Hot Off The Press

Latest statistics from Statistics New Zealand

Statistics New Zealand
TATAURANGA AOTEAROA

Embargoed until 10:45am – 1 May 2007

Productivity Statistics – 1988−2006

Revised 1 May 2007 – See attached Erratum

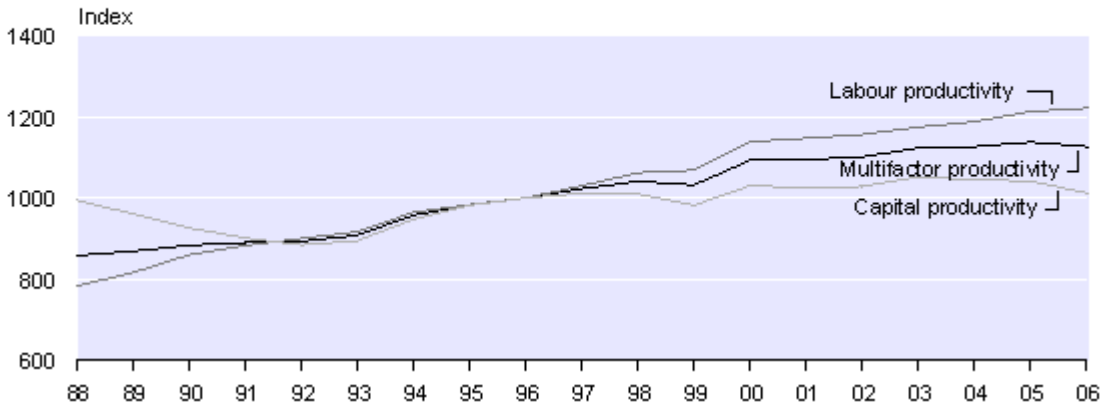
Highlights

- **Labour productivity grew 0.7 percent** in the measured sector for the year ended March 2006.
- **Annual labour productivity growth averaged 2.5 percent** in the measured sector from 1988 to 2006.
- **Multifactor productivity fell 1.0 percent** in the measured sector for the year ended March 2006.
- **Capital productivity fell 2.9 percent** in the measured sector for the year ended March 2006.

Measured Sector Productivity Indexes

Year ended March

Base: 1996 (=1000)



Dallas Welch
Acting Government Statistician

16 March 2007
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Commentary

Unless otherwise stated, all references to average movements are annual geometric mean movements relating to the 'measured sector'. In 2003, 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 – relating a measure of output to a single measure of input, or multifactor – 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 occurring 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.

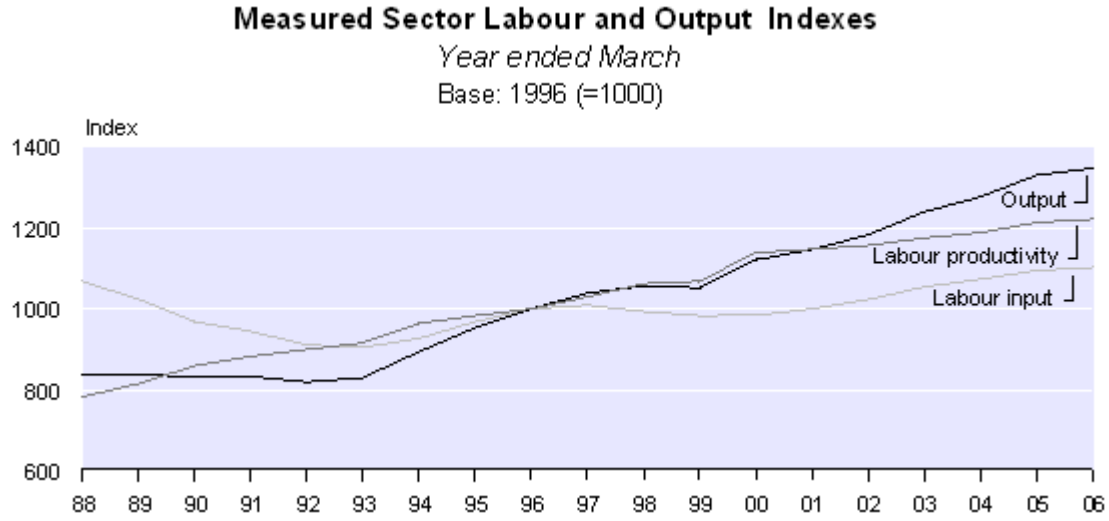
Statistics New Zealand's official productivity statistics comprise series for labour productivity, capital productivity and multifactor productivity (MFP). The MFP series uses the labour and capital input indexes, which are combined and weighted appropriately to create a total inputs series. All input 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 Co-operation and Development (OECD) guidelines.

The productivity measures are for the years ended March 1988 to 2006. This period reflects the current availability of relevant source data. Productivity series are of the most interpretative value when viewed in terms of business cycles rather than individual years. This is because factors such as capacity utilisation tend to vary over a business cycle. Statistics NZ intends to publish the productivity series back to 1978 and this longer time series will be more appropriate for the estimation of business cycles. In the absence of business cycles, the 18-year period has often been split into two distinct time spans – 1988 to 1993 and 1993 to 2006. There is widespread consensus that a break in the New Zealand economy occurred around 1993.

Revisions

This release contains revisions to previously published figures. These revisions result from: new and updated data used in the calculation of the input and output indexes; and the implementation of new methodologies. Refer to the Technical Notes of this release for more details.

Labour productivity



Labour productivity is measured as a ratio of output to labour input. Labour productivity in the measured sector increased 0.7 percent for the year ended March 2006. This compares with growth of 2.1 percent for 2005 and an annual average of 2.2 percent between 1993 and 2006. Low growth for the March 2006 year was driven by relatively weak output growth of 1.4 percent and sustained employment growth over the period.

A strong fall in the rate of labour productivity growth, as shown for the 2006 year, could be explained by several factors. One theory is that the utilisation of capital capacity falls as demand slows, which would lead to a fall in output growth. Another possible influence would be a change in the skill composition of the employed labour force, due to skill shortages resulting from a buoyant labour market. This was highlighted by a March-year record low unemployment rate (3.7 percent) and a record high labour force participation rate (68.1 percent) for 2006. Other potential factors include firms holding on to existing staff, despite a slowing of the economy, to minimise the cost of re-hiring staff when the economy picks up again.

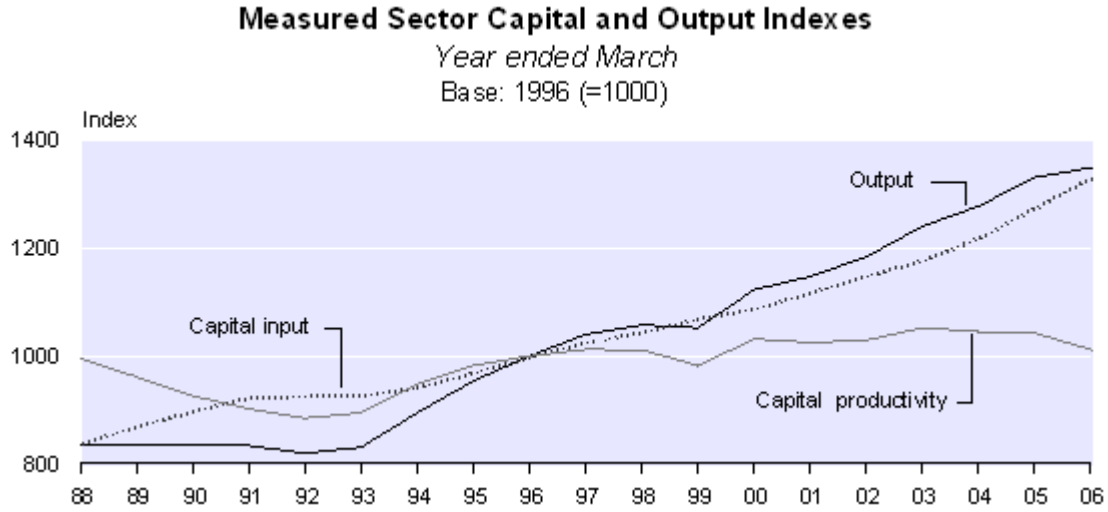
Over the entire 1988 to 2006 period, average annual growth in labour productivity was 2.5 percent. This was derived from a 2.7 percent annual growth rate in output, and 0.2 percent annual growth in labour input. The relatively low growth in labour input between 1988 and 2006 should be viewed in the context of the labour market dynamics over the period.

From 1988 to 1993, the labour market was characterised by declining employment (and rising unemployment). This decline was particularly evident in the measured sector (refer to the Technical Notes for a detailed definition of the measured sector). In contrast, the non-measured sector experienced slight upward growth. Average annual growth in measured sector labour input fell 3.2 percent over this period, while output declined slightly, averaging growth of -0.2 percent annually over the period. This led to an average annual increase of 3.2 percent in labour productivity.

From 1993 onwards, the series shows growth in labour input, averaging 1.5 percent per year. However, over this time the measured sector proportion of the labour market declined. This is because employment growth has been proportionately greater in industries (predominately service industries) outside the measured sector.

Initially, growth in employment over the 1993 to 2006 period was dominated by part-time employment, which has a dampening effect on labour input when measured in hours. Average annual output growth was 3.8 percent in the measured sector, leading to average annual growth in labour productivity of 2.2 percent over the period.

Capital productivity



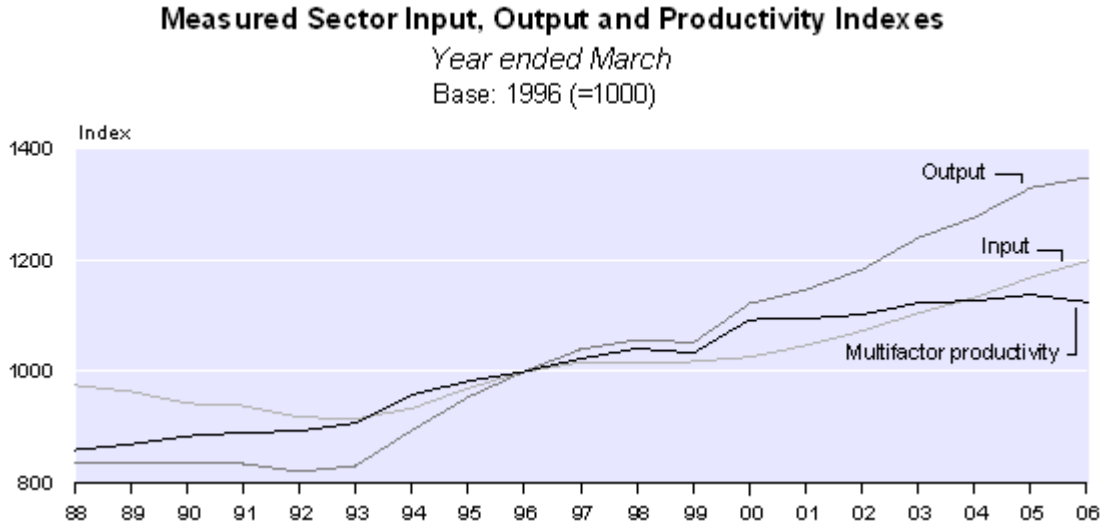
Capital productivity is measured as a ratio of output to capital input. Capital productivity in the measured sector decreased 2.9 percent for the year ended March 2006. This productivity measure is low when compared with the 0.3 percent decline for 2005, and the annual average of 0.9 percent growth between 1993 and 2006. The decline in capital productivity for the March 2006 year was the result of strong growth of 4.4 percent in capital input, combined with output growth of only 1.4 percent.

This decline in the productivity of capital is likely to be due to a combination of factors. These may include a drop off in the utilisation of existing capital capacity – where the total amount of capital may have increased, but the level of capital actually in use may have decreased. Measurement of capital input in these productivity statistics assumes constant capacity utilisation. Additionally, the very strong growth in capital input from 2004 to 2006 may have had a lagged effect on output. This lag would be due to learning effects involved in the adoption of new capital.

Capital productivity in the measured sector increased 1.7 percent between 1988 and 2006. This increase reflects a 61.0 percent growth in output, compared with a 58.3 percent growth in capital input over the period. Average annual growth in capital productivity was 0.1 percent between 1988 and 2006.

From 1988 until 1993, annual capital input rose 2.0 percent on average while output fell 0.2 percent on average. This led to an average annual decrease of 2.1 percent in capital productivity. From 1993 until 2006, average annual growth in capital input was 2.8 percent while growth in output was 3.8 percent. This resulted in average annual growth in capital productivity of 0.9 percent over the period.

Multifactor productivity



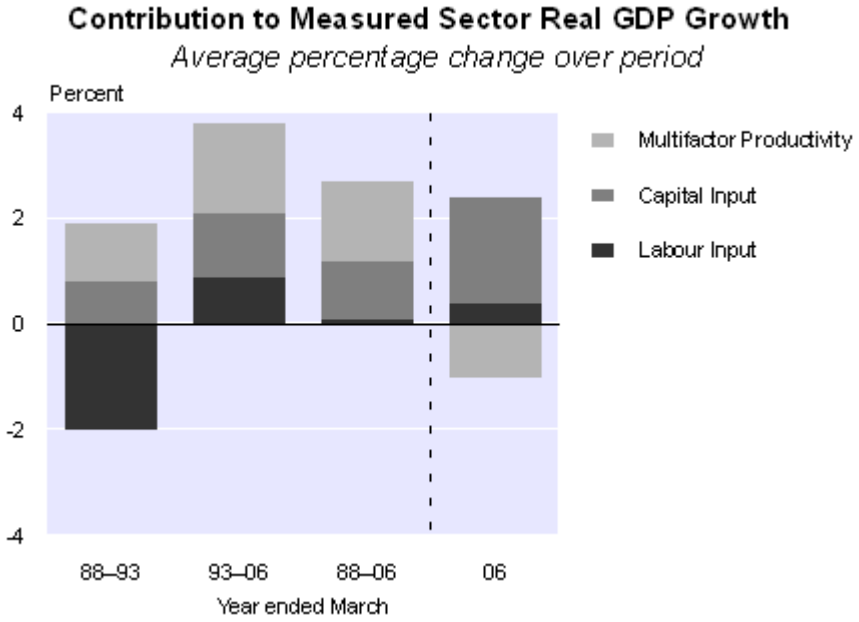
Multifactor productivity is growth that cannot be attributed to capital or labour, such as technological change or improvements in knowledge, methods and processes. In the measured sector, MFP decreased 1.0 percent for the year ended March 2006. This decline contrasts with a 1.0 percent increase for 2005 and the annual average increase of 1.7 percent between 1993 and 2006. The 2006 fall was driven by 2.4 percent growth in total input, and output growth of only 1.4 percent for the year ended March 2006. The growth in total input was driven by the 4.4 percent rise in capital input and the 0.7 percent rise in labour input.

In the measured sector, MFP increased 31.2 percent between 1988 and 2006. This increase reflects a 61.0 percent growth in output, compared with only 22.7 percent growth in total input. The movement in total inputs is a weighted average of the 3.3 percent growth in labour input and the 58.3 percent growth in capital input over this period. Average annual growth in MFP was 1.5 percent between 1988 and 2006.

From 1988 until 1993 annual growth in total input fell 1.3 percent on average, driven by a large fall in labour input. Output fell 0.2 percent annually over the same period. This led to an average annual increase of 1.1 percent in MFP. From 1993 until 2006, average annual growth in total input was 2.1 percent, while average annual growth in output was 3.8 percent. This led to average annual growth in MFP of 1.7 percent over the period.

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 1988 and 2006 in these three components.



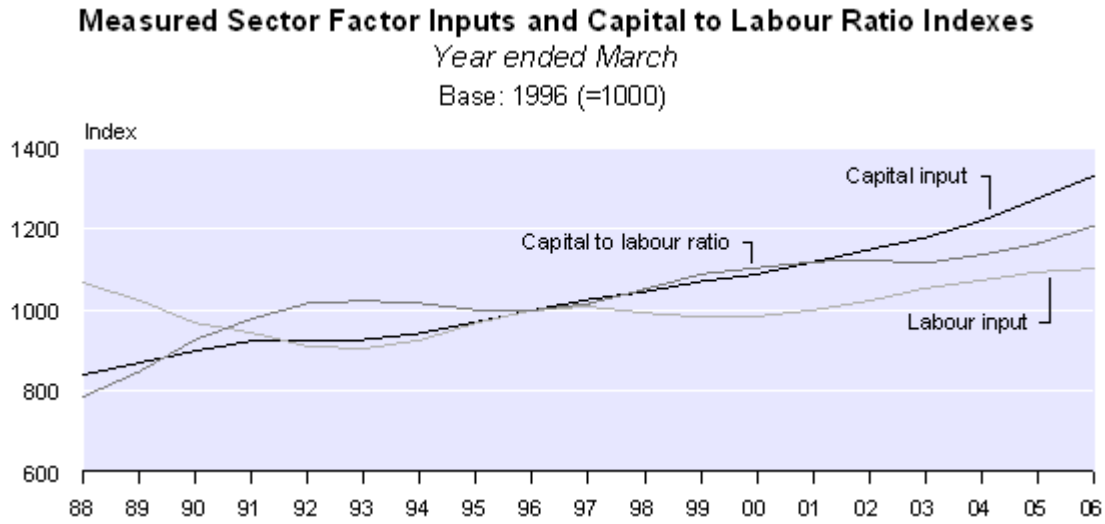
In 2006, output growth was 1.4 percent. Capital and labour inputs contributed 2.0 percent and 0.4 percent, respectively, while MFP partly offset this, declining 1.0 percent.

Over the entire 1988 to 2006 period, output growth averaged 2.7 percent. Capital input contributed 1.1 percent to this rise and labour input contributed 0.1 percent. Growth in MFP was consistently the largest contributor, averaging 1.5 percent on an annual basis.

From 1988 to 1993, labour input declined strongly, contributing -2.0 percent annual growth to GDP. This negative contribution was large enough to offset positive contributions from both capital input (which contributed 0.8 percent on average to annual GDP) and improvement in MFP (which contributed 1.1 percent average annual growth). GDP growth was slightly negative, averaging -0.2 percent annually over this period.

From 1993 to 2006, GDP growth was relatively strong, averaging 3.8 percent on an annual basis. This reflected positive growth from all three contributors: labour input contributed 0.9 percent annually, capital input contributed 1.2 percent, and MFP increased 1.7 percent on an average annual basis. Within this 13-year timeframe, 1994 to 1997 and 2000 to 2005 were periods of solid growth, with all three contributors (labour input, capital input and MFP) having a positive impact on growth. However, in 1998 and 1999 the New Zealand economy experienced a downturn, largely due to the Asian economic crisis. This resulted in declining labour input in both these years, and negative MFP growth in 1999. As a result, output growth was negative in 1999.

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 as capital shallowing. For the year ended March 2006, capital input increased 4.4 percent, while labour input increased 0.7 percent. This resulted in the capital to labour ratio rising 3.7 percent.

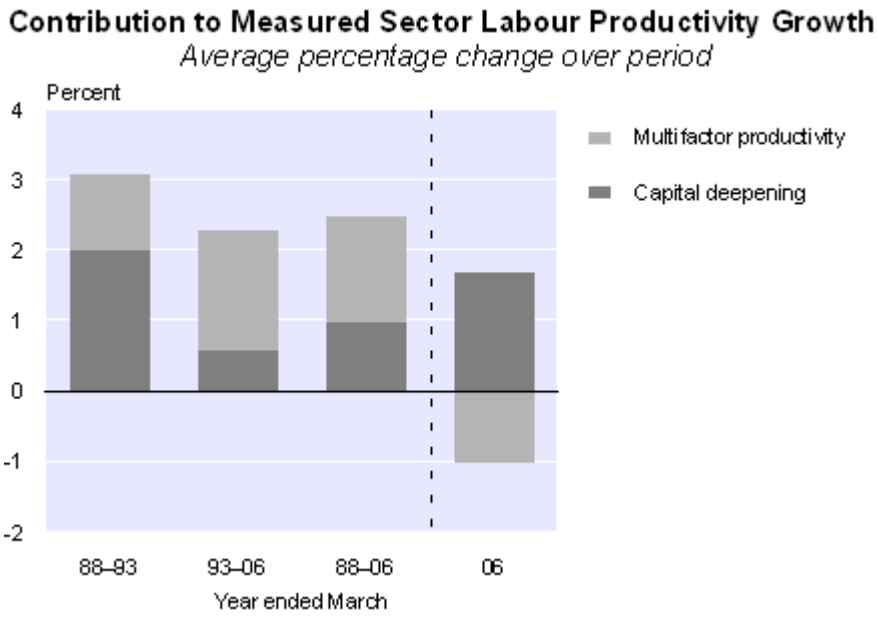
From 1988 to 2006, capital input increased 58.3 percent, compared with an increase of only 3.3 percent in labour input. This resulted in an increase of 53.3 percent in the capital to labour ratio over the 18 years. The annual average increase in the capital to labour ratio was 2.4 percent.

From 1988 to 1993, labour input growth fell an average of 3.2 percent on an annual basis. Average annual growth in capital input of 2.0 percent resulted in the capital to labour ratio increasing by an average of 5.4 percent annually. Over this period, there was steady growth in capital input, but the labour market was characterised by declining employment, resulting in a high level of capital deepening.

From 1993 to 2006, labour input increased at an average annual rate of 1.5 percent. Capital input increased at a higher average annual rate (2.8 percent), which resulted in the capital to labour ratio increasing by an average of 1.3 percent annually. Despite positive labour input growth, it was still outstripped by the capital input growth. Therefore, the economy experienced a more modest level of capital deepening from 1993 to 2006.

Growth accounting for labour productivity

As with growth in output, growth in labour productivity can be broken into components. In particular, a change in labour productivity can come from two possible sources: a change in the weighted capital to labour ratio (ie capital deepening or capital shallowing) and a change in MFP.



Capital deepening was the largest driver of the 0.7 percent labour productivity growth for the year ended March 2006. Its contribution of 1.7 percent growth contrasts with the 1.0 percent decline in MFP.

Over the entire 1988 to 2006 period, the average annual contribution to labour productivity growth from capital deepening was 1.0 percent. The average contribution of MFP growth was 1.5 percent on an annual basis. Labour productivity growth averaged 2.5 percent annually.

From 1988 to 1993, capital deepening was the largest contributor to growth in labour productivity, with an average contribution of 2.0 percent annually. During this time, firms shed significant amounts of labour, and unemployment reached a historic high of 10.9 percent in the September 1991 quarter. An annual average of 1.1 percent was contributed by MFP to annual labour productivity growth of 3.2 percent.

However, from 1993 to 2006 MFP growth was the largest contributor to labour productivity growth, averaging 1.7 percent on an annual basis. The decline in pre-1993 labour input reversed, resulting in smaller increases in the capital to labour ratio. Therefore, the contribution of capital deepening was subdued – it contributed 0.6 percent to labour productivity growth on an annual basis over this period. Labour productivity rose by 2.2 percent on an average annual basis.

Future productivity developments

Statistics NZ is embarking on a multi-year programme to enhance the productivity measures published in this release. The main priorities of this work will be: to backdate the current series from 1988 to 1978; to develop industry-level measures of labour, capital and multifactor productivity; and expansion of the measured sector for industries which are currently excluded.

For technical information contact:
Brendan Mai or Joel Cook
Wellington 04 931 4600
Email: info@stats.govt.nz

Technical Notes

What is productivity?

Productivity is a measure of how efficiently inputs (labour and capital, for example) are being used in the economy to produce outputs. It is commonly defined as a ratio of a volume measure of output to a volume measure of input use.

Productivity measures may be either single factor (relating a measure of output to a single measure of input) or multifactor (relating a measure of output to a bundle of inputs), and 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 include 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.

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 – mainly government non-market industries whose services, such as administration, health and education, are provided free or at nominal charges – whose real value-added in the national accounts is largely measured using input methods, such as number of employees. The measured sector is defined in the table below with reference to the Australia New Zealand Standard Industrial Classification (ANZSIC) (1996):

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	

Revisions

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

- revisions to quarterly constant price gross domestic product
- incorporation of the 2002 revised and 2003 balanced annual national accounts
- revision of the Linked Employer-Employee Data (LEED) based benchmarks in the labour input series for 2004 and 2005
- incorporation of revised land, livestock, standing stock of timber and gross fixed capital formation data from 2002 to 2005.

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

- A more appropriate data source used to calculate gross mixed income
- An improvement to the allocation of net taxes on production. Specific taxes and subsidies directly attributable to labour and capital are now apportioned to these factors where appropriate.

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

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. There are three components which are summed to an industry level:

- Employees in industries covered by Statistics NZ's Quarterly Employment Survey (QES): For this component, annual Business Demography counts of employees are rated forward by quarterly movements in employee count 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.

- Employees out of scope of the QES: The following ANZSIC industries are omitted from the QES coverage:
  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.

- Paid hours for these employees are estimated using the same procedures adopted for working proprietors below.
- Working proprietors: Both hours and employment data are benchmarked using totals from the population census. The series is interpolated between benchmarks using quarterly estimates of change from the Household Labour Force Survey.

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.

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 stocks 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 stock series are built up using a perpetual inventory model (PIM) that generates productive 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 given above.

Published series

The productivity indexes have an expression base: year ended March 1996=1000, consistent with the published national accounts. At present, the first year of the series is the March 1988 year.

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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. A technical paper *Productivity Statistics: Sources and Methods* that details the sources and methods used to compile the series, is also available. Both publications are available from the Statistics New Zealand website (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: 1978–2006 is planned to be released later in 2007.

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Erratum

Corrections were made on 1 May 2007 to the commentary and tables in the *Productivity Statistics: 1988-2006* Hot Off The Press information release, published on 16 March 2007. The correction is to the labour volume series for the year ended March 2006, and results in minor changes to the 2006 labour input, labour productivity, multifactor productivity, capital to labour ratio and the total inputs. As noted, the corrections only affect the numbers for the year ended March 2006.

Labour input growth has been corrected from 0.9 percent to 0.7 percent, resulting in a higher percentage change in labour productivity of 0.7 percent in 2006 (previously published at 0.4 percent). Additionally, multifactor productivity growth has been corrected from -1.1 percent to -1.0 percent for the year ended March 2006.

Table of corrections for the year ended March 2006

Series	Originally published	Corrected
Labour productivity (index)	1219	1222
Labour productivity growth	0.4 percent	0.7 percent
Multifactor productivity (index)	1125	1127
Multifactor productivity growth	-1.1 percent	-1.0 percent
Labour input (index)	1105	1103
Labour input growth	0.9 percent	0.7 percent
Total inputs (index)	1198	1196
Total inputs growth	2.5 percent	2.4 percent
Capital-labour ratio (index)	1205	1208
Capital-labour ratio growth	3.4 percent	3.7 percent
Labour volume (weekly hours paid (000))	45,305	45,170
Labour volume growth	1.3 percent	1.0 percent
Contribution of labour input to output growth	0.5 percent	0.4 percent
Contribution of capital deepening to labour productivity	1.6 percent	1.7 percent

Because the corrections to 2006 figures are small, they do not alter any of the average annual labour productivity changes, or average annual multifactor productivity changes for 1988–2006 or 1993–2006, as originally reported in the Hot Off The Press.

The reissued Hot Off the Press highlights and commentary reflect the corrections in the table above.

For media enquiries contact:
Geoff Bascand
Deputy Government Statistician
Wellington 04 931 4600

For technical information contact:
Brendan Mai
Project Manager, Productivity Statistics
Wellington 04 931 4600
Email: info@stats.govt.nz

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