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Statistics New Zealand
Tatauranga Aotearoa

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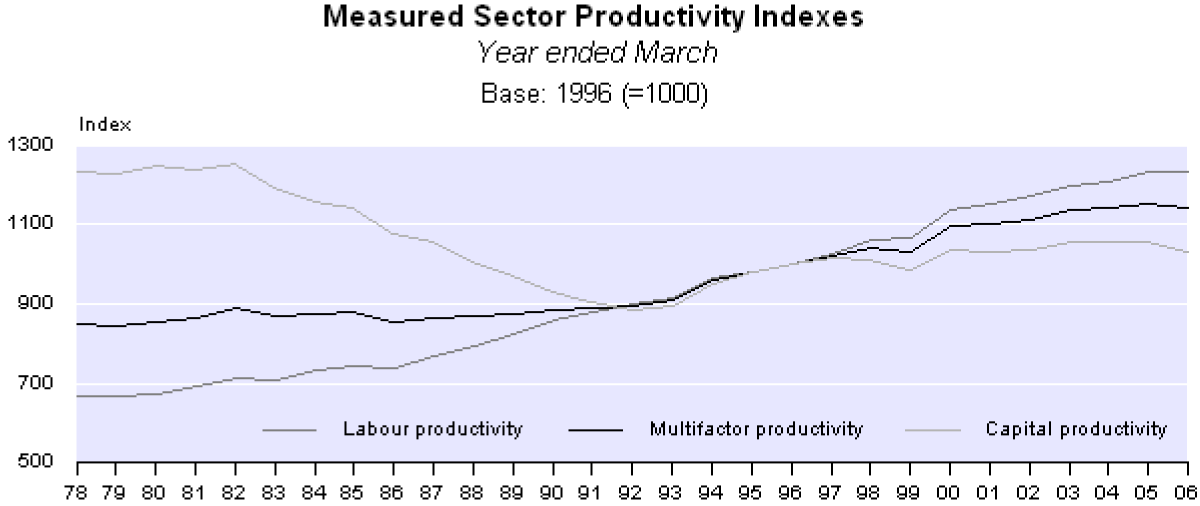
Productivity Statistics: 1978−2006

Highlights

- An extended annual productivity series for the measured sector from 1978–2006 is now available.
- Annual labour productivity growth averaged 1.4 percent in the measured sector from 2000–2006.
- Average annual growth in labour productivity was 2.2 percent for the measured sector from 1978–2006.
- Average annual growth in multifactor productivity was 1.1 percent for the measured sector from 1978–2006.
- Capital productivity fell 0.6 percent on an average annual basis for the measured sector from 1978–2006.



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Commentary

Unless otherwise stated, all references to average movements are annual geometric mean movements relating to the 'measured sector'. In 2004 (the latest year for which current price industry value added data are available), the measured sector covered approximately 63 percent of the economy. It excludes the following industries: government administration and defence, health, education, property and business services, and personal and other community services. Refer to the Technical notes of this release for a more detailed definition and explanation of the measured sector.

Background

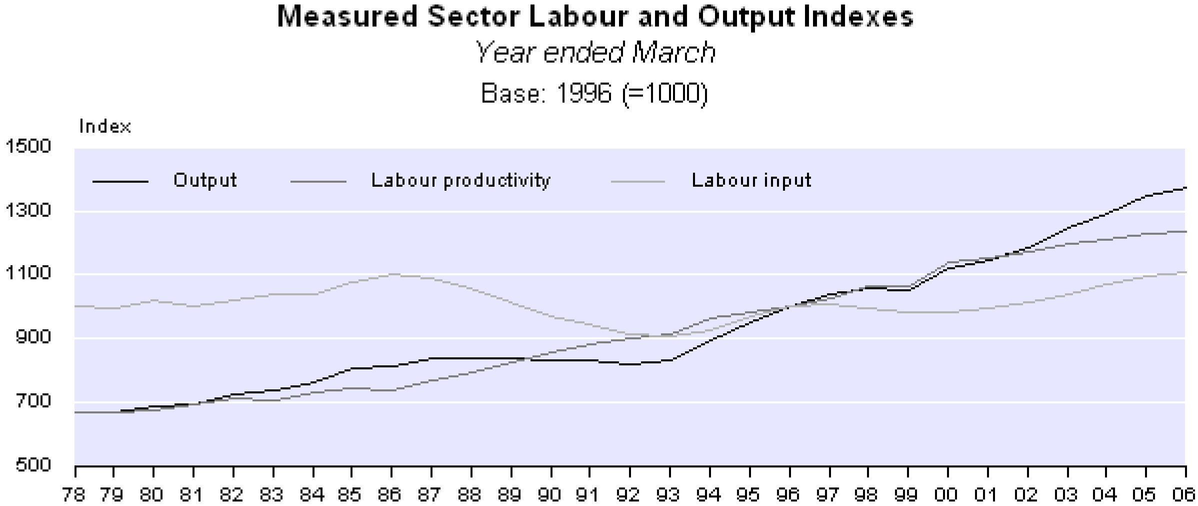
Productivity is a measure of how efficiently inputs are being used within the economy to produce outputs. Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input. Growth in productivity means that a nation can produce more output from the same amount of 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 composition 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 composition 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 composition of total inputs. The growth accounting sections of this commentary provide a breakdown of the sources of growth in real gross domestic product (GDP) and labour productivity.

Statistics New Zealand's official productivity statistics comprises series for labour productivity, capital productivity and multifactor productivity (MFP). The MFP series uses the labour and capital input indexes, which are combined and weighted appropriately to create a total inputs series. All input and output indexes measure growth in volumes and have a base year of 1996, with real GDP as the output measure. The development of these official statistics is consistent with Organisation for Economic Co-operation and Development (OECD) guidelines.

The productivity measures are for the years ended March 1978 to 2006. This period reflects the current availability of relevant source data. Statistics New Zealand has estimated growth cycles in the data to assist users in interpreting the results of the productivity series. There is general consensus that the productivity series are of the most interpretive value when viewed in terms of growth cycles.This is because factors such as capacity utilisation tend to vary from year to year, making interpretation of annual movements difficult. For more information, refer to the Estimating growth cycles section in the Technical notes.

Labour productivity



Labour productivity is measured as a ratio of output to labour input. The table below presents the average annual growth in labour productivity for the growth cycles identified within the series (see the Technical notes for more information on growth cycles).

Labour Productivity Average Annual Growth Rates (percent)[(1)(2)]
Year ended 31 March

Year	Output	Labour input	Labour productivity
1978–1982	2.1	0.4	1.7
1982–1985	3.4	2.0	1.4
1985–1990	0.7	-2.1	2.9
1990–1997	3.2	0.6	2.6
1997–2000	2.6	-0.8	3.5
2000–2006	3.4	2.0	1.4
1978–2006	**2.6**	**0.4**	**2.2**

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
(2) Percentage changes are calculated on unrounded index numbers.

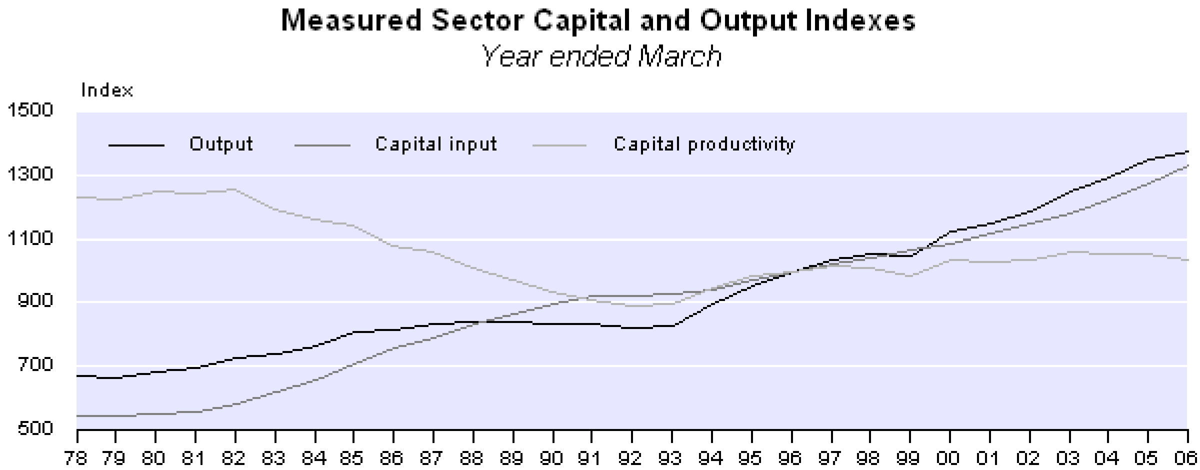
From 1978–2006, the average annual growth in labour productivity was 2.2 percent. This was derived from a 2.6 percent annual growth rate in output, and 0.4 percent annual growth in labour input.

From 1985–1990, there was a significant fall in the average annual rate for labour input, down 2.1 percent, while the average annual growth of output showed a relatively low increase of 0.7 percent. This led to an average annual increase of 2.9 percent in labour productivity. The fall in labour input reflects the declining employment (and rising unemployment) in the labour market during this cycle. For the year ended March 1990, the unemployment rate was 7.1 percent, compared to an unemployment rate of 4.1 percent in the year ended March 1987. Official unemployment statistics from the Household Labour Force Survey are unavailable prior to the March 1986 quarter.

Labour productivity growth peaked during the 1997–2000 cycle, with an annual rate of 3.5 percent. This was due to solid growth in output (average annual increase of 2.6 percent), and falling labour input (average annual decrease of 0.8 percent). The falling labour input was due to decreasing weekly paid hours per person in the measured sector, a trend that is evident from the beginning of the series, and that accelerated slightly in the 1997–2000 cycle. The number of people employed in the measured sector was either stagnant or falling throughout the late 1990s.

From 2000–2006, labour productivity grew again, but at a slower average annual rate of 1.4 percent. This was due to stronger growth in labour input, with an increase of 2.0 percent, compared with a fall of 0.8 percent in the previous cycle. The average annual unemployment rate during the 2000–2006 cycle was 4.7 percent, the lowest annual rate when compared with the previous three cycles.

Capital productivity



Capital productivity is measured as a ratio of output to capital input. The table below presents the annual average growth in capital productivity for the growth cycles identified within the series.

Capital Productivity Average Annual Growth Rates (percent)[1][2] *Year ended 31 March*			
Year	Output	Capital input	Capital productivity
1978–1982	2.1	1.7	0.4
1982–1985	3.4	6.7	-3.1
1985–1990	0.7	4.9	-4.0
1990–1997	3.2	1.9	1.3
1997–2000	2.6	2.0	0.6

2000–2006	3.4	3.5	-0.1
1978–2006	**2.6**	**3.3**	**-0.6**

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
(2) Percentage changes are calculated on unrounded index numbers.

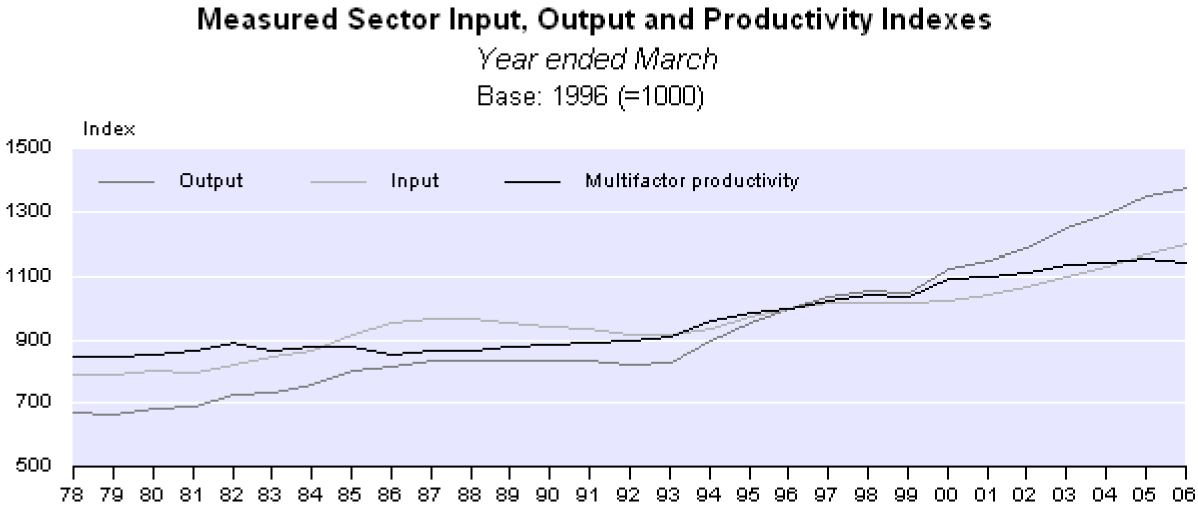
From 1978–2006, average annual growth in capital productivity fell 0.6 percent. This was driven by strong annual capital input growth of 3.3 percent and 2.6 percent annual growth in output.

From 1982–1985, very strong growth in capital input (averaging 6.7 percent) and strong growth in output (averaging 3.4 percent) led to an average annual decrease of 3.1 percent in capital productivity. The strong growth in capital input was largely driven by significant investment in the energy sector on a number of projects collectively known as 'Think Big'.

This period of strong input growth continued on to 1985–1990, when capital input rose 4.9 percent on average. Output was still increasing during this cycle, but at a much slower annual rate of 0.7 percent, which led to the lowest level of capital productivity for any of the six cycles, an average annual decrease of 4.0 percent.

The highest period of capital productivity growth was from 1990–1997, when it averaged 1.3 percent on an annual basis. This was due to high output growth, which averaged 3.2 percent annually while capital input was averaging 1.9 percent on an annual basis.

Multifactor productivity



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

Multifactor Productivity Average Annual Growth Rates (percent)[1][2] *Year ended 31 March*			
Year	Output	Total inputs	Multifactor productivity
1978–1982	2.1	0.9	1.2
1982–1985	3.4	3.8	-0.4
1985–1990	0.7	0.5	0.2
1990–1997	3.2	1.1	2.1
1997–2000	2.6	0.3	2.3
2000–2006	3.4	2.7	0.7
1978–2006	**2.6**	**1.5**	**1.1**

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
(2) Percentage changes are calculated on unrounded index numbers.

The average annual increase of 1.1 percent in MFP from 1978–2006 was due to output growth (up 2.6 percent annually) rising more than input growth (up 1.5 percent annually).

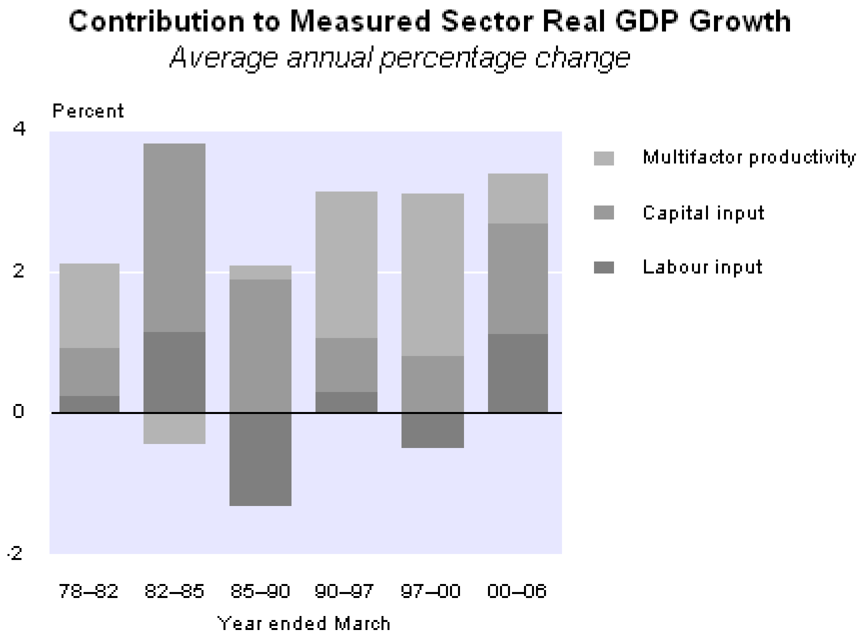
The MFP annual growth rates showed increases for five of the six cycles, with a range of 0.2 to 2.3 percent. The only cycle that showed a fall in MFP was between 1982 and 1985, with an annual drop of 0.4 percent. This was due to the average annual growth of total inputs (up 3.8 percent) increasing more than output growth (up 3.4 percent annually) during the cycle. The growth in inputs during this cycle was driven by strong growth in capital input, averaging 6.7 percent annually. Labour input also grew by an average of 2.0 percent on an annual basis during this cycle.

The average annual growth for MFP peaked between 1997 and 2000 at 2.3 percent. This was due to the strong output growth (average annual rate of 2.6 percent) compared to a relatively low total input growth (average annual rate of 0.3 percent). Output fell 0.6 percent in the March 1999 year, but it bounced back with an annual increase of 6.8 percent in the March 2000 year, which contributed to the strong average growth from 1997–2000.

From 2000–2006, MFP increased, but at a much slower average annual rate of 0.7 percent. This is because total inputs' annual growth was relatively high (averaging 2.7 percent), compared to the previous three cycles, even though output growth was sustained during this cycle.

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 output (real GDP) can arise from three different sources: an increase in labour input, an increase in capital input, or an increase in MFP. The graph below presents growth in output between 1978 and 2006 for the growth cycles identified in the series.



The table below 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 (percent) *Average annual growth rates* (1)(2) Year ended 31 March				
Year	Real GDP	Capital input	Labour input	Multifactor productivity
1978–1982	2.1	0.7	0.2	1.2
1982–1985	3.4	2.7	1.1	-0.4
1985–1990	0.7	1.9	-1.3	0.2
1990–1997	3.2	0.8	0.3	2.1
1997–2000	2.6	0.8	-0.5	2.3
2000–2006	3.4	1.6	1.1	0.7
1978–2006	2.6	**1.3**	**0.2**	**1.1**

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
(2) Percentage changes are calculated on unrounded index numbers.

Over the entire 1978–2006 cycle, output growth averaged 2.6 percent. Capital input was the largest contributor to GDP growth throughout the cycle, averaging 1.3 percent on an annual basis. Labour input contributed 0.2 percent to this rise in output and MFP contributed 1.1 percent.

From 1978–1982, growth in output was positive, averaging 2.1 percent on an annual basis. This was driven by positive growth from all three contributors: capital input contributed 0.7 percent, labour input contributed 0.2 percent and MFP contributed 1.2 percent, on an average annual basis.

From 1982–1985, capital input was relatively strong, contributing 2.7 percent average annual growth to GDP. This, along with positive growth in labour input (averaging 1.1 percent on an annual basis) contributed to strong growth in GDP, averaging 3.4 percent on an annual basis. Output growth in 1985 was particularly high, at 5.8 percent. The positive growth in both capital and labour input was large enough to offset the negative contribution from MFP (which contributed -0.4 percent on average to annual GDP).

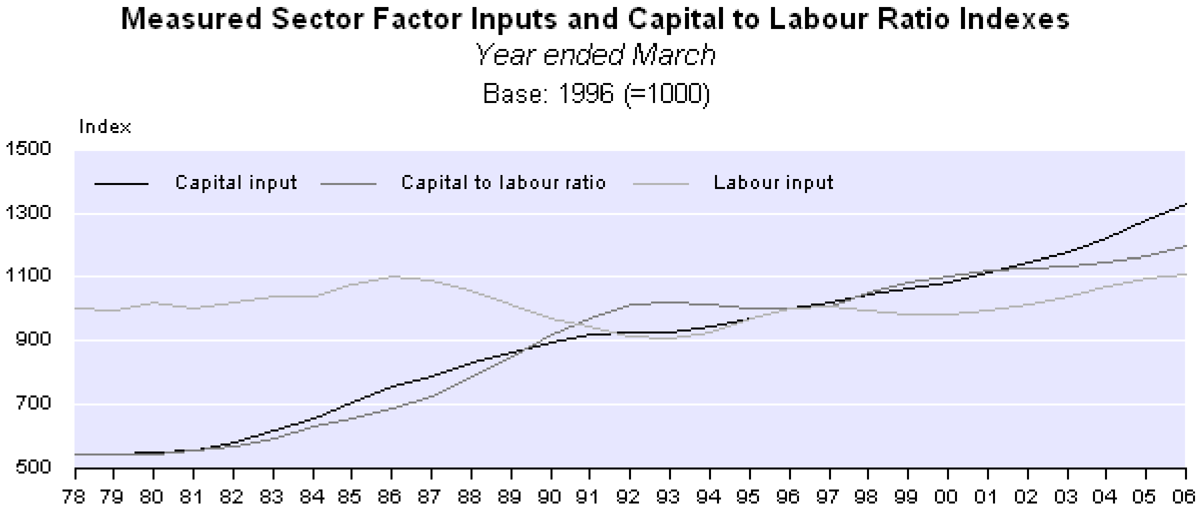
From 1985–1990, a decline in labour input contributed negative 1.3 percent annual growth to GDP. This negative contribution was an offsetting factor to positive capital input (which contributed 1.9 percent on average to annual GDP), and improvement in MFP (which contributed 0.2 percent to average annual GDP growth). Overall, GDP growth was low, averaging 0.7 percent annually over this cycle.

From 1990–1997, there was a marked improvement in GDP growth, averaging 3.2 percent on an annual basis. This reflected positive average annual growth from all three factors: capital input (0.8 percent), MFP (2.1 percent) and labour input (0.3 percent). In particular, the 1994–1997 period showed strong output growth, averaging 5.1 percent on an annual basis.

From 1997–2000, positive growth in capital input and strong growth in MFP, averaging 0.8 percent and 2.3 percent,respectively, on an annual basis, contributed to positive GDP growth (up 2.6 percent on an average annual basis) during this cycle. Output fell in the March 1999 year (down 0.6 percent), a combined result from the Asian economic crisis and two successive droughts that significantly reduced production of primary goods. However, the economic recovery following this was the main driver for the strong average growth from 1997–2000. In the year ended March 2000, output increased by 6.8 percent, the largest annual increase since 1994. There were three predominant factors contributing to the strong output growth in 2000. Firstly, a surge in export volumes (due to the combined effect of the low New Zealand dollar and growing demand from overseas) resulted in growth in prominent export-oriented industries, such as primary food manufacturing, forestry and agriculture. Secondly, sustained consumer spending was recorded throughout the year. Thirdly, business investment on fixed assets was up markedly, rising 7.4 percent in the March 2000 year. The positive growth in capital inputs and MFP was slightly offset by negative labour input (which contributed -0.5 percent on average to annual GDP).

Growth in GDP rose again during the 2000–2006 cycle (averaging 3.4 percent on an annual basis), reflecting positive growth from all three contributors: capital input contributed 1.6 percent, labour input contributed 1.1 percent, and MFP contributed 0.7 percent on an average annual basis. Growth in output was due to a combination of factors. High world prices for export commodities, a relatively low exchange rate for much of the cycle further boosting export growth, a booming residential construction sector and a strong labour market were key drivers in strong output growth during this cycle.

Capital to labour ratio



The capital to labour ratio simply measures capital inputs divided by labour inputs. An increase in the ratio is referred to as capital deepening, while a decrease is termed capital shallowing. The table below presents the average annual growth in the capital to labour ratio and capital and labour inputs for the growth cycles identified within the series.

Capital to Labour Ratio Average Annual Growth Rates (percent)[1][2]
Year ended 31 March

Year	Capital input	Labour input	Capital-labour ratio
1978–1982	1.7	0.4	1.3
1982–1985	6.7	2.0	4.7
1985–1990	4.9	-2.1	7.1
1990–1997	1.9	0.6	1.3
1997–2000	2.0	-0.8	2.9
2000–2006	3.5	2.0	1.4
1978–2006	**3.3**	**0.4**	**2.9**

(1) The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
(2) Percentage changes are calculated on unrounded index numbers.

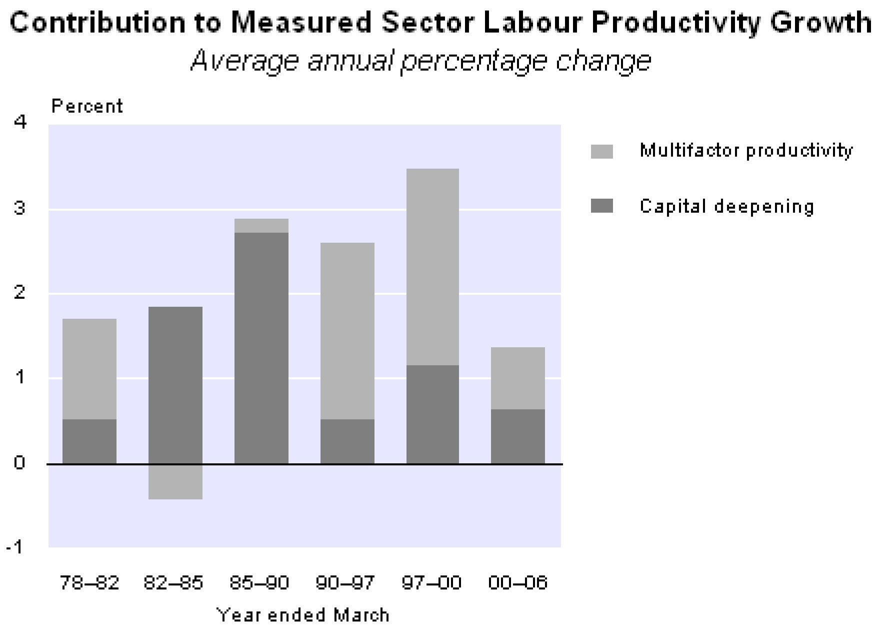
The New Zealand economy has experienced great capital deepening during the last 28 years. The average annual growth for the capital-labour ratio was 2.9 percent from 1978–2006, due to 3.3 percent average annual growth in capital input, compared with 0.4 percent average annual growth in labour input.

From 1985–1990, the average annual growth rate for the capital-labour ratio recorded its highest increase of 7.1 percent. This was due to a decrease in the average annual rate in labour input (down 2.1 percent), while capital input increased 4.9 percent on an average annual basis. As previously mentioned, the labour market was characterised by declining employment (and rising unemployment) during this cycle, which contributed to the fall in labour input.

From 1990 onwards, capital input has increased at a higher rate than labour input. This contributed to the capital-labour ratio continuing to increase, but at a lower rate than the 1985–1990 period.

Growth accounting for labour productivity

As with growth in 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 to labour ratio (that is, capital deepening or capital shallowing) and a change in MFP. The graph below presents growth in labour productivity between 1978 and 2006 for the growth cycles identified in the series.



The table below 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

Average Annual Growth Rates (percent)(1)(2)

Year ended 31 March

Year	Labour productivity	Contribution of capital deepening[3]	Multifactor productivity
1978–1982	1.7	0.5	1.2
1982–1985	1.4	1.8	-0.4
1985–1990	2.9	2.7	0.2
1990–1997	2.6	0.5	2.1
1997–2000	3.5	1.2	2.3
2000–2006	1.4	0.6	0.7
1978–2006	**2.2**	**1.1**	**1.1**

[1] The average annual growth rate values do not include the movement for the first year of each cycle, eg the 1978–1982 average annual growth rate does not include the movement for 1978.
[2] Percentage changes are calculated on unrounded index numbers.
[3] Contribution of capital deepening is equal to the growth rate in the capital–labour ratio weighted by capital's share of total income.

Over the entire 1978–2006 period, the average annual contribution to labour productivity growth from capital deepening was 1.1 percent. The average contribution of MFP growth was also 1.1 percent on an annual basis. Labour productivity growth averaged 2.2 percent annually.

In the 1980s, capital deepening was the main driver of growth in labour productivity. From 1982–1985, the contribution of capital deepening to labour productivity growth was 1.8 percent. The decline in labour productivity growth (down from 1.7 percent in the previous cycle to 1.4 percent) was due to a decrease of 0.4 percent in MFP, on an average annual basis. From 1985–1990, the contribution of capital deepening to the strong labour productivity growth (which rose 2.9 percent on an average annual basis) averaged 2.7 percent on an annual basis. During the late 1980s, unemployment increased rapidly, rising from 4.0 percent in the March 1987 quarter to a high of 10.9 percent in the September 1991 quarter. This led to declining labour input, and, coupled with strong capital input growth, resulted in significant capital deepening over this cycle. MFP contributed an average of 0.2 percent to annual labour productivity growth.

In the 1990s, a different picture emerges, as the main contributor to growth in labour productivity was MFP. From 1990–1997, labour productivity rose 2.6 percent on an average annual basis, reflecting on average contributions of 2.1 percent by MFP and 0.5 percent from capital deepening. The largest growth in labour productivity was from 1997–2000, when it averaged 3.5 percent annually. MFP contributed 2.3 percent to labour productivity on an average annual basis during this cycle. Capital deepening contributed an average of 1.2 percent to annual labour productivity.

Labour productivity over the 2000–2006 cycle was relatively low, averaging 1.4 percent on an annual basis. Contributions from capital deepening and MFP were subdued over this cycle, both showing small positive average annual movements of 0.6 and 0.7 percent, respectively.

Revisions

This release contains revisions arising from new and more up-to-date information. These result from the incorporation of:

- annual reweighted GDP data back to 1988, feeding into the output series
- March 2004 year constant price GDP data into the output series
- revised current price annual industry value added data for all industries for March years 2003 and 2004, which causes revisions to the industry-level factor income shares
- revised current and constant price productive capital stock data, for selected assets and industries for March years 2003 and 2004, into the capital input series
- 2006 Census data into the labour volume series, providing benchmarks for average working proprietor average hours and employees in industries outside of the scope of the QES.

This release also contains revisions resulting from improved methodology. These are:

- the incorporation of revised valued added data for the Agriculture industry, due to enhancements made to historic source data. These revisions feed into the output series.
- an improved methodology for benchmarking of annual constant price value added data for the Cultural and recreational services industry. These revisions also feed into the output series.
- incorporation of Linked Employer-Employee Data (LEED) for working proprietor and employee job counts from 2000 to 2006, into the labour volume series.

While there have been minor revisions to some annual movements, the underlying trend of the productivity series has remained unchanged.

Revisions to annual productivity indexes and movements are displayed in tables 7 and 8.

Future developments in productivity measures

Statistics NZ is committed to a multi-year programme to carry out enhancements to the productivity measures published in this release. The main priorities of this work will be to introduce quality adjusted labour input data; to develop industry-level measures of labour, capital and multifactor productivity; and to expand the measured sector to industries that are currently excluded. In addition, ongoing methodological and source data improvements will be made to the series, resulting in improved productivity measurement.

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Technical notes

What is productivity?

Productivity is a measure of how efficiently inputs are being used in the economy to produce outputs. Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input.

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). 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 New Zealand method of estimating productivity statistics is based on OECD guidelines, as outlined in the OECD Manual Measuring Productivity (OECD, 2001). 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 starting points for the cycles are estimated as years where capacity utilisation is at its highest point, hence the cycles chosen are 'peak-to-peak'. 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*, available at 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 table below with reference to the Australian New Zealand Standard Industrial Classification 1996 (ANZSIC 96).

Measured sector industries	Omitted industries
Measured sector industries	**Omitted industries**
A Agriculture, forestry and fishing	L Property and business services
B Mining	M Government administration and defence
C Manufacturing	N Education
D Electricity, gas and water supply	O Health and community services
E Construction	Q Personal and other services
F Wholesale trade	
G Retail trade	
H Accommodation, cafes and restaurants	
I Transport and storage	
J Communication services	
K Finance and insurance	
P Cultural and recreational services	

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 utilised 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 together 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.

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, Population of Census 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.

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.

Revisions to labour input index

The introduction of LEED as the main data source of counts of employees and working proprietors from 2000 has resulted in revisions to labour input from 2001 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 anunal 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.

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 three other assets, namely livestock, exotic timber grown for felling, and land in use in agriculture and forestry.
- 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 endogenous 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.

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 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.

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.

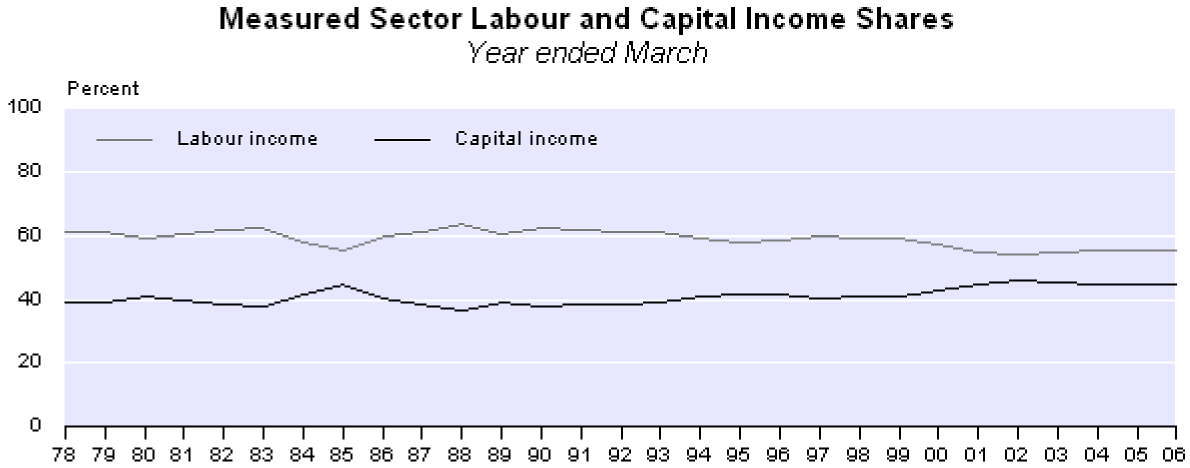
The income measure of GDP is calculated as compensation of employees plus gross operating surplus plus taxes on production and imports less subsidies (taxes less subsidies are known as net taxes). Included within gross operating surplus is the income of working proprietors, which is termed mixed income.

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 by firstly allocating taxes directly to labour and capital where appropriate, then apportioning the remaining net taxes using 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.



The average capital and labour income shares remain relatively stable over the 1978–2006 period, with the capital share at approximately 40 percent of total income and the labour share at approximately 60 percent of total income.

Published series

The productivity indexes have an expression base: year ended March 1996=1000, consistent with the published national accounts. The first year of the series is the March 1978 year. The measured sector GDP data used to calculate productivity indexes from 1978 to 1988 is currently provisional. Final GDP data will be available for incorporation into the output series, for the next productivity release in 2008.

Copyright

Liability

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. Two technical papers are also available. *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 1978–2006. Both publications are available from the Statistics New Zealand website (http://www.stats.govt.nz/).

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.

Next release...

Productivity Statistics: 1978–2007 is scheduled to be released in March 2008.

Tables

The following tables can be downloaded from the Statistics New Zealand website in Excel 97 format. If you do not have access to Excel 97 or higher, you may use the Excel file viewer to view, print and export the contents of the file.

List of tables

1. Productivity in the measured sector, productivity indexes and output measure
2. Productivity in the measured sector, productivity indexes – annual percentage change
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