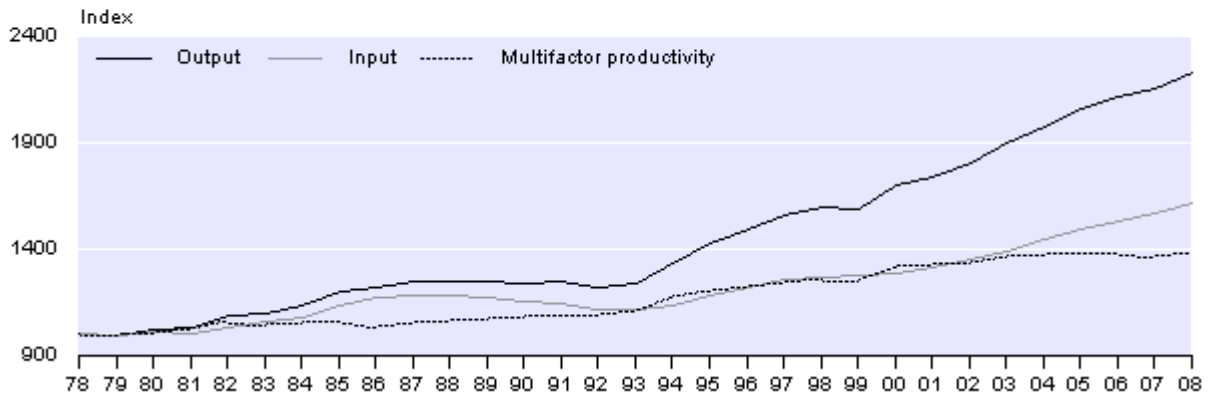
Over the entire time series (1978–2008), capital productivity fell 0.5 percent on an average annual basis. This was due to annual capital input growth of 3.2 percent increasing by more than the annual growth in output of 2.7 percent.

Multifactor productivity

Measured Sector Input, Output and Productivity Indexes

Year ended March, 1978–2008

Base: 1978 (=1000)



Multifactor productivity (MFP) is measured as a ratio of output to total inputs. It can also be defined as growth that cannot be attributed to capital or labour, such as technological change or improvements in knowledge, methods and processes. In the year to March 2008, MFP grew 0.9 percent, due to total inputs increasing (2.6 percent) by less than output growth of 3.6 percent.

The following table presents the annual average growth in multifactor productivity within the growth cycles identified for the series.

Multifactor Productivity Average Annual Growth Rates⁽¹⁾⁽²⁾ <i>Year ended 31 March</i>			
Cycle	Output	Total inputs	Multifactor productivity
	Percent ⁽³⁾		
1978–82	2.1	0.7	1.4
1982–85	3.4	3.3	0.1
1985–90	0.7	0.3	0.4
1990–97	3.3	1.3	2.0
1997–2000	3.0	0.9	2.1
2000–08	3.4	2.9	0.6
1978–2008	2.7	1.6	1.1

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.

(2) Business services, and personal and other community services are included in the measured sector from 1996 onwards.

(3) Percentage changes are calculated on unrounded index numbers.

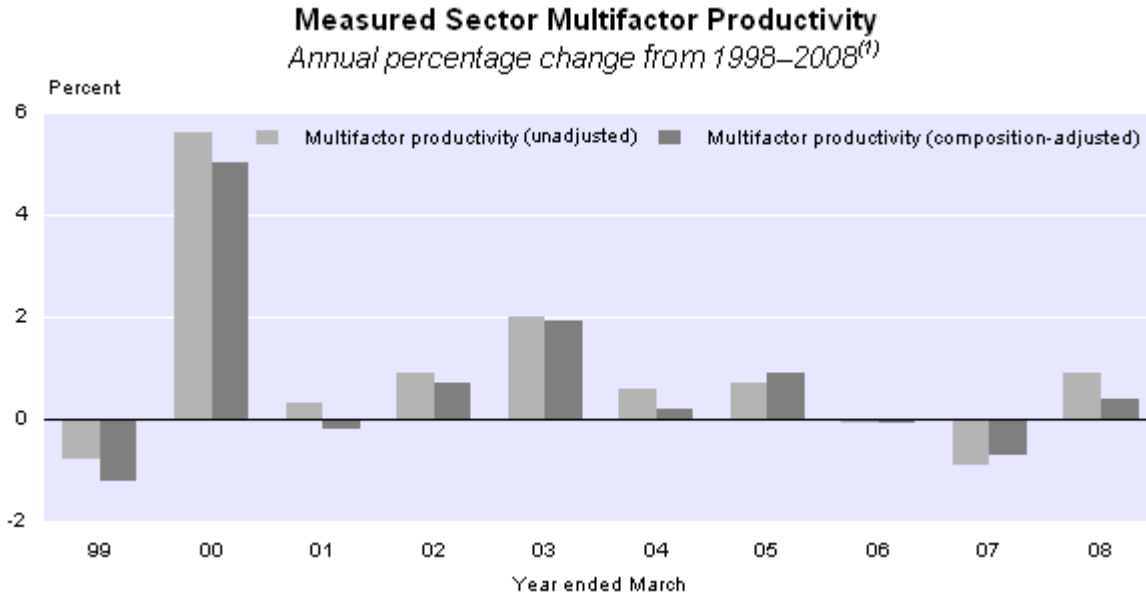
From 2000–08, MFP has grown, but at a slower rate than two previous cycles (caution should be exercised in this comparison as the 2000–08 period is not a complete cycle), with an average increase of 0.6 percent annually. Output rose 3.4 percent on an average annual basis, while total inputs rose 2.9 percent. The main contributor to the growth in total inputs was capital input.

The average annual increase of 1.1 percent in MFP over the entire 1978–2008 series was due to output (up 2.7 percent) rising more than input growth of 1.6 percent.

Composition-adjusted MFP

In the year ended March 2008, composition-adjusted multifactor productivity increased by 0.4 percent for the measured sector. This was due to adjusted total inputs (up 3.2 percent) increasing by less than output growth of 3.6 percent.

The following graph shows that on an annual basis adjusted MFP growth is lower than the headline (unadjusted) measure of MFP, except for the 2005 and 2007 years (where the adjusted MFP growth is marginally higher).

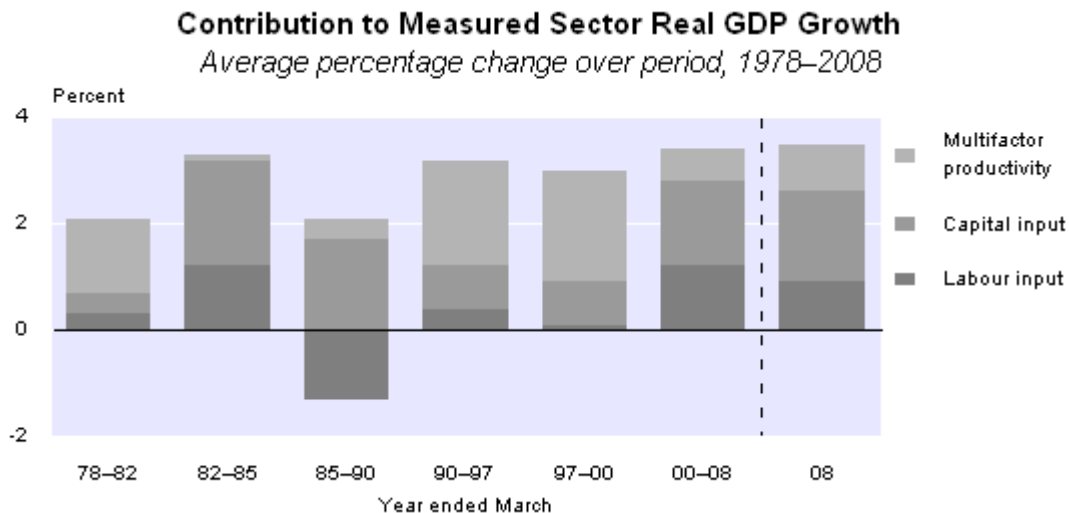


(1) The series begins in 1998, meaning annual percentage changes can only be calculated from 1999 onwards.

From 1998 to 2008 average annual growth in adjusted MFP (0.7 percent) is lower than it is for unadjusted MFP (0.9 percent).

Growth accounting for real GDP

Growth accounting examines how much of the economy's growth in output can be explained by the growth of combined inputs. In particular, growth in real GDP (output) can arise from three different sources: an increase in labour input, an increase in capital input, or an increase in MFP. The following graph presents growth in output between 1978 and 2008 for the growth cycles identified in the series.



In 2008, growth in output was 3.6 percent. This was driven by capital input (contributing 1.7 percent to the growth in output), and to a lesser extent by labour input and multifactor productivity (both contributing 0.9 percent).

The following table presents the annual average growth in output and its contributing factors for the growth cycles identified within the series.

Contribution to Measured Sector Real GDP Growth <i>Average annual growth rates (1)(2)</i> Year ended 31 March				
Cycle	Real GDP	Contribution of capital input ⁽³⁾	Contribution of labour input ⁽⁴⁾	Multifactor productivity
	Percent ⁽⁵⁾			
1978–82	2.1	0.4	0.3	1.4
1982–85	3.4	2.0	1.2	0.1
1985–90	0.7	1.7	-1.3	0.4
1990–97	3.3	0.8	0.4	2.0
1997–2000	3.0	0.8	0.1	2.1
2000–08	3.4	1.6	1.2	0.6
1978–2008	2.7	1.2	0.4	1.1

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.

(2) Business services, and personal and other community services are included in the measured sector from 1996 onwards.

(3) Contribution of capital input is equal to the growth rate in capital input weighted by capital's share of total income.

(4) Contribution of labour input is equal to the growth rate of labour input weighted by labour's share of total income.

(5) Percentage changes are calculated on unrounded index numbers.

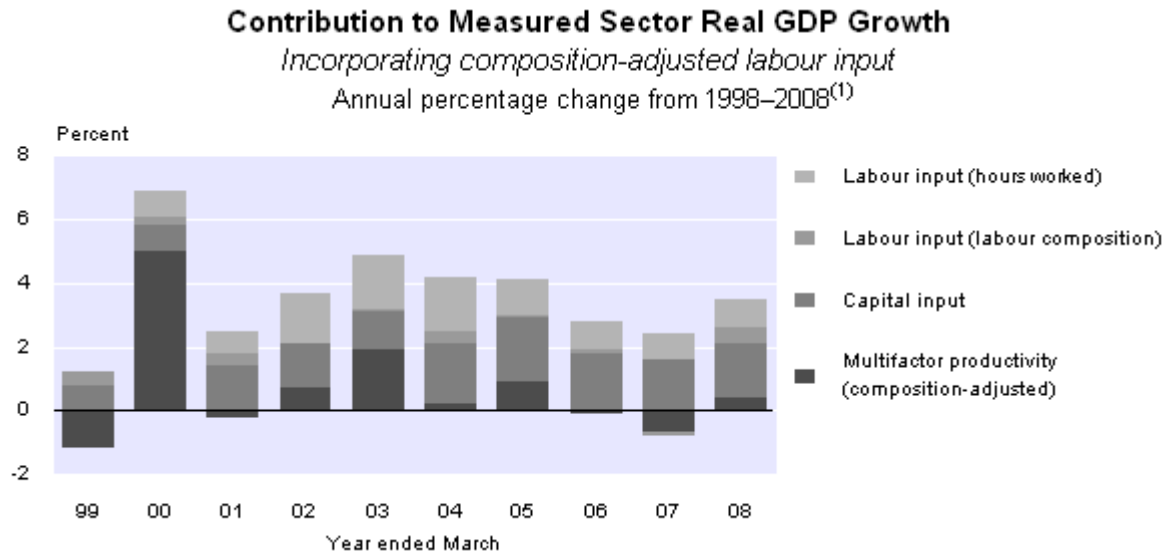
For the latest period, 2000–08, average annual growth in output was 3.4 percent. This was driven by growth in capital and labour inputs, contributing 1.6 and 1.2 percent respectively on an average annual basis. Multifactor productivity contributed 0.6 percent to the increase in growth on an average annual basis. Growth in output was due to a combination of factors. High world prices for export commodities and a relatively low exchange rate in the early part of the period boosted export growth, while a thriving construction sector, which peaked in 2006 then slowed in recent years, were key drivers in strong output growth during this cycle.

Over the entire 1978–2008 series, output growth averaged 2.7 percent. Capital input was the largest contributor, averaging 1.2 percent on an annual basis. Labour input contributed 0.4 percent to this rise in output and MFP contributed 1.1 percent.

Composition-adjusted productivity growth accounting for real GDP

The inclusion of a compositionally adjusted labour input series allows for the decomposition of growth in real GDP (output) into capital input, hours worked, labour composition and, composition-adjusted MFP.

The following graph presents the contributions to annual growth in output for the adjusted series from 1998 to 2008. Labour composition changes have not been a major driver of increases in GDP over this time period.



(1) The series begins in 1998, meaning annual percentage changes can only be calculated from 1999 onwards.

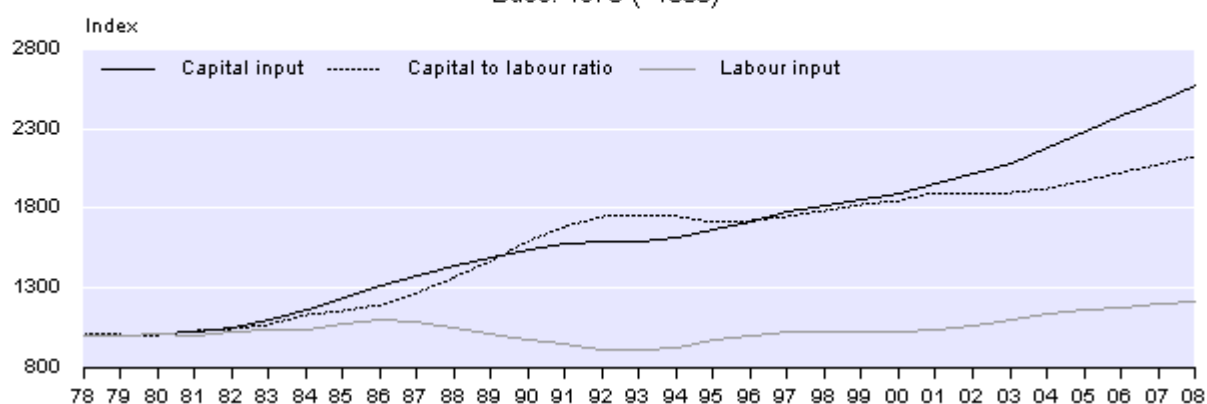
In 2008, growth in output was 3.6 percent. This was largely driven by capital input (contributing 1.7 percent to the growth in output), and to a lesser extent by hours worked and labour composition (contributing 0.9 percent and 0.5 percent respectively). Adjusted MFP contributed 0.4 percent to the rise in output.

Capital-labour ratio

Measured Sector Factor Inputs and Capital to Labour Ratio Indexes

Year ended March, 1978–2008

Base: 1978 (=1000)



The capital-labour ratio is calculated as the capital input index divided by the labour input index. An increase in the ratio is referred to as capital deepening, while a decrease is called capital shallowing. In the year to March 2008, the capital-labour ratio rose 2.5 percent, compared with a 2.2 percent rise in the year to March 2007.

The following table presents the average annual growth in the capital-labour ratio and capital and labour inputs for the growth cycles identified within the series.

Capital-Labour Ratio Average Annual Growth Rates (percent)⁽¹⁾⁽²⁾ <i>Year ended 31 March</i>			
Cycle	Capital input	Labour input	Capital-labour ratio
	Percent ⁽³⁾		
1978–82	1.3	0.4	0.9
1982–85	5.4	2.0	3.3
1985–90	4.5	-2.1	6.8
1990–97	2.1	0.8	1.3
1997–2000	2.1	0.1	2.0
2000–08	3.9	2.1	1.7
1978–2008	3.2	0.7	2.5

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.

(2) Business services, and personal and other community services are included in the measured sector from 1996 onwards.

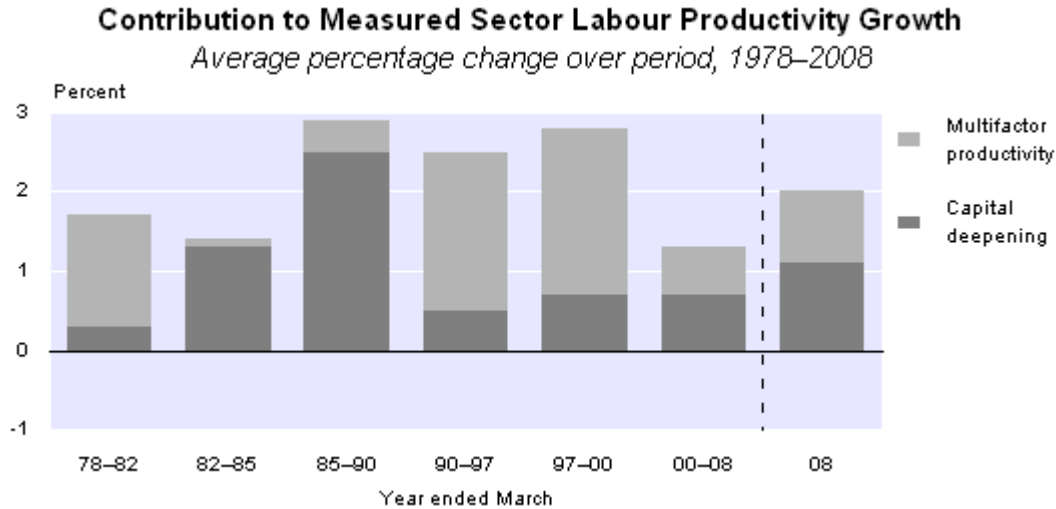
(3) Percentage changes are calculated on unrounded index numbers.

In the latest period, 2000–08, the capital-labour ratio has continued to increase with an annual growth rate of 1.7 percent, due to 3.9 percent average annual growth in capital input coupled with 2.1 percent growth in average labour input.

The New Zealand economy has experienced capital deepening during the last 30 years. The average annual growth in the capital-labour ratio was 2.5 percent over the entire 1978–2008 series, due to 3.2 percent average annual growth in capital input, compared with 0.7 percent average annual growth in labour input.

Growth accounting for labour productivity

As with growth in real GDP (output), growth in labour productivity can be broken down into components. In particular, a change in labour productivity can come from two possible sources: a change in the weighted capital-labour ratio (that is, capital deepening or capital shallowing) and a change in MFP. The following graph presents the contributions to labour productivity growth between 1978 and 2008 for the growth cycles identified in the series.



In 2008, growth in labour productivity was 2.0 percent. The annual contribution from capital deepening was 1.1 percent closely followed by a 0.9 percent annual contribution from MFP.

The following table presents the annual average growth in labour productivity and its contributing factors for the growth cycles identified for the series.

Contribution to Measured Sector Labour Productivity Growth			
<i>Average annual growth rates⁽¹⁾⁽²⁾</i>			
Year ended 31 March			
Cycle	Labour productivity	Contribution of capital deepening ⁽³⁾	Multifactor productivity
	Percent ⁽⁴⁾		
1978–82	1.7	0.3	1.4
1982–85	1.4	1.3	0.1
1985–90	2.9	2.5	0.4
1990–97	2.5	0.5	2.0
1997–2000	2.9	0.7	2.1
2000–08	1.3	0.7	0.6
1978–2008	2.0	1.0	1.1

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–82 average annual growth rate does not include the movement for 1978.

(2) Business services, and personal and other services are included in the measured sector from 1996 onwards.

(3) Contribution of capital deepening is equal to the growth rate in the capital-labour ratio weighted by capital's share of total income.

(4) Percentage changes are calculated on unrounded index numbers.

Labour productivity over the latest 2000–08 period was relatively low, averaging 1.3 percent annually. Contributing to this was subdued capital deepening and MFP growth (0.7 and 0.6 percent, respectively, on an average annual basis). In the latter half of this period, capital deepening has grown at a faster rate, whilst MFP growth has slowed.

Over the entire 1978–2008 series, the average annual contribution to labour productivity growth from capital deepening was 1.0 percent. The average contribution of MFP growth was 1.1 percent on an annual basis. Labour productivity growth averaged 2.0 percent annually.

Revisions

Updates in data sources and ongoing methodology improvements have caused a number of revisions to the previously published productivity series. Please refer to tables 7 and 1.7 in the downloadable excel spreadsheets for the magnitude and direction of these revisions.

Regular revisions (due to updates in data sources) have arisen from the following:

- revised constant price GDP data, feeding into the output series
- revised current price national accounts data, with current price industry data now available for 2005, feeding into the industry income-based weights
- revised current and constant price productive capital stock data for selected assets and industries for March years 2006 and 2007, feeding into the capital input series
- the addition of Linked Employer-Employee Data (LEED) to replace survey-based data for working proprietor counts for the March 2007 year, and employee counts for the March 2007 quarter, feeding into the labour input series.

Revisions resulting from improved methodology are:

- a modification to the method for calculating asset user costs, which are used in the determination of asset weights in the capital input series. The main impact of this on the capital input series (which flows into capital productivity, total inputs, and MFP) is for years prior to 1989
- the addition of commercial, industrial, mining and other non-agricultural land to the set of assets within the capital input series, from 1996 onwards
- revisions to LEED for the labour volume series of employee counts from 2000 onwards.

Due to the amount of provisional data that is used in productivity calculation for the most recent years, the last four years of the series are released with provisional status. While there have been revisions to some annual movements, the underlying trend of the productivity series has remained unchanged.

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Next release...

Productivity Statistics: 1978–2009 is scheduled to be released in March 2010.

Technical notes

What is productivity?

Productivity is a measure of how efficiently inputs are being used within the economy to produce outputs. Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input. Growth in productivity means that a nation can produce more output from the same amount of input. Productivity growth is an important contributing factor to a nation's long-term material standard of living.

Productivity measures can be either single factor (that is, relating a measure of output to a single measure of input), or multifactor (that is, relating a measure of output to a bundle of inputs). Labour and capital productivity are single (or partial) factor productivity measures; they show productivity growth in terms of that particular input. Hence, productivity changes shown in these indexes may be due to a change in the mix of total inputs rather than a direct productivity increase from the relevant input. For example, if additional machinery (capital input) is used to assist in production, less labour input may be required to produce the same level of output. This will increase labour productivity, simply because the mix of the inputs has altered. On the other hand, multifactor productivity takes into account substitution between labour and capital inputs, and is therefore not directly affected by a change in the mix of total inputs.

The output measure chosen may be either gross output or value-added. The official productivity series all use constant price value-added as the output measure. Separate series are produced for labour productivity, capital productivity and multifactor productivity (MFP).

Productivity measurement

The Statistics NZ method of estimating productivity statistics is based on OECD guidelines, as outlined in the OECD manual *Measuring Productivity - OECD Manual Measurement of Aggregate and Industry-level Productivity Growth* (available from OECD website, www.oecd.org). The approach adopted is referred to in the manual as "the index number approach in a production theoretic framework. The growth accounting technique examines how much of an observed rate of change of an industry's [or economy's] output can be explained by the rate of change of combined inputs. Thus the growth accounting approach evaluates the MFP growth residually."

In its simplest form, a production function is postulated as follows:

$$V = A(t) \times f(L,K)$$

where V = value-added in constant prices

L = real labour inputs

K = real capital inputs

f(L,K) = a production function of L and K that defines an expected level of output

A(t) = a parameter that captures disembodied technical shifts over time, ie outward shifts of the production function allowing output to increase with a given level of inputs (= MFP)

or, rearranging the equation, we have:

$$A(t) = V / f(L,K)$$

As the technology parameter cannot be observed directly, MFP growth is derived residually as the difference between the growth in an index of outputs and an index of inputs. For MFP to be a measure of disembodied technology change, certain assumptions must be met, the key ones being that the production function must exhibit constant returns to scale and the coverage of the inputs needs to be complete.

In practice, these conditions will not be met and the resulting MFP residual needs to be interpreted with some caution. Given the importance of technological progress as an explanatory factor in economic growth, attention often focuses on the MFP measure as though it was a measure of technological change. However, this is not the case. When interpreting MFP, the following should be noted:

- Not all technological change translates into MFP growth. Embodied technological change, such as advances in the quality of capital or improved human capital, will be captured in the measured contributions of the inputs, provided they are measured correctly (ie the volume input series includes quality change).
- MFP growth is not necessarily caused by technological change. Other non-technology factors will be picked up by the residual, including economies of scale, cyclical effects, inefficiencies and measurement errors.

Given the existence of index values for labour volume and value-added, it is possible to calculate labour productivity for the measured sector as:

$$LP = V / L$$

Where LP = an index of labour productivity. This is an index of value-added in constant prices divided by an index of labour inputs.

Similarly, a capital productivity index KP is calculated as:

$$KP = V / K$$

Where KP = an index of capital productivity. This is an index of value-added in constant prices divided by an index of capital inputs.

Care is also needed in interpreting the partial measures of productivity. For example, labour productivity only partially measures 'true' labour productivity, in the sense of capturing the personal capacities of workers or the intensity of their efforts. Labour productivity reflects the level of capital available per worker and how efficiently labour is combined with the other factors of production. Labour productivity may change due to a substitution of capital for labour (capital deepening) or due to a change in technology, with no change occurring in the labour input itself.

Estimating growth cycles

This release contains productivity data presented as annual averages within growth cycles. A range of univariate filters used to generate cycles within the series were investigated, and ultimately the Hodrick-Prescott filter was determined to be the most appropriate filter. While the productivity model assumes no differences (across industry and time) in asset capacity utilisation rates, in reality capacity utilisation of capital will vary across a cycle. The cycles are chosen as 'peak to peak' and their starting points are determined by a number of factors, such as where output growth and multifactor productivity growth are at their highest deviation from trend, and where capacity utilisation is at its highest point. The final growth cycles selected also take into account economic events throughout the time period. For further detail on the methodology and associated economic commentary used for determining the growth cycles, refer to the Statistics NZ information paper *Extracting Growth Cycles from Productivity Indexes*, on [Productivity statistics – Information releases web page](#), available on Statistics NZ website www.stats.govt.nz.

Industry coverage – the measured sector

The productivity measures do not cover the entire economy. The industry coverage of the statistics is defined as the 'measured sector', consisting of industries for which estimates of inputs and outputs are independently derived in constant prices. Excluded are those industries for which real value-added in the national accounts is largely measured using input methods, such as number of employees. This is mainly government non-market industries that provide services, such as administration, health and education, free or at nominal charges. The measured sector is defined in the following table.

Productivity industry coverage ⁽¹⁾	
Measured sector industries	Omitted industries
A Agriculture, forestry and fishing	LA Property services
B Mining	LB Ownership of owner occupied dwellings
C Manufacturing	M Government administration and defence
D Electricity, gas and water supply	N Education
E Construction	O Health and community services
F Wholesale trade	
G Retail trade	
H Accommodation, cafes and restaurants	
I Transport and storage	
J Communication services	
K Finance and insurance	
LC Business services ⁽²⁾	
P Cultural and recreational services	
Q Personal and other community services ⁽²⁾	
⁽¹⁾ Based on the Australian New Zealand Standard Industrial Classification (ANZSIC).	
⁽²⁾ Included from March 1996 onwards in the measured sector	

In the *Productivity Statistics: 1978–2007* release the measured sector was expanded, it now includes business services, and personal and other community services, from March 1996 onwards.

The former measured sector tables, now published as supplementary to this release, cover industries A to K and P. They maintain continuity with the previously released series and are comparable with the Australian official productivity statistics.

Output series methodology

This is defined as constant-price value added. The annual value added for the measured sector is derived following the same procedures as used to derive constant price GDP, namely – as a chained Laspeyres volume index of the constant-price value added of the industries that comprise the measured sector.

Labour series methodology

The labour volume series

The labour volume series is an estimate of paid hours for all employed persons engaged in the production of goods and services in the measured sector in New Zealand. The series is compiled using a number of data sources, from which the best characteristics of each are used for productivity measurement.

Throughout the series, there are three components that are summed to an industry level:

- employees in industries covered by employment surveys
- employees in industries out of scope of employment surveys
- working proprietors.

For each of these components, the labour volume series is constructed by estimating:

- job/worker counts
- weekly paid hours per job/worker.

These are multiplied to give total weekly paid hours for the measured sector. An annual (March year) average of the weekly paid hours is calculated at the industry level. It is aggregated to the measured sector level, as published in table 3, 1.3 and 2.3.

For the first of the three components, data from the Department of Labour (DoL) Employment Information Survey is used up to 1980, when it became the DoL Quarterly Employment Survey (QES). The DoL data was the sole source for employee counts and hours paid for this component until 1989, from which point annual Business Demography counts are rated forward by quarterly movements in employee counts from the QES. The resulting quarterly series of employee numbers is then multiplied by average weekly paid hours from the QES to achieve a quarterly series for paid hours. In 1989, Statistics NZ assumed responsibility for administering the QES. From 2000 onwards, monthly Linked Employer-Employee Dataset (LEED) has replaced Business Demography as the sole data source for employee counts, and is combined with QES data on average weekly paid hours.

The second component includes employees in the following ANZSIC industries that are omitted from the coverage of the surveys above:

- A01 – Agriculture
- A02 – Services to agriculture
- A04 – Commercial fishing
- I6301 – International sea transport
- L7711 – Residential property operators
- M813 – Foreign government representation
- Q97 – Private households employing staff.

Prior to 2000, Census of Population and Dwellings data provides benchmarks for employee counts and average weekly hours for this component. Prior to 1986, counts are interpolated using data from the Agriculture Census where appropriate. From 1986 to 2000, quarterly estimates of change from the Household Labour Force Survey (HLFS) are used to interpolate weekly hours between census benchmarks. From 2000 onwards, LEED provides monthly data on employee counts, while the average hours methodology remains unchanged.

For working proprietors, the third component, prior to 1986, census benchmarks are used to calculate both counts and average hours for almost all industries, supplemented by data from the DoL employment surveys and the Agriculture Census where appropriate. From 1986 to 2000, both hours and count data are benchmarked using totals from the census and interpolated using data from the HLFS, as in the previous component. From 2000 onwards, LEED provides annual benchmarks for working proprietor counts, supplemented by data from the HLFS and QES. Census data continues to provide average hours benchmarks during this period.

Rating forward the Labour Volume Series to calculate 2008 values

LEED employee count data is unavailable for the last quarter of the series and LEED working proprietor count data is unavailable for the last year of the series so both are rated forward. Employee counts are rated forward using QES movements, and HLFS movements are used for industries outside the QES scope. Working proprietor counts are rated forward using HLFS movements. Adjustments are made to the QES and HLFS data where necessary. Average hours worked per industry is calculated as in previous years, however the data is adjusted to account for the proportion of secondary jobs for employees in industries out of scope of the QES and working proprietors.

The labour input index

The industry volume series are aggregated to the measured sector level by means of a chained Törnqvist index. The quantity relatives in the index are two-period ratios of industry labour volumes. Industry two-period mean shares of measured sector nominal labour income form the exponential weights.

Use of LEED

LEED is the main data source of counts of employees and working proprietors from 2000 onwards. The LEED dataset is created by linking a longitudinal dataset from the Statistics NZ Business Frame with longitudinal data from administrative taxation sources. Statistics NZ sees LEED as the best available data source for measuring labour counts for the reasons outlined below.

For measurement of employees, LEED data differs to the previous Business Demography Database (BDD) in the following ways:

- LEED employee count data is monthly, whereas under the previous approach, quarterly data was used. Therefore LEED captures the seasonality of labour volume better.
- Unlike the previous approach, LEED counts are not interpolated using survey information, reducing the effect of sample error on the series.
- LEED data includes information about secondary jobs for industries outside of the scope of the Quarterly Employment Survey (QES). These jobs were previously excluded from the series.

For measurement of working proprietors, LEED data differs to the previous census/HLFS measurement in the following ways:

- The majority of the working proprietor data is based on LEED annual benchmarks, based on a working proprietor's main income source over the year, ie it is not a point-in-time estimate. It is modified to incorporate seasonality using the HLFS and QES, however the annual average counts remain the same.
- LEED data includes information about people with secondary jobs (based on income) as a working proprietor. These jobs were previously excluded from the series.
- Under the previous methodology, census benchmarks could be extrapolated forward for up to five years before being finalised. However, LEED provides annual benchmarks and at most, it is only the latest year which will be extrapolated forward.
- Working proprietors who pay themselves a salary can now be identified more accurately using LEED.

Composition-adjusted labour input

Composition-adjusted productivity measures account for the impact of changes in the skill-composition of workers. As MFP is measured residually, when change in skill is incorporated as part of labour input, it provides a theoretically better productivity measure as it would otherwise be allocated to MFP.

Composition-adjusted labour is calculated by adjusting the Labour Volume Series using movements in a labour composition index, which estimates changes in skill composition using proxies for skill, namely education attainment and work experience. The labour composition index is calculated using the HLFS to estimate the proportions of each skill category of worker, while the New Zealand Income Survey (NZIS), an annual supplement to the HLFS, is also used to compile income shares for each of these groups.

Due to the availability of NZIS data, the series runs from 1998. For further background on composition-adjustment, and details on the methodology, consult the Statistics NZ information paper *Accounting for changes in labour composition in the measurement of labour productivity*, available on www.stats.govt.nz.

Capital input series methodology

The capital services input index measures the flow of capital services generated by the use of the stock of capital assets for a given March year. No allowance is made for differences (across industry and time) in asset capacity utilisation rates.

As capital service flows cannot be directly measured, industry level flows are modelled, based on the productive capacity of industry capital stock. The industry level flows are aggregated to the measured sector level using industry shares of the measured sector current-price capital income as weights. More specifically, the following steps occur:

- The starting point is the annual constant-price productive capital stock series. An asset's productive capital stock is its gross capital stock adjusted for the decline in its efficiency. Measured in constant prices, the productive stock represents standardised efficiency units and can be interpreted as a measure of the potential capital services that the asset can contribute to the production process. The productive capital stock series are built up using a perpetual inventory model (PIM) that generates productive capital stock estimates for 26 asset types by industry, of which only 24 are used in the capital services index. The model specifies for each asset type a mean expected useful life, a retirement function based on a distribution about this life and its pattern of (hyperbolic) efficiency decline. These parameters, and gross fixed capital formation in constant prices, are used to estimate an asset type's productive capital stock in constant prices.
- In addition to the PIM-derived fixed asset stocks, the range of capital included in the productivity measures is supplemented by estimates for seven other assets, namely livestock, exotic timber grown for felling, and five different types of land: agricultural and forestry; commercial; industrial; mining; and other non-agricultural land.
- Capital service flows are assumed to be proportional to these productive stock estimates, and are aggregated to the industry level using a Törnqvist index, with weights based on implicit rental prices (or user costs) which are a function of an exogenous rate of return, depreciation, net taxes on production and asset price changes.

The measured sector capital services index is calculated, in turn, as a Törnqvist index of the industry indexes, with mean two-period industry shares of the measured sector current-price capital income providing the weights.

Enhancements to the capital input series methodology for this release

The methodology underlying the capital input series has been altered for this release. Two enhancements have been incorporated into the series, namely:

1. **Additional land assets**
Four additional land assets: commercial, industrial, mining and other non-agricultural land have been included in the capital asset scope. They supplement the agricultural and forestry land assets already included in the series. Apart from mining land (used only by the Mining industry), the additional land asset types are used by various industries within the measured sector. They have been included from 1996 onwards, reflecting the availability of source data. The price and volume data for estimating the productive capital stock of these additional land assets are sourced from Quotable Value Ltd.
2. **Modification of the user cost equation**
User costs provide the exponential asset weights within a Tornqvist index when aggregating to the industry level. The user cost equation has been modified in two areas. Firstly, the rate of return is now determined exogenously rather than endogenously, reflecting the ex-ante decision-making process which businesses undertake. Secondly, the asset-specific capital gain has been removed, as it is not considered to be a factor in a businesses' decision to purchase capital assets.

The modified user cost equation differs from that used by the Australian Bureau of Statistics. In particular, their default is to use an endogenous rate of return, with capital gains applied to all assets.

Total input series methodology

A composite total input index is constructed by combining the labour and capital input indexes at the measured sector level. The total inputs index is a Törnqvist index, with the industry factor income shares providing the weights.

Calculating the productivity indexes

The construction of output, labour input, capital input and composite total input indexes then allows for the calculation of the labour productivity, capital productivity and multifactor productivity measures, using the formulae in the Productivity measurement section of these Technical notes.

Growth accounting decomposition

Growth accounting is the decomposition of output growth into its contributing factors. For a given production function, changes in output and due to changes in the volumes of labour and capital, and/or changes in the multifactor productivity term. Under the composition-adjusted approach, changes in output can also come from a change in the skill composition of labour.

The growth accounting decomposition for output (ie value added, or real GDP) is presented as follows:

$$V = (L \wedge W_L) \times (K \wedge W_K) \times \text{MFP}$$

V = the change in value added (over one period)

L = the change in labour input (over one period)

K = the change in capital input (over one period)

MFP = the change in MFP (over one period)

W_L = labour's share of total income

W_K = capital's share of total income

As can be seen, the changes in labour input and capital input are exponentially weighted by their respective shares of total income. This gives the contribution of labour input and capital input, respectively, to output growth.

Under the composition-adjusted approach, output growth is decomposed into an additional variable, namely the skill composition of labour. This is presented in the equation below:

$$V = (L \wedge W_L) \times (S \wedge W_L) \times (K \wedge W_K) \times \text{MFP}$$

S = the change in skill composition (over one period)

To obtain the contribution of the skill composition, it once again needs to be exponentially weighted by labour's share of total income.

Capital and labour income shares

The measured sector capital and labour nominal income shares are calculated as the ratio of capital and labour income, respectively, to total income. Capital and labour nominal income totals are calculated at the industry level, and are derived from the income measure of GDP within the national accounts.

The income measure of GDP is calculated as compensation of employees plus gross operating surplus plus taxes on production and imports less subsidies (taxes less subsidies are known as net taxes). Included within gross operating surplus is the income of working proprietors, which is termed mixed income.

Mixed income is split into labour and capital components by calculating the labour income of working proprietors directly, and deriving the capital income of working proprietors residually.

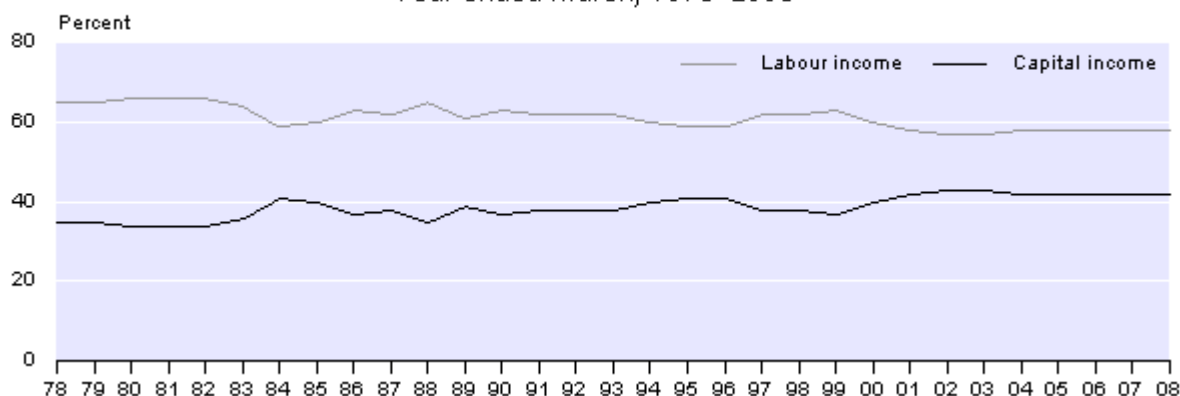
Net taxes on production and imports are split into labour and capital components according to existing industry income shares.

Labour income is calculated as compensation of employees plus labour mixed income plus net taxes on production and imports attributable to labour. Capital income is calculated as gross operating surplus plus capital mixed income plus net taxes on production and imports attributable to capital.

Capital and labour income shares are used as weights within the productivity series. Mean two-period industry income shares are used to weight the capital and labour input indexes from the industry level to the measured sector level. Mean two-period measured sector income shares are then used to weight capital and labour when deriving the total inputs index, which is used in the calculation of MFP. Capital and labour income shares are also used to weight the contribution of capital input and labour input, respectively, within the growth accounting framework.

Measured Sector Labour and Capital Income Shares

Year ended March, 1978–2008



The average capital and labour income shares remain relatively stable over the 1978–2008 period, with the capital share at approximately 40 percent of total income and the labour share at approximately 60 percent of total income. The small level shift in the series in 1996 is due to the introduction of business services, and personal and other community services into the measured sector.

Published series

The productivity indexes now have an expression base year ended March 1978=1000, consistent with the first year of the series. The composition-adjusted productivity indexes have an expression base year ended March 1998=1000, consistent with the first year of the series. The measured sector GDP data used to calculate productivity indexes from 1978 to 1988 is currently provisional.

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Further information

The information paper *Productivity Statistics: 1988–2005* was released in March 2006 and provides additional material on the nature of the productivity measures, their construction, and comparisons with similar productivity statistics published by the Australian Bureau of Statistics and the OECD.

The information paper *Accounting for changes in labour composition in the measurement of labour productivity* was released in December 2008. It provides background to, and application of, adjusting for compositional change in the labour productivity series. The primary output of the paper is the experimental composition-adjusted productivity series, which have now been updated to include 2008, and incorporated into this release.

Two technical papers are also available on [Productivity statistics – Information releases web page](#), on the Statistics NZ website (www.stats.govt.nz). *Productivity Statistics: Sources and Methods* details the sources and methods used to compile the series and *Estimating Growth Cycles from Productivity Indexes* details the methodology used to derive growth cycles for the published series from 1978–2007.

Timing

Timed statistical releases are delivered using postal and electronic services provided by third parties. Delivery of these releases may be delayed by circumstances outside the control of Statistics NZ. Statistics NZ accepts no responsibility for any such delays.

Tables

The following tables are printed with this Hot Off The Press and can be downloaded from the Statistics New Zealand website in Excel format. If you do not have access to Excel, you may use the [Excel file viewer](#) to view, print and export the contents of the file.

1. Productivity in the measured sector, productivity indexes and output measure
2. Productivity in the measured sector, productivity indexes and output measure – annual percentage change
3. Productivity in the measured sector, input measures
4. Productivity in the measured sector, input measures – annual percentage change
5. Productivity in the measured sector, growth accounting analysis – contributions to growth
6. Productivity in the measured sector, growth accounting analysis – contributions to labour productivity
7. Productivity in the measured sector, productivity indexes – annual percentage change, revisions summary

Supplementary tables

The following tables can be downloaded from the Statistics New Zealand website in Excel format.

Former measured sector

- 1.1 Productivity in the former measured sector, productivity indexes and output measure
- 1.2 Productivity in the former measured sector, productivity indexes and output measure – annual percentage change
- 1.3 Productivity in the former measured sector, input measures
- 1.4 Productivity in the former measured sector, input measures – annual percentage change
- 1.5 Productivity in the former measured sector, growth accounting analysis – contributions to growth
- 1.6 Productivity in the former measured sector, growth accounting analysis – contributions to labour productivity
- 1.7 Productivity in the former measured sector, productivity indexes – annual percentage change, revisions summary

Composition-adjusted

2.1 Composition-adjusted productivity in the measured sector, productivity indexes and output measure

2.2 Composition-adjusted productivity in the measured sector, productivity indexes and output measure – annual percentage change

2.3 Composition-adjusted productivity in the measured sector, input measures

2.4 Composition-adjusted productivity in the measured sector, input measures – annual percentage change

2.5 Composition-adjusted productivity in the measured sector, growth accounting analysis – contributions to growth

2.6 Composition-adjusted productivity in the measured sector, growth accounting analysis – contributions to labour productivity