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TATAURANGA AOTEAROA

Industry Productivity Statistics

1978–2008

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Preface

There has been growing interest in gaining a better understanding of New Zealand's productivity performance, both within industries and relative to other countries, notably Australia. Productivity growth is critical to long-term growth in material living standards. In line with this growing interest, Statistics New Zealand received funding in 2006 to enhance and develop official estimates of labour, capital, and multifactor productivity. These were first published in March 2006 for the 'measured sector', an aggregation of industries which now covers 74 percent of the economy.

Industry Productivity Statistics 1978–2008 takes the measured sector data and breaks it down into 23 industries. For all but three of those, the estimates extend back 30 years. It is a major step forward in determining New Zealand's productivity performance from 1978.

The estimates in this publication are consistent with international best-practice outlined in the OECD manual, *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth* (2001). In addition this report has benefited from the advice received from the external advisory committee for the project. I am particularly grateful for the review of the estimates undertaken by Simon McLoughlin, and wish to thank the other members of the advisory committee – John Janssen, Viv Hall, Adolf Stroombergen, and Philip Stevens – for their assistance.

Statistics NZ plans to publish updated productivity estimates by industry on an annual basis, in conjunction with the March release of measured sector data.

Geoff Bascand
Government Statistician

Standards and further information

Percentage changes

Percentage movements are, in a number of cases, calculated using data of greater precision than published. This could result in slight variations.

Rounding procedures

On occasion, figures are rounded to the nearest thousand or some other convenient unit. This may result in a total disagreeing slightly with the total of the individual items as shown in tables. Where figures are rounded the unit is in general expressed in words below the table headings.

Changes of base

Where consecutive figures have been compiled on different bases and are not strictly comparable, a footnote is added indicating the nature of the difference.

Source

All data is compiled by Statistics New Zealand, except where otherwise stated. Both administrative and survey data has been used in this report.

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1 Introduction

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 over time, a nation or an industry can produce more output from the same amount of inputs, or the same amount of output with fewer inputs.

Over recent years, interest in productivity measurement has increased significantly. Successive governments have placed priority on raising New Zealand's productivity growth, identifying it as a means to raising New Zealand's living standards and the competitiveness of the economy.

Statistics New Zealand has been producing official annual measures of labour, capital, and multifactor productivity (MFP) for the measured sector of the economy[1] since 2006. In 2007, the measured sector covered approximately 74 percent of the economy. *Industry Productivity Statistics 1978–2008* presents the official estimates of labour, capital, and MFP growth rates for 23 industries that comprise the measured sector. Contributions to output growth and to labour productivity growth are presented within a growth accounting framework. The level of industry detail is consistent with the lowest level currently published within official gross domestic product (GDP) statistics.[2] To allow for comparison with Australia, the sub-industries within agriculture; forestry and fishing; and manufacturing are aggregated.

The industry productivity statistics presented in this report use the same underlying data as the measured sector estimates published in *Productivity Statistics: 1978–2009*.[3] However, the industry estimates are only published to 2008 due to the timeliness of underlying labour input data:

- The cultural and recreational services industry is included in the measured sector productivity statistics from 1978, but its time series in this report is only available from 1996. Before 1996 the output measures are not derived independently of the labour input in the production process.
- Business services, and personal and other community services are also only available at this industry level from 1996 for the same reason, and only included in the measured sector from that point.

In compiling these new statistics, Statistics NZ followed the methods outlined in the Organisation for Economic Co-operation and Development (OECD) manual, *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth* (2001), which is based on early work by Jan Tinbergen in 1942 and Robert Solow in 1957. They formulated productivity

1. For a list of measured sector industries, see chapter 3, 'Overview of sources and methods'.

2. An exception to this is forestry and fishing, which have been aggregated.

3. There is one exception to this. A revision has been incorporated into the productive capital stock of the road transport equipment asset in the finance and insurance industry. This revision affects the asset weights, capital services index, capital productivity index, total inputs index, and multifactor productivity index for this industry, from 1993 onwards. By implication, it also affects the same measured sector indexes, to a much smaller degree. There is no change to the underlying trend of the measured sector productivity.

measures in a production function context and linked them to the analysis of economic growth. This approach offers a consistent and well-founded method that integrates the theory of the firm, index number theory, and the National Accounts.

The method recommended in compiling the estimates implicitly assume that the proportion of capital stock used in production (capital utilisation) does not alter; therefore, any real-world change in the extent to which capital is utilised in production will be recorded as a change in productivity. For this reason, estimating productivity growth over cycles is preferable, as it accounts for changes in capital utilisation rates. The cycles presented here are consistent with those published for the measured sector in *Productivity Statistics: 1978–2009*. The peak years identified for the measured sector are 1982, 1985, 1990, 1997, 2000, and 2006. It is important to note that the end-points of the series (ie 1978–82 and 2006–08) are not complete cycles, and therefore, have not been presented alongside the five other complete cycles. For more information on the growth cycles see www.stats.govt.nz/productivity.

Chapter 2 is a brief summary of results, presenting labour, capital, and MFP growth rates by industry, as well as industry contributions to measured sector productivity growth across business cycles. Chapter 3 provides an overview of the sources and methods used in compiling the productivity statistics.

Chapters 4 to 19 contain the individual industry analyses. Chapter 20 provides a comparison with Australia. Use of the same industrial classification system (Australian and New Zealand Standard Industrial Classification (ANZSIC) 1996), and similar industry coverage within the measured sector, allows this comparison to be made from 1986 to 2008 for 12 industries. These industries comprise approximately 63 percent of both economies. Both industry growth rates and industry contributions to measured sector growth rates are compared and contrasted. Appendix 1 provides further details on the methodology and data. Detailed annual tables are available in downloadable Excel format at www.stats.govt.nz/productivity.

Statistics NZ will publish industry productivity estimates on an annual basis, incorporated into the March release of measured sector data.

2 Summary

This chapter presents a summary of industry productivity estimates, highlighting labour and MFP growth in industries that make up the measured sector in New Zealand. Labour productivity is broken down into factors – MFP and the contribution of capital deepening (see glossary for definitions). Industry contributions to measured sector labour productivity growth are also presented. The industry coverage of this report is outlined in table 2.1.

Table 2.1

Industry coverage of productivity statistics
By percentage contribution to GDP
Year ended March 2007

Industry	Contribution to GDP (%)
Agriculture, forestry, and fishing	5.6
Agriculture	4.8
Forestry and fishing	0.8
Mining	1.3
Manufacturing	15.1
Food, beverage, and tobacco	5.4
Textile and apparel	0.5
Wood and paper products	1.5
Printing, publishing, and recorded media	1.1
Petroleum, chemical, plastic and rubber	1.7
Non-metallic mineral products	0.6
Metal products	1.7
Machinery and equipment	2.2
Furniture and other	0.5
Electricity, gas, and water supply	2.9
Construction	5.7
Wholesale trade	7.1
Retail trade	6.2
Accommodation, cafés, and restaurants	2.0
Transport and storage	4.4
Communication services	3.1
Finance and insurance	7.0
Business services (1)	9.2
Cultural and recreational services (1)	2.4
Personal and other community services (1)	1.6
Total measured industries	**73.7**
Non-measured industries (2)	**26.3**

1. Included in the measured sector from 1996.
2. Non-measured industries are property services; ownership of owner-occupied dwellings; government administration and defence; education; health and community services. Also included in the non-measured industries is financial intermediation services indirectly measured (FISIM).

Source: Statistics New Zealand

Growth in labour and multifactor productivity

From 1978–2008, labour productivity grew at an average annual rate of 2.1 percent for the aggregate measured sector in New Zealand (see table 2.2). The communication services industry had the highest labour productivity growth rate over this time, increasing by 9.3 percent each year. Other high performers were the agriculture, forestry, and fishing, and the electricity, gas, and water supply industries. Transport and storage, as well as finance and insurance also grew stronger than the measured sector over this period.

The only industry in which labour productivity declined from 1978–2008 was the accommodation, cafés and restaurants industry. The cultural and recreational services, and business services industries also experienced declines in labour productivity, but these series began only in 1996.

Table 2.2

Labour productivity by industry
Average annual percentage change by growth cycle
Year ended March

Industry	Growth cycle					Average for 1978–2008 (%)
	1982–1985	1985–1990	1990–1997	1997–2000	2000–2006	
	Average annual % change					
Agriculture, forestry, and fishing	1.9	7.9	6.3	-0.2	4.0	**4.0**
Agriculture	1.8	6.6	7.4	-0.8	4.3	**4.0**
Forestry and fishing	2.9	18.2	-0.9	0.2	3.2	**3.9**
Mining	12.1	4.9	8.1	2.1	-5.6	**1.9**
Manufacturing	2.7	1.7	1.3	3.3	1.8	**1.7**
Electricity, gas, and water supply	3.1	4.3	7.0	21.0	-3.0	**4.4**
Construction	1.7	1.4	0.3	-1.7	0.0	**0.5**
Wholesale trade	-1.1	0.8	-1.0	6.2	0.7	**0.7**
Retail trade	-2.4	0.7	1.5	3.1	2.1	**1.0**
Accommodation, cafés, and restaurants	-2.3	-1.4	-0.7	-0.8	0.4	**-1.3**
Transport and storage	4.6	6.1	5.9	2.9	0.6	**3.6**
Communication services	6.3	12.3	13.6	13.2	6.8	**9.3**
Finance and insurance	1.9	0.1	3.2	12.3	3.3	**3.4**
Business services(1)	..	..	..	-1.9	0.8	**..**
Cultural and recreational services(1)	..	..	..	-0.6	-2.5	**..**
Personal and other community services(1)	..	..	..	9.2	1.2	**..**
Measured sector	**1.5**	**2.9**	**2.6**	**3.1**	**1.3**	**2.1**

1. Data available only from 1996.

Symbol:
.. figure not available

Source: Statistics New Zealand

MFP growth is presented in table 2.3 by growth cycles. From 1978–2008, MFP in the measured sector increased at a rate of 1.1 percent a year. Apart from having the highest labour productivity growth over the period, communication services also had the highest MFP growth over the series, increasing at a rate of 5.2 percent annually. Transport and storage, along with agriculture also performed well.

Accommodation, cafés, and restaurants showed the largest decline in MFP from 1978–2008, and was also the only industry in which MFP declined across every cycle. Other low performers include mining and construction. Cultural and recreational services, and business services also showed negative MFP growth across all their cycles, but these series only commenced in 1996.

Table 2.3

Multifactor productivity by industry
Average annual percentage change by growth cycle
Year ended March

Industry	Growth cycle					Average for 1978–2008 (%)
	1982–1985	1985–1990	1990–1997	1997–2000	2000–2006	
	Annual average % change					
Agriculture, forestry, and fishing	0.5	6.2	5.0	-0.2	2.6	**3.1**
Agriculture	0.2	6.0	6.7	-0.4	3.1	**3.4**
Forestry and fishing	2.9	6.7	-1.3	0.6	0.1	**1.5**
Mining	10.2	-3.7	5.7	0.0	-3.8	**-0.3**
Manufacturing	0.3	-0.9	0.9	2.1	1.3	**0.6**
Electricity, gas, and water supply	2.9	0.8	0.9	0.7	-1.7	**0.7**
Construction	2.3	1.0	-0.9	-1.4	-0.4	**0.0**
Wholesale trade	-2.6	-0.8	-0.6	5.6	0.5	**0.2**
Retail trade	-3.0	-0.6	1.1	2.5	1.4	**0.3**
Accommodation, cafés, and restaurants	-2.5	-2.2	-0.4	-0.6	-0.7	**-1.5**
Transport and storage	5.7	4.8	6.9	2.5	-0.2	**3.4**
Communication services	2.0	3.6	7.1	7.8	5.5	**5.2**
Finance and insurance	-2.3	-3.2	2.8	6.5	1.4	**1.3**
Business services[1]	..	..	..	-2.1	-0.2	**..**
Cultural and recreational services[1]	..	..	..	-2.2	-2.7	**..**
Personal and other community services	..	..	..	7.8	0.0	**..**
Measured sector	**0.2**	**0.4**	**2.1**	**2.1**	**0.7**	**1.1**

1. Data available only from 1996.

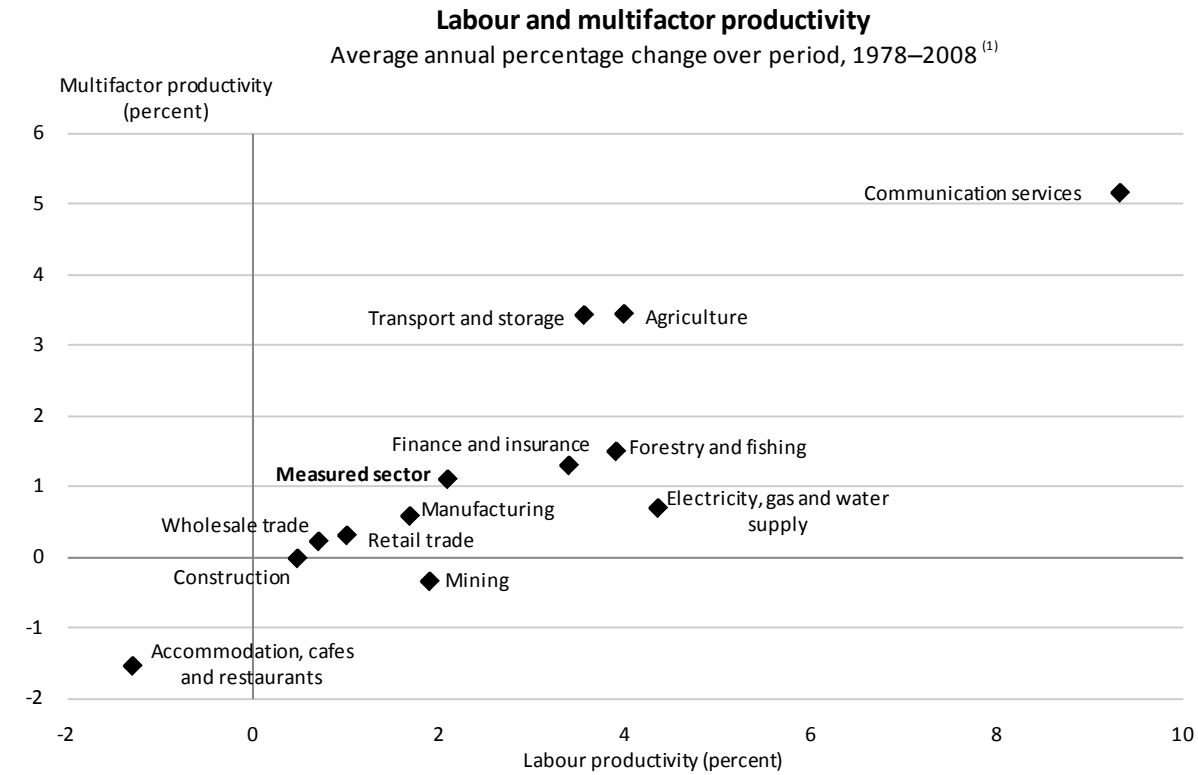
Symbol:
.. figure not available

Source: Statistics New Zealand

Labour productivity and MFP growth from 1978–2008 for all measured sector industries (excluding business services, cultural and recreational services, and personal and other services as data is not available for the total time series) are displayed in figure 2.1.

The communication services industry has the highest growth of all industries in the measured sector in both labour and multifactor productivity growth. The accommodation, cafés, and restaurants industry was the only industry to have a decline in both labour productivity and MFP.

Figure 2.1



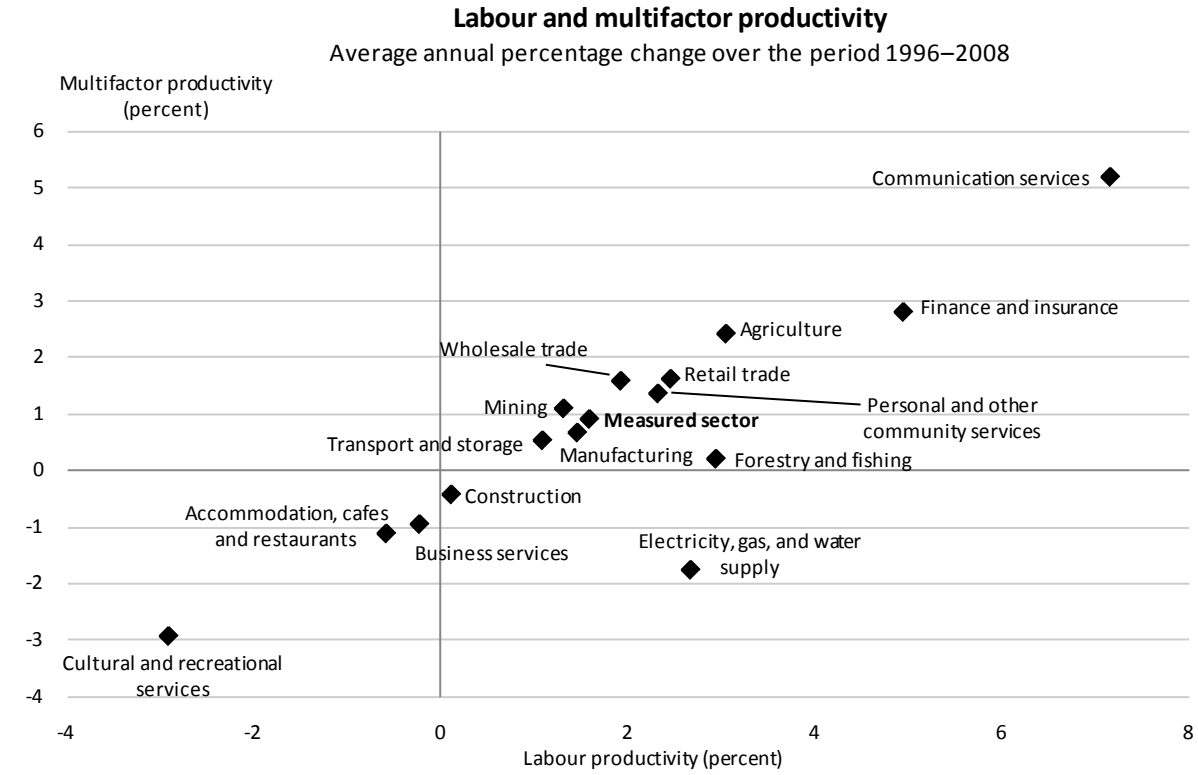
1. Note that business services, cultural and recreational services, and personal and other community services have not been included in this figure due to the unavailability of data.

Source: Statistics New Zealand

Labour productivity growth in relation to MFP growth from 1996–2008 is presented in figure 2.2 for all the measured sector industries. Once again, the communication services industry was the highest performer in the measured sector in terms of both labour and MFP growth. Several industries have declined in labour productivity for this period, with cultural and recreational services being the most significant.

Finance and insurance grew strongly in the period from 1996–2008, to be the second highest performer in both labour and MFP growth. Wholesale and retail trade also showed relatively higher labour and MFP growth in this latter period than over the total series. Transport and storage, a high performer over the total series, had not grown as strongly since 1996 as it had since 1978.

Figure 2.2



Source: Statistics New Zealand

Contributions to labour productivity growth

Changes in labour productivity can come from two possible sources: a change in the weighted capital-labour ratio (ie capital deepening or shallowing) and a change in MFP. The growth accounting analysis for labour productivity for each industry is presented in table 2.4.

Apart from accommodation, cafes, and restaurants, all of the industries in the measured sector showed growth in labour productivity from 1978–2008. Business services and cultural and recreational services have had declining labour productivity since 1996. Aside from cultural and recreational services, every industry in the measured sector showed some degree of capital deepening over time. This is reflected through higher labour productivity growth than MFP growth for all industries.

The growth accounting decomposition of labour productivity growth effectively highlights the different drivers of industries. For example, agriculture; electricity, gas and water supply; and transport and storage have all displayed strong labour productivity growth. In agriculture, and transport and storage, this is largely driven by MFP, whereas capital deepening is the major driver for growth in labour productivity in the electricity, gas and water supply industry. The highest performing industry – communication services – had labour productivity growth driven by both capital deepening and MFP.

Table 2.4

Contributions to labour productivity growth by industry
Year ended March 1978–2008

Industry	Labour productivity	Multifactor productivity	Capital deepening
		%	
Agriculture, forestry, and fishing	4.0	3.1	0.9
Agriculture	4.0	3.4	0.5
Forestry and fishing	3.9	1.5	2.4
Mining	1.9	-0.3	2.3
Manufacturing	1.7	0.6	1.1
Electricity, gas, and water supply	4.4	0.7	3.6
Construction	0.5	0.0	0.5
Wholesale trade	0.7	0.2	0.5
Retail trade	1.0	0.3	0.7
Accommodation, cafés, and restaurants	-1.3	-1.5	0.3
Transport and storage	3.6	3.4	0.1
Communication services	9.3	5.2	4.0
Finance and insurance	3.4	1.3	2.1
Business services(1)	-0.2	-1.0	0.7
Cultural and recreational services(1)	-2.9	-2.9	0.0
Personal and other community services(1)	2.3	1.4	1.0
Measured sector	**2.1**	**1.1**	**1.0**

1. Data available only from 1996.

Source: Statistics New Zealand

Contributions to measured sector labour productivity growth

Aggregate productivity growth in the measured sector can be broken down to examine the industry drivers of growth. Industry contributions to aggregate labour productivity growth can be expressed as a weighted sum of industry labour productivity growth plus a residual that reflects the effect of the reallocation of hours worked on aggregate labour productivity growth. The weights for calculating the contribution of each industry to measured sector labour productivity growth are given by a two-period average share of industry labour income.

The industry contribution to the change in aggregate measured sector labour productivity growth from 1978–96 and 1996–2008 is shown in figure 2.3. From 1978–96, labour productivity in the measured sector grew by 2.4 percent annually. From 1996–2008, the growth rate slowed to 1.6 percent per year. It is important to note that the figures in the graph present a weighted contribution – therefore, strong labour productivity growth within an industry may not necessarily result in a high contribution to measured sector labour productivity growth due to the relatively low weight of that industry. An example of this is the electricity, gas, and water supply industry. From the other perspective, an industry that had relatively low growth in labour productivity can still contribute significantly to measured sector labour productivity growth if it has a high weight. Manufacturing is a good example of this.

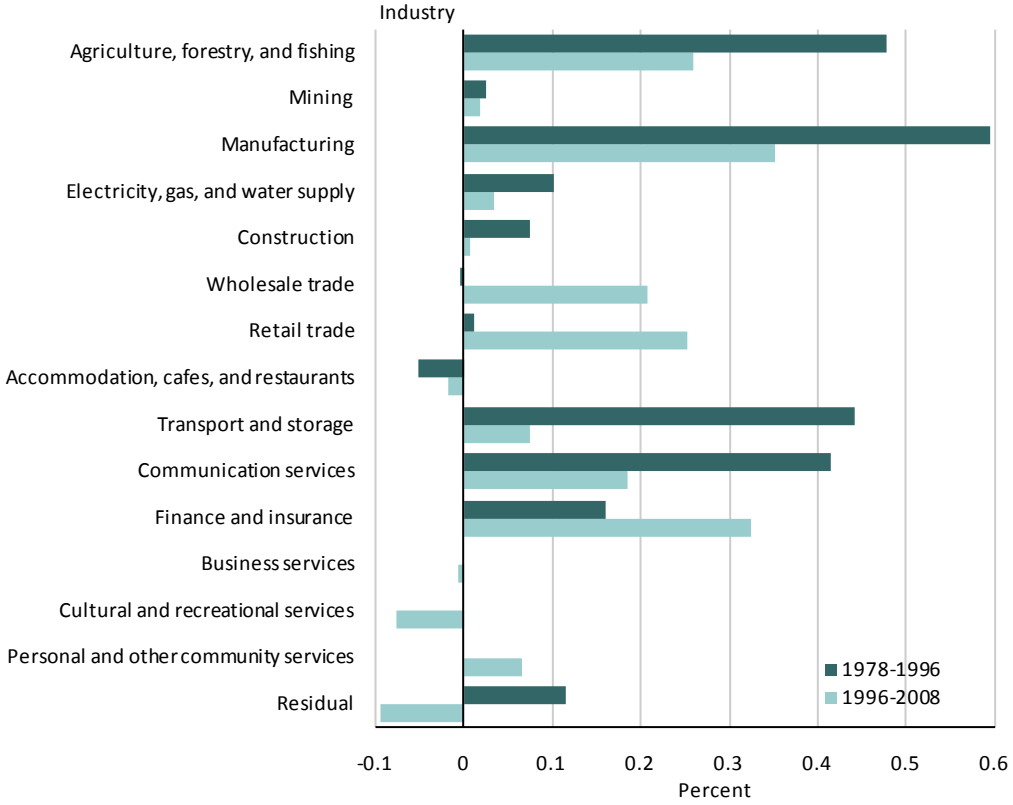
From 1978–96, four industries stand out in terms of contributions to measured sector labour productivity: agriculture, forestry and fishing; manufacturing; transport and storage; and communication services. In the latter period, finance and insurance, along with wholesale and retail trade have come into prominence. The primary industries – agriculture, forestry and fishing; and manufacturing – have remained strong

contributors to measured sector labour productivity growth, but their contribution has dropped off considerably.

Figure 2.3

Industry contributions to measured sector labour productivity growth

Average annual contribution 1978–1996 and 1996–2008[1]



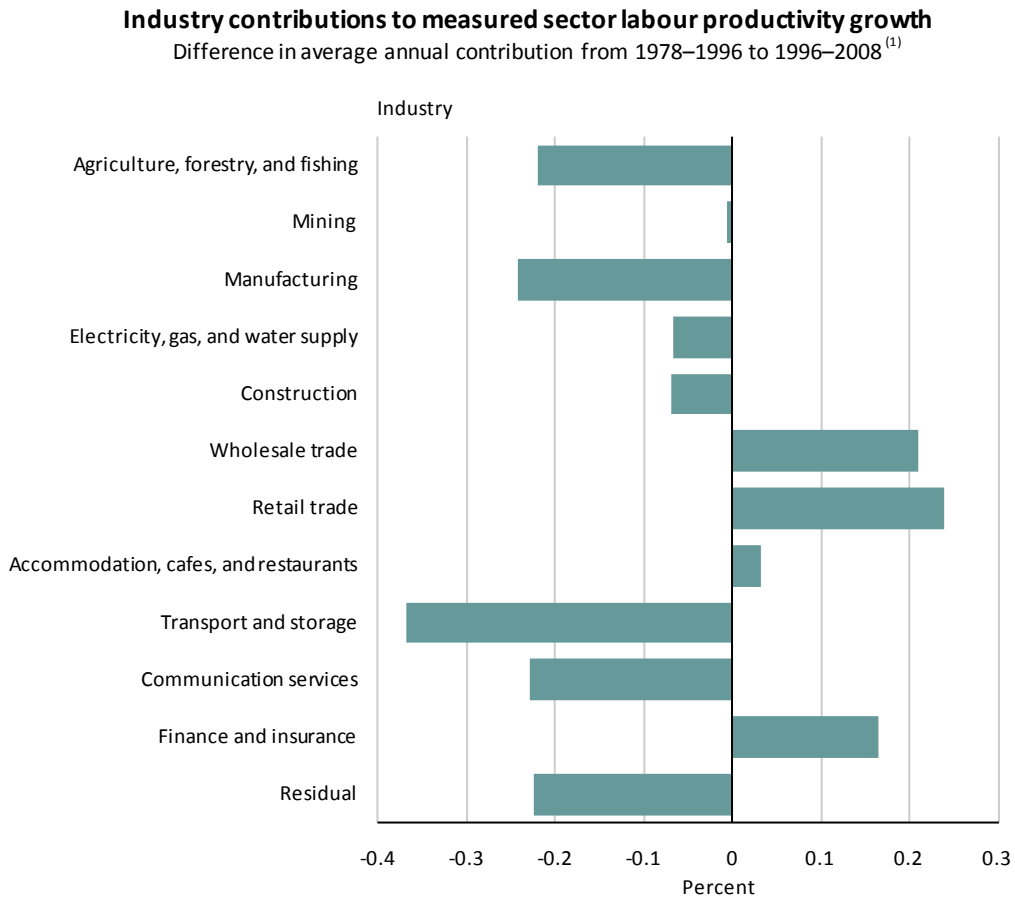
1. Business services, cultural and recreational services and personal and other community services are only available for the period 1996–2008.

Source: Statistics New Zealand

Differences between the 1996–2008 and the 1978–96 contributions to measured sector labour productivity growth are of importance (see figure 2.4). Essentially, industries that show a negative value in figure 2.4 have decreased their contribution to measured sector productivity growth, and those that show a positive value have increased their contribution. It is important to bear in mind that measured sector growth has slowed in the 1996–2008 period.

Interestingly, figure 2.4 highlights the decline in the contribution from the four industries that drove measured sector labour productivity growth from 1978–96: agriculture, forestry and fishing; manufacturing; transport and storage; and communication services. The contribution of transport and storage had the largest decrease of all industries. Industries that have significantly increased their contribution are wholesale and retail trade, along with finance and insurance.

Figure 2.4



1. Business services, cultural and recreational services and personal and other community services are only available for the period 1996–2008. Their contributions are included in the residual.

Source: Statistics New Zealand

Industry income shares

The capital and labour income shares for three years over the series –the start point (1978), mid-point (1993), and end point (2008) – are shown in table 2.5. In 2008, highly labour-intensive industries included construction, business services and personal and other community services. This has changed somewhat since 1978, when the most labour-intensive industries were still construction, but also retail trade, and accommodation, cafés, and restaurants. Mining, and electricity, gas, and water supply have remained the most capital-intensive industries over the time series.

Most industries' capital income share across the series show a general increase, which is reflected in the measured sector's capital income share's rise from 36 percent in 1978 to 41 percent in 2008. With developments in technology, and the automation of previously labour-intensive services, communication services led the shift from a predominantly labour-driven economy to one that is becoming more capital driven. Retail trade, manufacturing, and accommodation, cafés, and restaurants also reflect a large shift from labour to capital income from 1978–2008. The only industries to lower their share of capital income over the series were agriculture, and wholesale trade.

Table 2.5

Capital and labour income share proportions by industry
Year ended March

Industry	Capital			Labour		
	1978	1993	2008	1978	1993	2008
	%					
Agriculture, forestry, and fishing	56	44	44	44	56	56
Mining	69	83	78	31	17	22
Manufacturing	29	37	42	71	63	58
Electricity, gas, and water supply	67	76	86	33	24	14
Construction	19	19	22	81	81	78
Wholesale trade	45	34	41	55	66	59
Retail trade	21	22	31	79	78	69
Accommodation, cafés, and restaurants	20	7	27	80	93	73
Transport and storage	32	36	39	68	64	61
Communication services	26	57	68	74	43	32
Finance and insurance	45	47	57	55	53	43
Business services[1]	..	..	22	..	..	78
Cultural and recreational services[1]	..	..	50	..	..	50
Personal and other community services[1]	..	..	23	..	..	77
Measured sector	**36**	**39**	**41**	**64**	**61**	**59**

1. Data available only from 1996.

Symbol:
.. figure not available

Source: Statistics New Zealand

Outline of the industry chapters

Chapters 4 to 19 detail the productivity statistics for the 15 industries comprising the measured sector. Each chapter has the following structure:

- Highlights – outlines growth in output and its drivers, along with labour and MFP
- Outline – a brief overview on the size and composition of the industry and some contextual information
- Contributions to output growth – decomposition of output growth by the contributions of MFP, along with labour and capital input growth
- Productivity – presents labour, capital, and MFP growth
- Contributions to labour productivity growth – decomposition of labour productivity growth by the contributions of MFP and capital deepening.

3 Overview of sources and methods

What is productivity?

Productivity is a measure of how efficiently inputs (capital and labour) are being used by an industry 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 an industry can produce more output from the same amount of input, or the same level of output from fewer inputs.

Productivity analysis aims to explain the drivers of growth in output. Growth in output can be attributed to either an increase in labour or capital input, more efficient utilisation of inputs, or from a combination of both. 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. Multifactor productivity (MFP) 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. Gross output is the total value of products produced in an industry, while value added is the total value of products produced in an industry minus the value of intermediate inputs used during the production process. The official productivity series all use chain-volume value added as the output measure. Separate series are produced for labour productivity, capital productivity, and MFP.

Series for output, labour inputs, and capital inputs are used for deriving partial productivity estimates. The two primary inputs (labour and capital) are combined to form a composite input index, which then allows for the residual calculation of MFP. A change in MFP reflects the change in output that cannot be accounted for by changes in the measures of labour and capital inputs.

Productivity measurement and interpretation

Statistics New Zealand's method of estimating productivity statistics is based on OECD guidelines, as outlined in *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth* (OECD, 2001). The approach used is referred to in the manual as "the index number approach in a production theoretic framework."

The calculation of industry productivity statistics begins by postulating a production function of the form:

$V_i = A_{i(t)} \times f(L_i, K_i)$

where V_i = industry chain-volume value added
L_i = industry labour inputs
K_i = industry capital inputs
$f(L_i, K_i)$ = a production function of L and K that defines an expected level of output for a specific industry
$A_{i(t)}$ = a parameter that captures disembodied technical shifts over time, that is, outward shifts of the production function allowing output to increase with a given level of inputs (= MFP)

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

$LP_i = V_i / L_i$

Where LP = an index of labour productivity. This is an index of chain-volume value added divided by a volume index of labour inputs.

Similarly, a capital productivity index KP is calculated as:

$KP_i = V_i / K_i$

Where KP = an index of capital productivity. This is an index of chain-volume value added divided by a volume index of capital inputs.

Care is 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 MFP, with no change occurring in the labour input itself. Similarly, capital productivity measures have their constraints.

Capital services in production analysis are assumed to be proportional to the capital stock. If the factor of proportionality does not change over time, the growth rate of capital services is identical to the rate of growth of the capital stock. This is clearly an unrealistic assumption, given the variations in the rates of capacity utilisation of capital stocks. Consequently, swings in the rates of capacity utilisation are picked up by the residual productivity measure ie MFP.

The final productivity index that can be calculated is for MFP. The technological parameter that represents disembodied technological change (or MFP) cannot be observed directly. By rearranging the production function equation, it can be shown that the technology parameter can be derived residually as the difference between the growth in an index of outputs to an index of inputs:

$A_{i(t)} = V_i / f(L_i, K_i)$

Certain assumptions must be met for MFP to be a measure of disembodied technological change. The key assumptions are that the production function must exhibit constant returns to scale and all inputs need to be included in scope of the production function.

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.

Limitations of productivity measurement and interpretation

To interpret the figures correctly, it is also important to remember what productivity is not. In particular, it is not:

- just about efficiency, it represents other factors such as technological change and measurement error.
- 'economy' or 'value-for-money'. This concept reflects cost per output while productivity examines input to output. Productivity measures volume changes with price effects removed.
- a measure of effectiveness. Productivity reflects how much extra output is produced per unit of input, not whether that input has an effective outcome.
- the same as production. Productivity growth may occur even when output (production) remains the same.
- a measure of competitiveness or profitability.
- a complete performance-management tool. There are other indicators to consider in determining performance.

Growth accounting

The growth accounting technique examines how much of an industry's output growth can be explained by the growth rate in different inputs (namely, labour and capital). The additional output growth – known as MFP – is determined residually.

The growth accounting technique also examines how much of an industry's labour productivity growth can be determined by growth in the amount of capital available per worker. Again, the additional labour productivity growth is determined residually, and is termed MFP.

A growth accounting approach must rely on a number of simplifying assumptions:

- production processes can be represented by a production function at the industry level of the economy. A production function will relate a maximum output level to a set of available inputs;
- producers behave efficiently, that is, they maximise revenue and / or minimise costs;
- markets are competitive. Market participants are price takers, which means they can only adjust quantities and can not individually influence market prices.

These assumptions are not necessarily met in practice, but provide a reasonable approximation to many markets.

Industry contributions to measured sector productivity growth

Measured sector productivity growth can be disaggregated to contributions from each industry. Industry contributions to aggregate labour productivity growth can be expressed as a weighted sum of industry labour productivity growth plus a residual that reflects the effect of the reallocation of hours worked on aggregate labour productivity growth. The weights for

aggregating industry labour productivity growth are given by a two-period average share of industry labour income in aggregate labour income.

Presentation across growth cycles

This report contains productivity data presented as annual averages within measured sector growth cycles. While the productivity model assumes no differences (across industry and time) in the asset capacity utilisation rates, in reality, capacity utilisation of capital will vary across a cycle. The cycles are identified as 'peak to peak', determined where output growth and MFP growth are at their highest deviation from trend. The final growth cycles selected also take into account economic events throughout the time period. Excluded from the industry analysis are the incomplete cycles at the beginning and end of the series.

Industry coverage

The current productivity estimates 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 volume terms. 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 free or at nominal charges. Non-measured industries are property services; ownership of owner-occupied dwellings; government administration and defence; education; and health and community services.

Published series

The productivity indexes for the majority of the published industries have an expression base year ended March 1978 (=1000), consistent with the first year of the series. There are three industries which commence in 1996, and they have an expression base year ended March 1996 (=1000). Industry GDP data used to calculate productivity indexes from 1978 to 1988 is currently provisional.

Output series methodology

This is defined as constant-price value added. Annual movements in the industry output index are identical to annual movements in published gross domestic product (GDP) statistics, namely a chain-volume Laspeyres index of constituent sub-industries, aggregated to the industry level.

Industry value-added data used to calculated productivity indexes from 1978 to 1987 is currently provisional. It is not published within the National Accounts at this level of industry detail over this period.

Labour series methodology

The labour volume series (LVS) is an estimate of paid hours (ordinary time plus overtime) for all employed persons engaged in the production of goods and services, by industry 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, each industry's 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 each industry. An annual (March year) average of the weekly paid hours is then calculated.

Quality assurance of the industry labour volume series

As a quality assurance measure for the industry level productivity measures, several coherence adjustments were made to the employee job/worker counts and weekly paid hours series that feed into the industry labour volume series (LVS). The main data sources used in the construction of the LVS are sourced independently of the estimates of compensation of employees (CoE) from the National Accounts, which are primarily derived from the Annual Enterprise Survey. Current price CoE estimates were deflated using the Quarterly Employment Survey average hourly earnings measure to derive an implicit series of labour volume. This provided a benchmark for comparing against the LVS at an industry level. For years in which the LVS showed a significantly different movement to the deflated CoE series, both movements were compared against alternative labour volume data sources. The result of this comparison was that adjustments were made to the industry LVS where it was deemed appropriate.

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. The capital services measure takes as its starting point the chain-volume productive capital stock series from the National Accounts, supplemented by estimates of nine other assets: inventories (which include estimates of livestock and timber before 1980), and six different types of land (commercial, industrial, mining, agricultural, forestry, and other). Capital service flows are assumed to be proportional to the productive capital stock of each asset, and these flows are aggregated to industry level using a Tōrnqvist index, with weights based on asset-specific implicit rental prices (user costs).

Capital and labour income shares

Capital and labour nominal income shares are calculated as the ratio of capital and labour income, respective 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. In calculating the labour income of working proprietors, an assumption is made that the average hourly wage rate of a working proprietor is equivalent to that of an employee, within each industry.

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 less labour 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 income shares are used to weight capital and labour when deriving the total inputs index, which is used in the calculation of MFP. The same income shares are used at industry level, to weight each industry in the measured sector capital and labour input indexes. Capital and labour income shares are also used to weight the contribution of capital and labour input within the growth accounting for output framework. Furthermore, the capital income share is used to weight the contribution of capital deepening within the growth accounting for labour productivity equation.

Annual income data are only available up to 2007, the latest year for which the National Accounts have gone through the supply-use balancing process. Therefore, industry labour and capital income shares are held constant from 2007 to 2008.

Data sources

The data used in this publication is derived from a number of sources and the relevant release titles and dates are described below:

Table 3.1

Industry productivity statistics data sources

Data	Publication	Release date
Output	*Gross domestic product: September 2009 quarter*	23 Dec 2009
Labour volume	*Linked Employer-Employee Data: December 2008 quarter*	23 Feb 2010
	Household Labour Force Survey: December 2009 quarter	4 Feb 2010
	Quarterly Employment Survey: December 2009 quarter	2 Feb 2010
	Linked Employer-Employee Data: March 2008 year	25 Nov 2009
Capital	*National Accounts: Year ended March 2009*	19 Nov 2009
Income shares	*National Accounts: Year ended March 2009*	19 Nov 2009
User costs	*National Accounts: Year ended March 2009*	19 Nov 2009

4 Agriculture

Highlights

From 1978–2008:

- Output growth in the agriculture industry averaged 3.0 percent. MFP was the main driver of this growth, contributing 3.4 percent annually.
- Labour productivity grew at 4.0 percent a year, higher than that for the total measured sector (2.1 percent).
- MFP followed a similar pattern to labour productivity, but its growth over the series was lower at 3.4 percent per year.

Introduction

The agriculture industry contributed 8.7 percent to total GDP in 1978 and 4.8 percent in 2007, making it the seventh largest measured sector industry in 2007. Despite a declining contribution to GDP, the industry has traditionally been important to the New Zealand economy. Output has continued to rise over time and the industry has been one of the stronger performers in terms of productivity growth in New Zealand.

The agriculture industry consists of a broad range of activities, namely the breeding, keeping, and cultivation of all kinds of animals or vegetable life except forest trees and marine life.

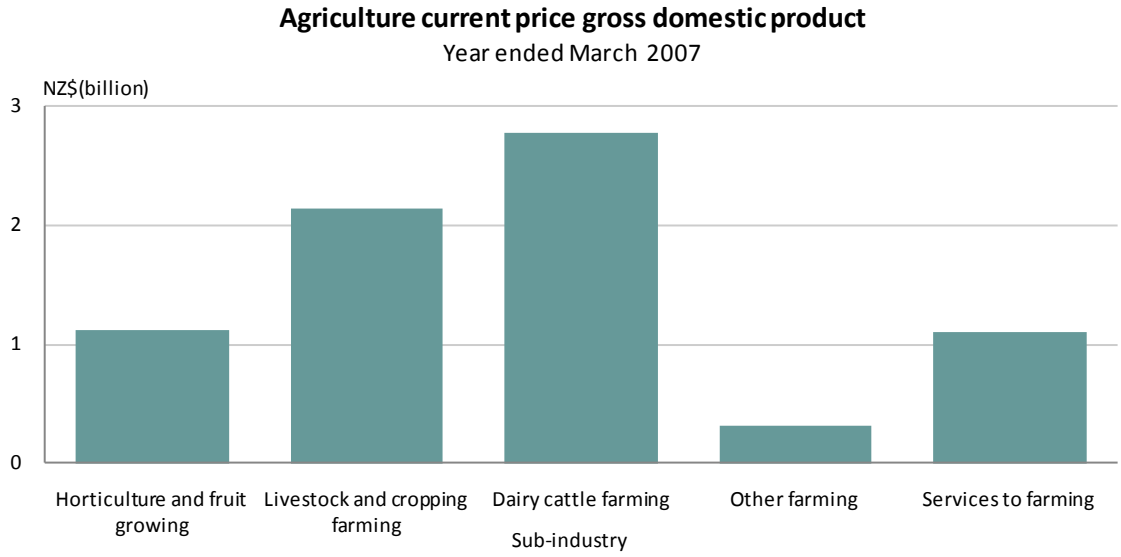
Historically, job counts are highest in the horticulture and fruit growing sub-industry (Statistics New Zealand, 2010). This sub-industry employs a large number of seasonal employees. Over the entire industry, there were moderate increases in the number of wage and salary earners, offset by falls in the number of self-employed, particularly in dairy cattle farming.

In terms of output, dairy farming was the largest sub-industry in 2007, followed by livestock and cropping farming (see figure 4.1).

Changes in the composition of agricultural output have occurred over time. In the horticulture growing sub-industry this shift was visible within apple tree and wine grape planting. The number of hectares of apple trees decreased from 15,257 in 1994 to 9,247 hectares in 2007. However, over the same time the number hectares of wine grapes planted increased from 7,160 to 29,616 (Statistics New Zealand, nd a). Within livestock farming the main changes occurred in the numbers of sheep and dairy cattle. Sheep numbers decreased from 49.4 million in 1994 to 34.1 million in 2008, while dairy cattle increased from 3.8 million in 1994 to 5.6 million in 2008 (Statistics New Zealand, nd b).

There are various events which occurred in the agriculture industry over the series. For example, in 1979 minimum payments (Supplementary Minimum Payments) for some agricultural production were introduced. However, these were removed for wool, beef, sheep meat, and dairy products by the end of 1984. Tax concessions for farmers were withdrawn and free government services for farmers were also eliminated. Access to concessionary Reserve Bank funding was withdrawn from producer boards. From 1987 the subsidies for land development loans, fertiliser and irrigation and subsidised credit were also reduced and phased out, as were assistance for flood control, soil conservation, and drainage schemes (Tyler & Latimore, 1990: cited in Vitalis, 2007).

Figure 4.1



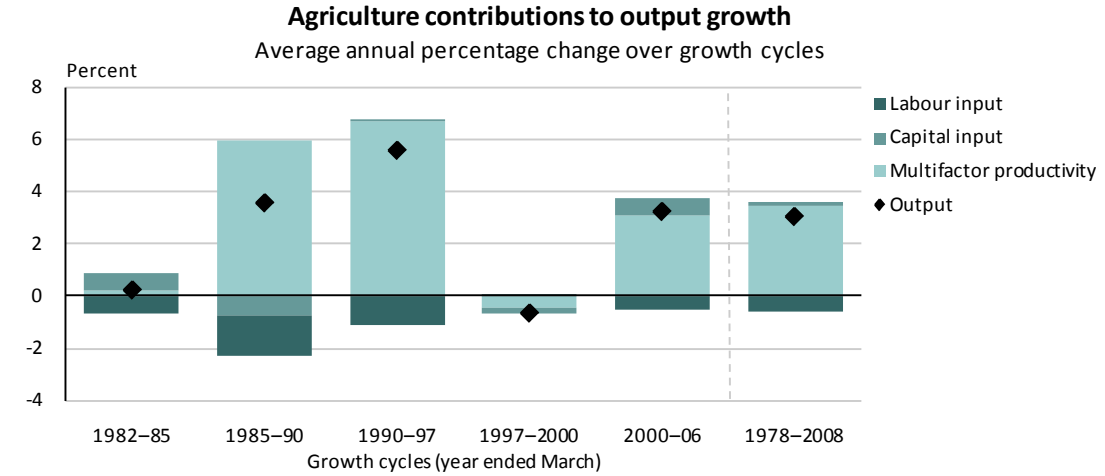
Source: Statistics New Zealand

Within the agriculture industry, dry conditions, which can lead to drought in some regions, restricts production and limits productivity growth. This can have flow on effects to other industries.

Contributions to output growth

Averaging 3.4 percent annually, MFP was the primary contributor to the agriculture industry's annual output growth of 3.0 percent (see figure 4.2). The average contributions of labour and capital input to output growth were -0.6 percent and 0.2 percent per year, respectively. Labour input contributed negatively in every cycle except from 1997–2000.

Figure 4.2



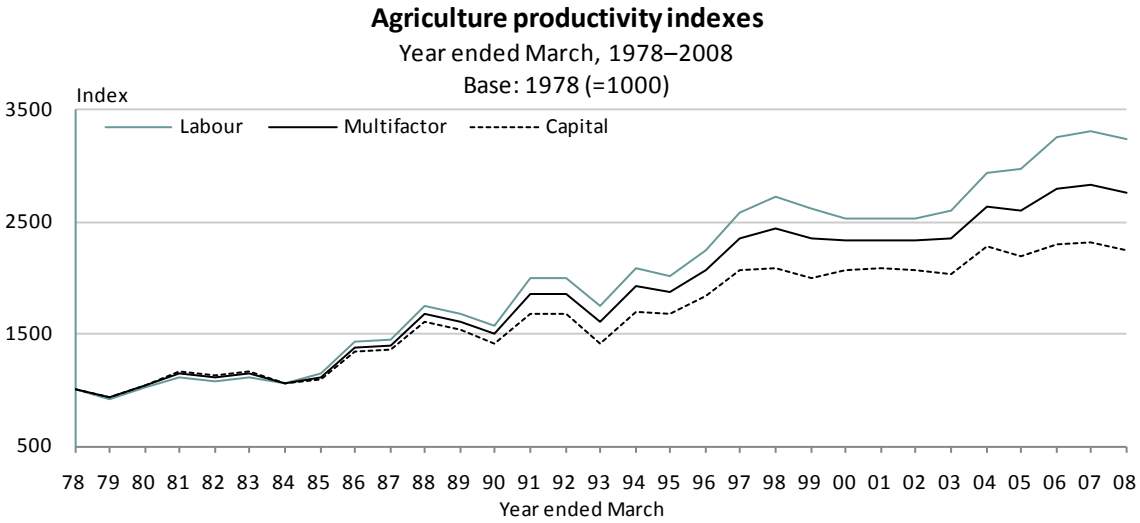
Source: Statistics New Zealand

The strongest growth in output for this industry occurred from 1990–97, at an annual average of 5.6 percent. MFP contributed 6.7 percent to the output growth. MFP contributed positively to output growth in all cycles except for 1997–2000.

Productivity

Over the series, the average labour productivity growth was 4.0 percent per year (see table 4.1), higher than that of the measured sector, which grew at an annual average of 2.1 percent.

Figure 4.3



Source: Statistics New Zealand

All three measures of productivity followed similar patterns (see figure 4.3). The agriculture industry's growth in capital productivity was the second highest for all industries, at 2.7 percent a year.

The fluctuations in productivity growth were mainly due to changes in output. Input growth was minimal in this industry, especially relative to the measured sector average.

Table 4.1

Agriculture productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	1.8	-1.1	0.2
1985–1990	6.6	5.3	6.0
1990–1997	7.4	5.5	6.7
1997–2000	-0.8	0.0	-0.4
2000–2006	4.3	1.8	3.1
1978–2008	**4.0**	**2.7**	**3.4**

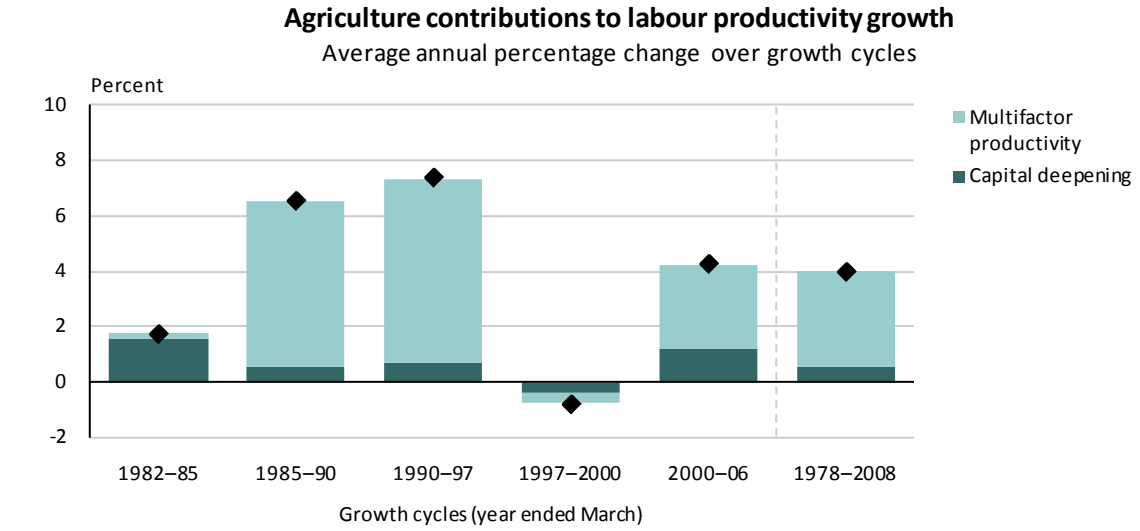
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

For most of the cycles, growth in labour productivity was influenced most by MFP contribution (see figure 4.4). The exception to this is the 1982–85 period where it was driven by capital deepening.

Figure 4.4



Source: Statistics New Zealand

The period from 1990–97 had the highest growth in labour productivity at 7.4 percent per year. As in the previous period, this growth was mainly driven by MFP, with its highest contribution to labour productivity at an annual growth rate of 6.7 percent.

5 Forestry and fishing

Highlights

From 1978–2008:

- Output growth in the forestry and fishing industry averaged 3.3 percent. Capital input was the main driver of this growth, contributing 2.1 percent annually.
- The industry recorded an annual average labour productivity growth of 3.9 percent per year over the entire series, the fourth highest of all industries. Labour productivity growth has increased since 1985.
- MFP has had low to flat growth since 1990. The growth over the series was 1.5 percent per year.
- The industry shifted from being driven mainly by labour during the early 1980s, to becoming more capital intensive over time.

Introduction

Forestry and fishing contributed a combined 0.8 percent to GDP in 2007 from a peak of 2.1 percent in the mid-1990s. This sector is dominated by forestry, which accounted for 81.2 percent of combined output in 2007. Forestry and fishing have been combined together for two reasons. Firstly, they are two of the smaller industries of the 23, and even when combined, are still small in terms of contribution to GDP. Secondly, prior to 2000, labour input data are scarce for the fishing industry. Fishing is not in scope of establishment-based surveys in New Zealand, so pre-2000 labour input data comes from the 5-yearly Census and is interpolated using Household Labour Force Survey statistics.

Forestry consists of a range of activities such as planting, harvesting, and gathering of forest products as well as services supporting forestry. Fishing includes catching, gathering, breeding, and cultivation of marine life from ocean, coastal, and inland waters.

In 1987 the Forest Service was disestablished, resulting in the transfer of government-owned plantations to a new state-owned enterprise, Forestry Corporation of New Zealand. Non-commercial responsibilities were taken up by the Ministry of Forestry, with the newly formed Department of Conservation responsible for public-owned native forests.

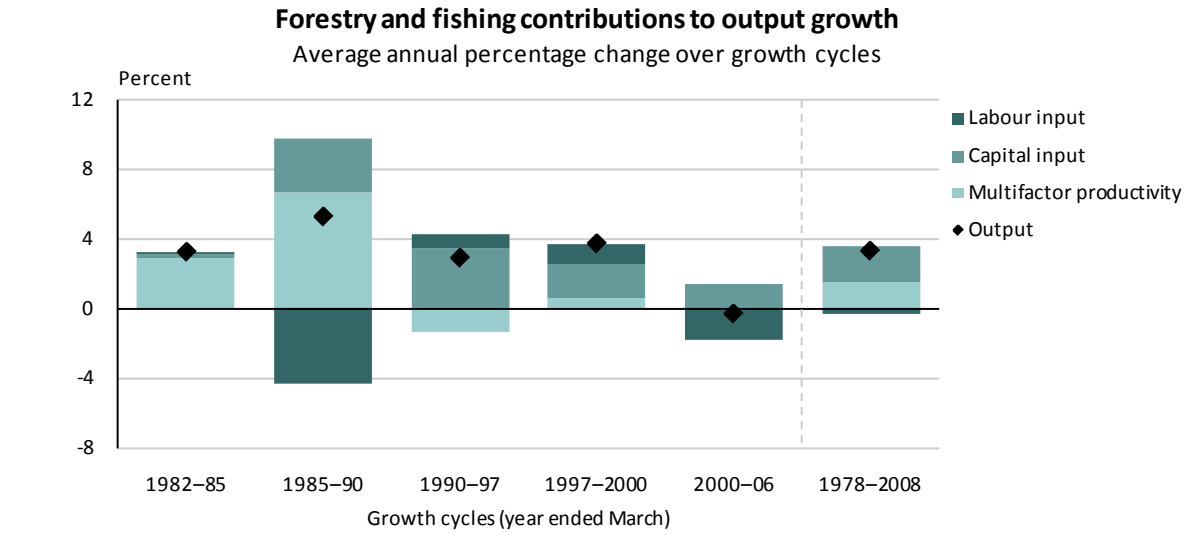
The estimated total volume of harvested roundwood for the year ended March 2008 was 20.4 million cubic metres. Roundwood logs export volume for this period was 14.2 million cubic metres (Ministry of Agriculture and Forestry, 2009). The rest of the harvested wood is further processed into products such as sawn timber, pulp and paper, panel products, and furniture components before being either consumed domestically or exported.

Within the fishing industry, the mid- to late 1980s was a period of change. In October 1986, the Quota Management System (QMS) was introduced. The QMS was designed to ensure the sustainable use of fisheries resources via directly controlling harvest levels.

Contributions to output growth

The greatest contribution to output growth came from capital input, closely followed by MFP, contributing 2.1 percent and 1.5 percent per year, respectively (see figure 5.1). Output grew at 3.3 percent annually from 1978–2008.

Figure 5.1



Source: Statistics New Zealand

The industry's strongest cycle of output growth was from 1985–90, at 5.3 percent per year. This growth occurred during the restructuring of the forestry industry, and happened despite a large amount of labour being shed. While labour input dropped very significantly, many workers who were previously classified as forestry employees began working as contractors. These contractors were employed in the construction or business services industries amongst others. Their production enabled output growth in the forestry industry.

The weakest period of output growth for the forestry and fishing industry was from 2000–06, where it declined at a rate of 0.3 percent per year. The main contributor to this slowdown was labour input.

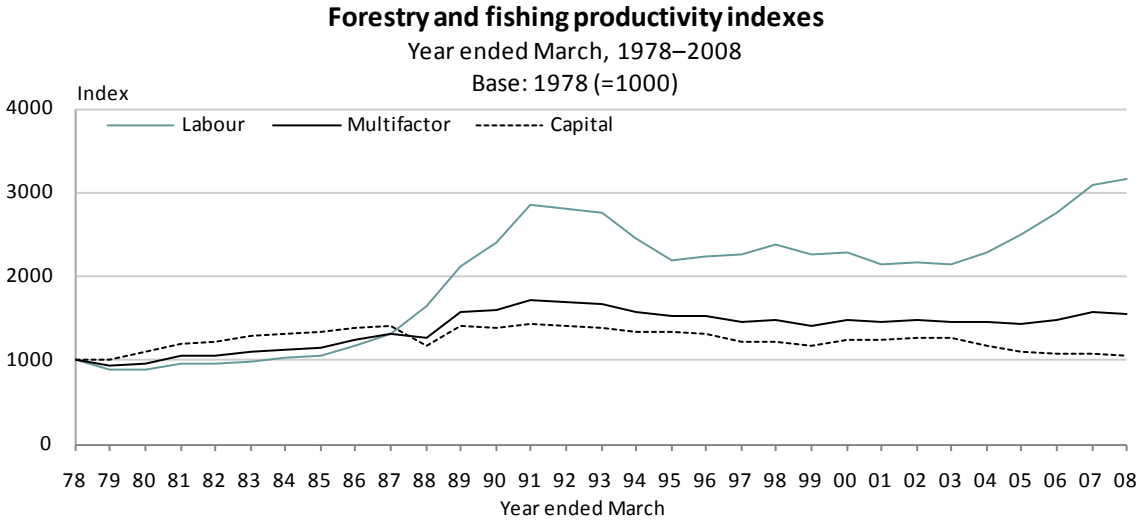
Changes in the contribution of capital input are mainly driven by a change in inventories. In the forestry industry, inventories consist of standing timber.

Productivity

Labour productivity grew at an annual rate of 3.9 percent, which was above the measured sector average, and was similar to that for agriculture (4.0 percent per year). Labour productivity growth was highest during the 1985–90 cycle at 18.2 percent annually (see table 5.1). This high growth was mainly due to drops in forestry job counts. During the 1990s, labour productivity growth declined, but recovered in the 2000s due again to a drop in job counts in the labour volume series.

Capital productivity increased at an annual average rate of 0.2 percent across the series (see figure 5.2). A steady decline in capital productivity growth was recorded from 1991 onwards.

Figure 5.2



Source: Statistics New Zealand

The average annual increase in MFP was 1.5 percent, with strong growth of 6.7 percent annually during the 1985–90 cycle.

Table 5.1

Forestry and fishing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	2.9	3.1	2.9
1985–1990	18.2	0.6	6.7
1990–1997	-0.9	-1.7	-1.3
1997–2000	0.2	0.9	0.6
2000–2006	3.2	-2.5	0.1
1978–2008	**3.9**	**0.2**	**1.5**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

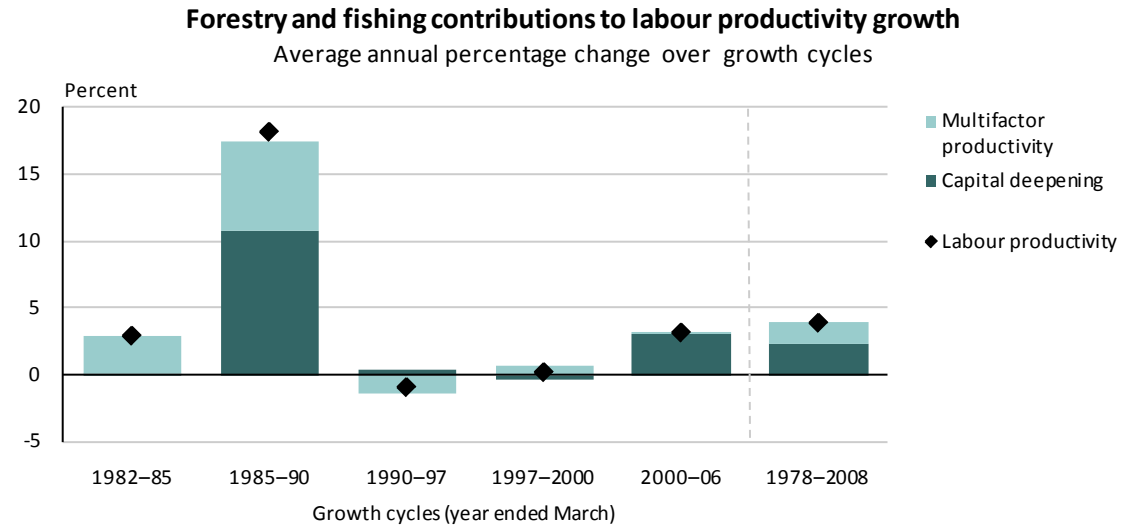
Source: Statistics New Zealand

Contributions to labour productivity growth

The variation within labour productivity growth was mainly driven by changes in capital deepening (see figure 5.3).

The strongest growth in labour productivity was during the 1985–90 period, at an annual rate of 18.2 percent. This growth was driven by capital deepening, with a contribution of 10.8 percent a year. As mentioned previously, the capital deepening that occurred during this period was due to a combination of capital input growth and labour shedding. This was also the period with the highest MFP growth, which contributed 6.7 percent annually.

Figure 5.3



Source: Statistics New Zealand

6 Mining

Highlights

From 1978–2008:

- Output growth in the mining industry averaged 1.9 percent. Capital input was the main driver of this growth, contributing 2.2 percent annually.
- Increases in labour productivity were mainly due to capital deepening.

Introduction

Mining is one of the smaller industries in the economy, contributing 1.5 percent to total economy GDP in 1978 and 1.3 percent in 2007. The mining industry includes oil and gas exploration and extraction, coal mining, other mining, and services to mining. Oil and gas exploration and extraction were the main contributors to GDP, while services to mining drove the labour input series.

The industry is heavily capital intensive, with capital contributing 78 percent of industry income in 2008. Based on income, it is the second most capital-intensive industry behind electricity, gas, and water supply. There are low levels of employment in the mining industry with approximately 0.3 percent of the total workforce employed in mining in 2008 (Statistics New Zealand, 2010).

Due to its nature, the industry can be influenced by major one-off events, such as the opening or closing of a mine or oilfield. Major one-off events over the series include the installation of projects on various oil and gas fields from 1979 (Maui A), 1992 (Maui B), and in 2003 (Tui). Over this time, there were a number of smaller oil and gas fields discovered in the Taranaki Basin, including Tariki / Ahuroa, Kupe, and Waihapa (Crown Minerals, 2006). In 1978, the Kapuni field was the largest in New Zealand. While its volume of production was superceded by Maui A in the early 1980s, and more recently by Tui, Kapuni is the only field that has been open from 1978(Crown Minerals, 2009).

Within the mining industry, there can be a lag between capital formation and the associated output and this is particularly so within the highly capital-intensive oil and gas exploration and extraction sector. By way of example, Maui A opened in 1979 (Crown Minerals, 2009), and strong output growth occurred in 1983, 1985, and 1986.

The mining and quarrying industry was privatised in 1987 when State Coal Mines became Coal Corp. This was the primary cause of labour input declines over the period, as staff numbers fell from 1,800 to 890 in a short time (New Zealand Minerals Industry Association, nd). In 1973, (five years prior to start of the series) there were 78 mines in operation, while in early 2010, there were just 21.

Contributions to output growth

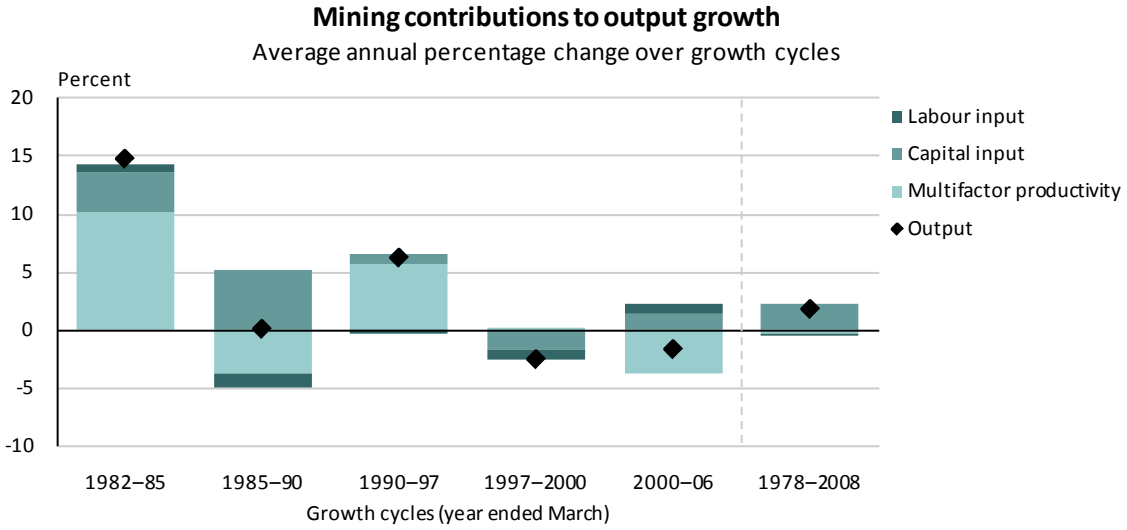
Across the series, the primary contribution to output growth came from capital inputs, at 2.2 percent per year. The contribution of labour input was minimal across the series (see figure 6.1).

The highest increase in output was in the 1982–85 cycle, at 14.7 percent annually. MFP contributed 10.2 percent, with growth in capital and labour inputs contributing 3.5 percent and

0.6 percent respectively, per year. This was the only period where all three factors contributed positively.

Considerable investment in mineral exploration resulted in a positive contribution from capital input over the 1985–90 cycle. This rise was offset by smaller labour input and MFP contributions to output growth.

Figure 6.1



Source: Statistics New Zealand

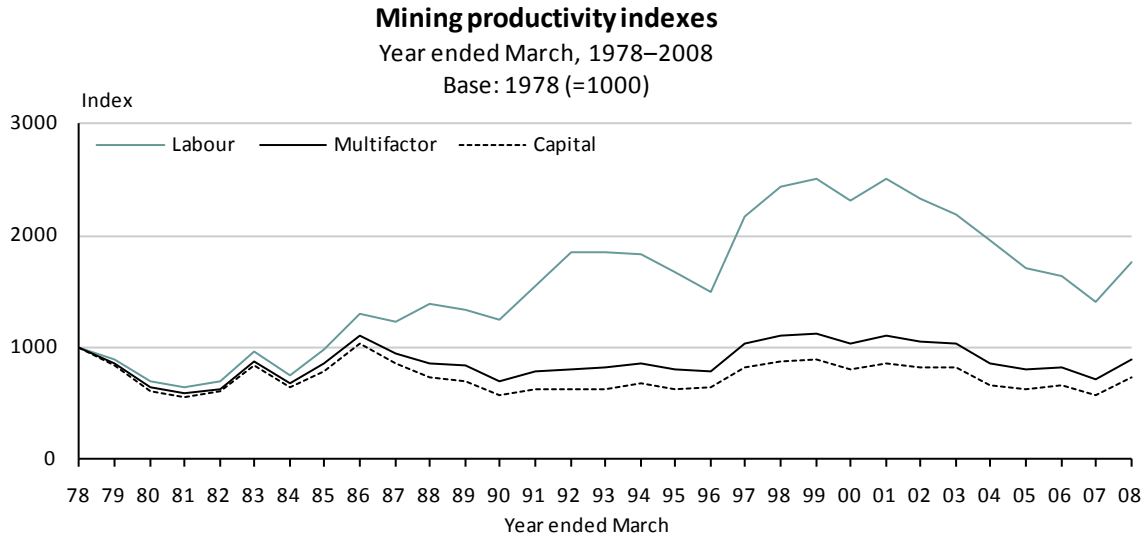
Output growth slowed across the remainder of the series, with one other peak in 1990–97 (up 6.3 percent). MFP was the main contributor to this increase, contributing 5.7 percent. The contribution of labour input declined by 0.3 percent, while the capital input contribution increased 0.8 percent per year.

Output growth was negative for the latest two cycles, with the 1997–2000 cycle showing a moderate 2.4 percent decline in output. This was the only period where the contribution capital inputs declined (down 1.6 percent). A decline in output growth over the 2000–06 cycle was driven by a 3.8 percent decline in MFP, offset by small increases in the contribution of capital and labour input.

Productivity

Labour productivity in the mining industry averaged 1.9 percent annually from 1978–2008 (see table 6.1), slightly below the measured sector average of 2.1 percent.

Figure 6.2



Source: Statistics New Zealand

Capital productivity declines averaged 1.0 percent annually across the series, a larger fall than the measured sector (at 0.4 percent per year). The key period of decline was between 1978 and 1981 (see figure 6.2). Due to the capital-intensive nature of the industry, capital input is relatively heavily weighted compared with labour input, and so the MFP index tracks capital productivity quite closely. MFP fell by 0.3 percent per year.

Table 6.1

Mining productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	12.1	9.6	10.2
1985–1990	4.9	-6.2	-3.7
1990–1997	8.1	5.3	5.7
1997–2000	2.1	-0.5	0.0
2000–2006	-5.6	-3.3	-3.8
1978–2008	**1.9**	**-1.0**	**-0.3**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

Since 1978, growth in labour productivity was solely due to capital deepening. In the 1985–90 cycle capital deepening contributed 9.0 percent in contrast to a -3.7 percent contribution from MFP (see figure 6.3). The capital deepening was due to a combination of strong growth in capital input, coupled with a decline in labour input. Labour productivity growth has trended down across the series and in fact, labour productivity declined significantly from 2000–06.

Figure 6.3

Source: Statistics New Zealand

7 Manufacturing

Highlights

From 1978–2008:

- Output growth in the manufacturing industry averaged 1.4 percent. Capital input was the main driver of this growth, contributing 1.0 percent annually.
- Labour productivity growth rose consistently across the series, rising 1.7 percent per year.
- MFP rose 0.6 percent per year, less than that for the measured sector.

Introduction

The manufacturing industry has been the largest industry in New Zealand since the series began in 1978. However, its share of the economy decreased over the 30-year period, peaking in 1983 at 23.4 percent of GDP, and declining to 15.1 percent in 2007. Although there was a relative decrease in its economic contribution, manufacturing output continued to rise across the series.

The manufacturing industry includes activities that relate to the physical or chemical transformation of materials or components into new products. The industry can be broken down into nine distinct sub-industries. Table 7.1 highlights these sub-industries, their rates of productivity growth, and the main components of each.

Table 7.1

Manufacturing sub-industries productivity
Average annual growth rates
Years ended March 1978–2008

Sub-industry	Labour productivity	Capital productivity	Multifactor productivity
	Percent		
Food, beverage, and tobacco manufacturing	2.1	-1.5	0.8
Textiles and apparel manufacturing	2.3	-0.4	1.6
Wood and paper product manufacturing	2.5	-0.4	1.3
Printing, publishing, and recorded media	0.8	-1.4	0.0
Petroleum and industrial chemical	1.8	-2.3	-0.1
Non–metallic mineral product manufacturing	1.5	-0.4	0.7
Metal product manufacturing	1.3	-1.2	0.6
Machinery and equipment manufacturing	1.1	-1.9	0.3
Furniture and other manufacturing.	0.2	-0.9	-0.1
Manufacturing industry	**1.7**	**-1.5**	**0.6**

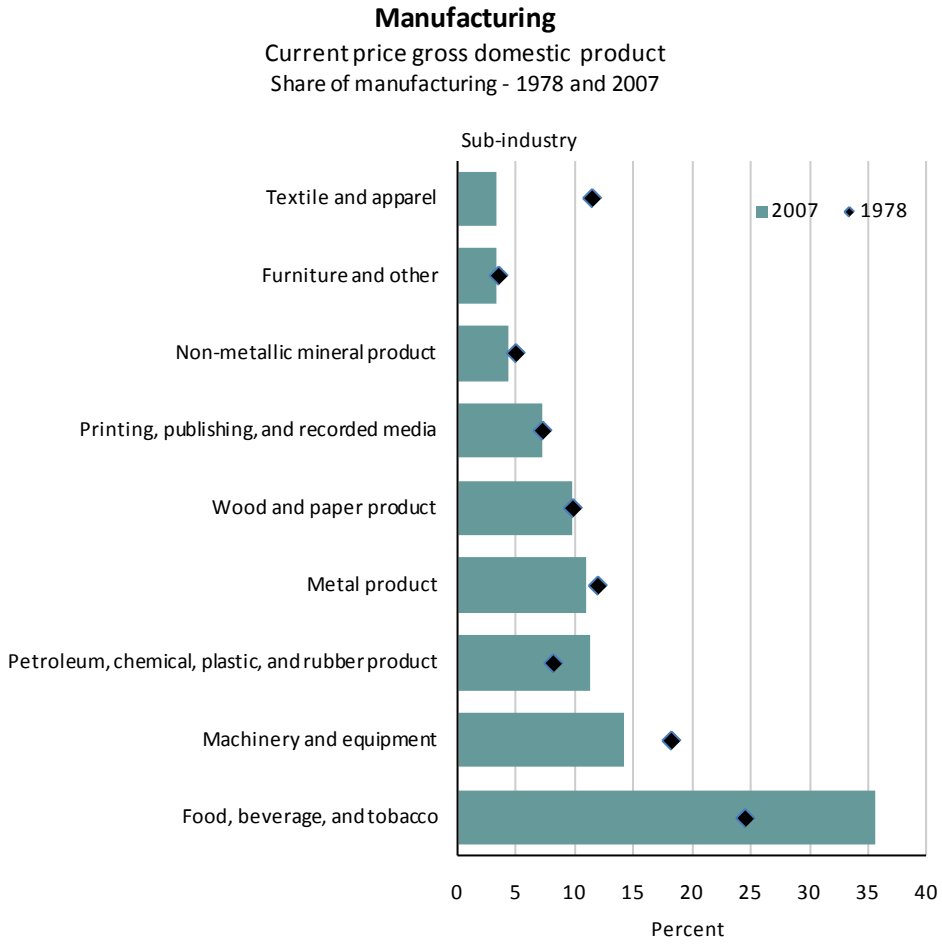
Source: Statistics New Zealand

Sub-industry contributions to the manufacturing industry have varied across the series. The food, beverage, and tobacco manufacturing sub-industry had a significant contribution throughout the

series, and was 5.4 percent of total economy GDP in 2007, which is 35.6 percent of the manufacturing industry's contribution.

The sub-industry was impacted by the deregulation of producer boards and the restructuring of the dairy industry in the 2001 calendar year, and the effects are reflected in the statistics from the September 2002 quarter. This discontinuity should be noted when interpreting the results. This sub-industry was one of only two to increase its share of overall manufacturing from 1978 to 2007, the other being petroleum and industrial chemical manufacturing (see figure 7.1, Statistics New Zealand, 2010a).

Figure 7.1



Source: Statistics New Zealand

Textile and apparel manufacturing had the most significant decline in its share of total manufacturing, down from 11.5 percent in 1978 to 3.3 percent in 2007. The removal of import licensing and the reductions of tariffs since the mid-1980s have increasingly opened New Zealand's economy to international competition, impacting on the textile and apparel industry. In 2009, tariffs on imported clothes had reduced to 10 percent (Tolerton, 2010), having previously ranged from 20 to as high as 65 percent (Ministry of Economic Development, nd). The value of imports for the clothing and footwear sub-industry as proportions of total merchandise imports has increased (Statistics New Zealand, 2010b).

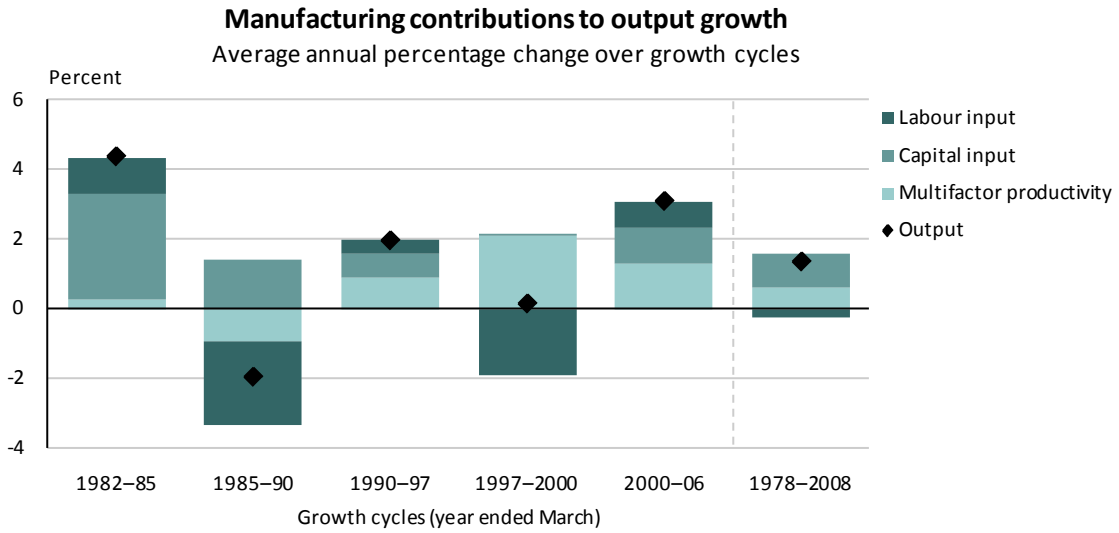
The trends of the manufacturing sector as a whole are given in this chapter, while those for the industry's nine sub-industries are provided in chapter 8.

Contributions to output growth

Across the series, capital input had the greatest contribution to output growth, at an average of 1.0 percent. This was followed by MFP, at an average of 0.6 percent. Labour input contributed negligibly to output growth over the entire series (see figure 7.2).

Strong annual output growth of 4.4 percent in the 1982–85 cycle was offset by output declines in the 1985–90 cycle. The growth from 1982–85 was driven by a 3.0 percent annual contribution from capital input. Labour input and MFP also contributed positively, at 1.0 percent and 0.3 percent, respectively. Over the same period, government 'Think Big' initiatives led to strong investment in the manufacturing industry. An example of this was the Motunui synthetic petrol plant in the petroleum manufacturing industry.

Figure 7.2



Source: Statistics New Zealand

The 1.9 percent annual decline in output over the 1985–90 cycle was driven by strong decreases in both the contribution of labour input and MFP, by 2.4 percent and 0.9 percent, respectively. This was the only cycle in the series in which output declined. While labour input and MFP declined, capital inputs continued to increase, contributing 1.4 percent annually.

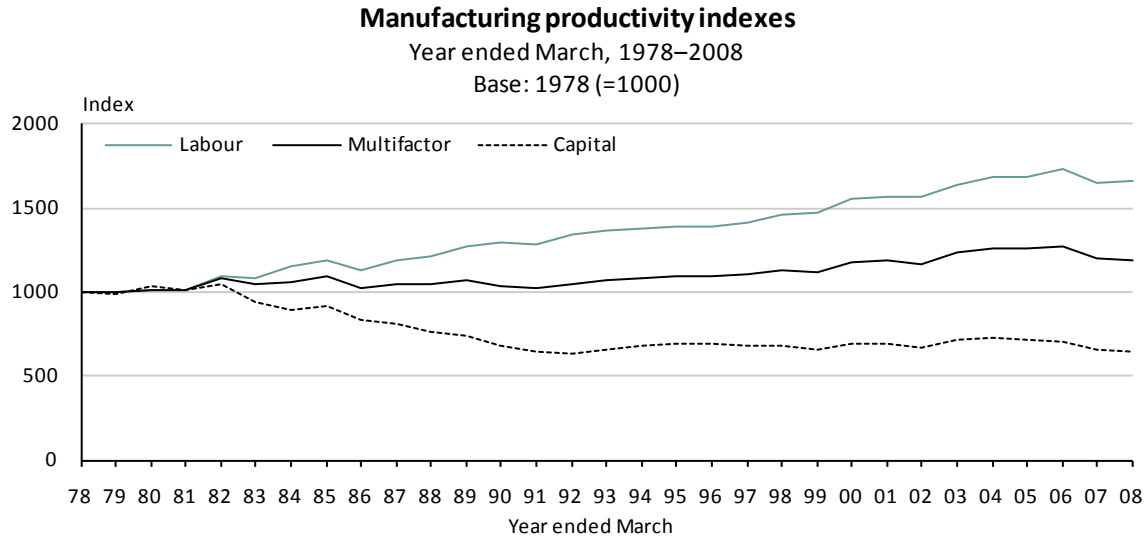
The contribution of labour inputs declined in the 1985–90 and the 1997–2000 cycles, at -2.4 and -1.9 percent per year, respectively. This decline was offset by growth in MFP and capital inputs in both the 1990–97 and 1997–2000 cycles. Output growth in the 1997–00 period aligns with low growth in the economy over this cycle.

Output grew strongly in the 2000–06 cycle at a rate of 3.1 percent a year. MFP drove these increases, rising by 1.3 percent annually. Labour and capital inputs contributed 0.8 percent and 1.0 percent, respectively, over this period.

Productivity

Between 1978 and 2008, labour productivity increased by 1.7 percent annually, and MFP rose by 0.6 percent a year (see figure 7.3). Capital productivity declined by an average of 1.5 percent per year. Each of these annual growth rates is lower than that of the measured sector.

Figure 7.3



Source: Statistics New Zealand

Relative to other industries, manufacturing showed consistent growth in labour productivity over the series. Labour productivity was at its strongest in the 1982–85 and 1997–2000 cycles. From 1982–85 labour productivity increased when industry output growth was strong. Labour productivity growth from 1997–2000 coincided with a period of labour shedding.

MFP growth followed a similar pattern to labour productivity across the series, but at a much weaker rate of 0.6 percent annually.

Capital productivity declined very steadily from 1982 until 1992. From then the series has been relatively flat, with all cycles after 1990 showing slight growth. Not surprisingly, given manufacturing is the largest industry, these patterns are reflective of the measured sector results. Over the series, capital's share of income increased from 27 percent in 1981 to 42 percent in 2008.

Table 7.2 presents growth rates for the three productivity measures from 1978–2008.

Table 7.2

Manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	2.7	-4.4	0.3
1985–1990	1.7	-5.8	-0.9
1990–1997	1.3	0.2	0.9
1997–2000	3.3	0.1	2.1
2000–2006	1.8	0.5	1.3
1978–2008	**1.7**	**-1.5**	**0.6**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

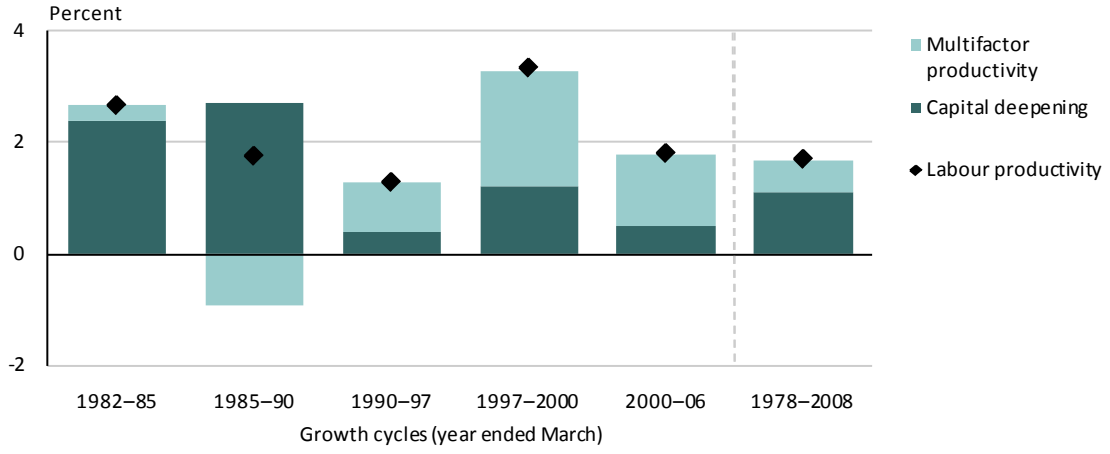
Source: Statistics New Zealand

Contributions to labour productivity growth

From 1978–2008, most of the manufacturing industry's growth in labour productivity was due to capital deepening, contributing 1.1 percent annually. MFP contributed an average of 0.6 percent (see figure 7.4). The dominance of capital deepening relative to MFP is evident in the 1982–90 period. From 1985–90, the manufacturing industry underwent significant capital deepening, which contributed 2.7 percent annually over the period. Over this time, MFP declined by 0.9 percent a year.

Figure 7.4

Manufacturing contributions to labour productivity growth
Average annual percentage change over growth cycles



Source: Statistics New Zealand

Since 1990, MFP has been the main contributor to labour productivity growth. From 1997–2006, it averaged 1.6 percent annually, while capital deepening contributed 0.7 percent.

8 Manufacturing sub-industries

A Food, beverage, and tobacco manufacturing

Highlights

From 1978–2008:

- Output growth in the food, beverage, and tobacco manufacturing industry rose 2.0 percent annually. This growth was driven by capital input, which contributed 1.3 percent annually.
- Labour productivity rose 2.1 percent annually.
- MFP rose 0.8 percent each year.

Introduction

In 2007, food, beverage, and tobacco manufacturing made up 35.6 percent of the manufacturing industry in terms of GDP, and was the largest of the nine manufacturing sub-industries. In 1978 its share of the manufacturing industry was just 24.5 percent. Food, beverage, and tobacco manufacturing includes firms engaged in the manufacture of meat and meat products, dairy products, other foods, beverages, malts, and tobacco. When combined, meat and dairy manufacturing contributed the highest proportion of output in most years since 1987. Due to a restructure within the dairy industry, the meat and dairy manufacturing time series has a discontinuity in the September 2002 quarter. Before this period, dairy product manufacturers in New Zealand sold their export products to a producer board that in turn exported these products. The producer board was classified as a wholesaler. From the September 2002 quarter, dairy manufacturers have been able to export directly. This discontinuity should be noted when interpreting the results of the series.

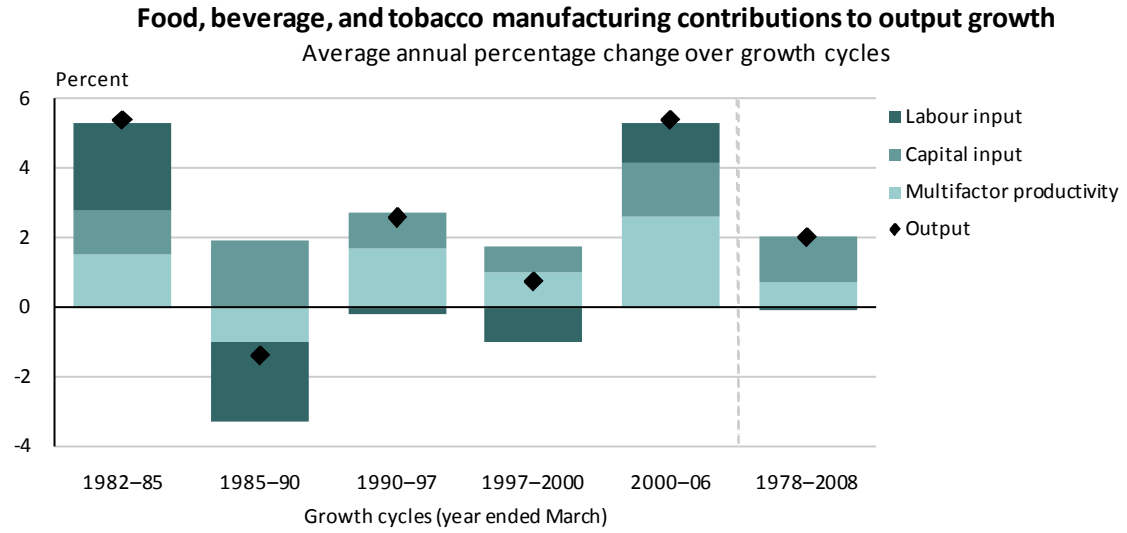
New Zealand's agricultural sector depends heavily, and in some cases almost exclusively, on international markets. Dairy exports sales were more than NZ$8.3 billion for the 2008 March year, making it New Zealand's leading export earner (Statistics New Zealand, 2010). New Zealand is also the largest exporter of dairy in the world (Ministry of Agriculture and Forestry, 2008).

The industry became significantly more reliant on capital input to assist production over time and this is supported by an increasing share of capital relative to labour. In 2008 labour's share of income was 52 percent, down from the peak of 82 percent in 1981.

Contributions to output growth

The greatest contribution to output growth came from capital input, followed by MFP (see figure 8.1). Capital input contributed an average of 1.3 percent annually, while fluctuations in the contribution of labour input cancelled each other out over the 30-year series.

Figure 8.1



Source: Statistics New Zealand

Output growth was quite volatile across the series, particularly in the 1980s. In the 1982–85 cycle, output growth was 5.4 percent per year. There was strong growth in the contribution of labour input over this time, while capital input and MFP also contributed positively.

However, this turned around from 1985–90 as a significant amount of labour was shed, not only in food, beverage, and tobacco manufacturing, but in most industries throughout the economy. Total job counts from the labour volume series declined by 17.5 percent from 1985–90. MFP also declined over this time, while capital input growth was strong.

From 1990 onwards, labour input was flat, with small declines in the 1990s cancelled out by weak growth from 2000–06. The contribution of capital input was also relatively stable, recording anywhere from 0.7 percent annually in the 1997–2000 cycle, to 1.5 percent annually in the 2000–06 cycle.

The MFP growth was positive, peaking at 2.6 percent per year in the latest cycle, from 2000–06. During this time, output growth again averaged 5.4 percent. Compared with the 1982–85 cycle, more of the output growth in 2000–06 cycle had come from MFP rather than labour input.

Productivity

Labour productivity growth averaged 2.1 percent annually across the series (see table 8.1). This rise is strong compared with total manufacturing, which averaged 1.7 percent across the series. Labour productivity growth peaked in the 2000–06 cycle, averaging 3.2 percent annually.

Table 8.1

Food, beverage, and tobacco manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	1.7	1.3	1.5
1985–1990	2.4	-6.2	-1.0
1990–1997	2.8	0.1	1.7
1997–2000	2.6	-0.8	1.0
2000–2006	3.2	1.8	2.6
1978–2008	**2.1**	**-1.5**	**0.8**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

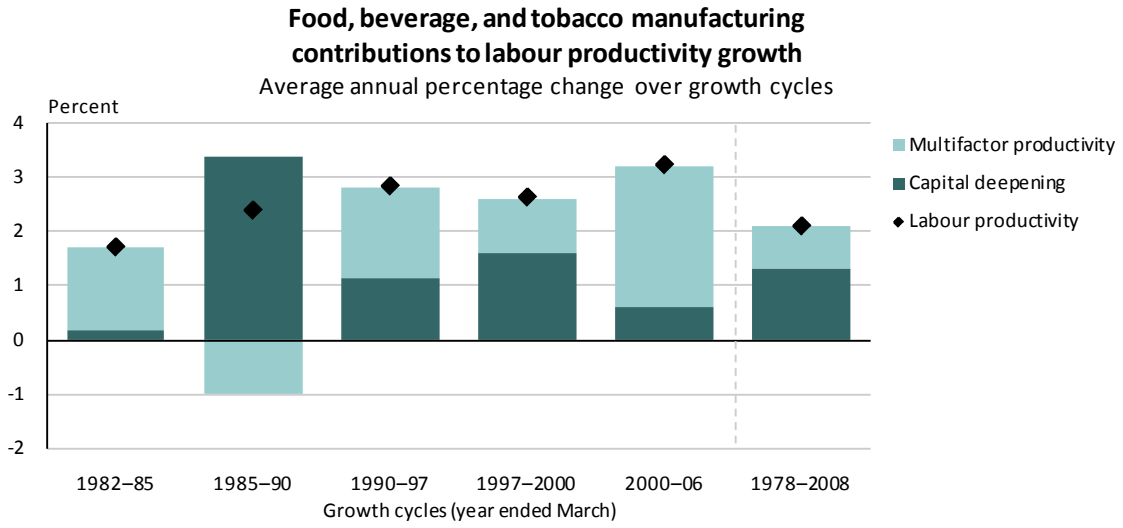
Capital productivity declined by an average of 1.5 percent across the series. This decrease is in line with the total manufacturing industry, and was driven by the 1985–90 cycle when capital productivity fell by 6.2 percent per year. During this period output declined, while capital input growth was strong.

Contributions to labour productivity

Across the series, most of the growth in labour productivity in food, beverage, and tobacco manufacturing was due to capital deepening (see figure 8.2). The average contribution from capital deepening was 1.3 percent, while MFP growth contributed an average of 0.8 percent annually.

While capital deepening was the most significant contributor over the entire time series, it performed better than MFP growth in only two of the five cycles. This was particularly evident from 1985–90, when capital deepening contributed 3.4 percent annually to labour productivity growth. This was offset slightly by a decline in MFP. During this time, there was significant investment in computers, and other electronic and electrical equipment. While there were not significant stocks of these assets, investment growth was rapid enough to impact on the industry. For example, the productive stock of computers increased eightfold from 1985–90.

Figure 8.2



Source: Statistics New Zealand

From 1990 onwards labour productivity growth was consistent across cycles, ranging from 2.6 percent to 3.2 percent, with positive contributions from both MFP and capital deepening. In the most recent cycle from 2000–06, MFP growth peaked at 2.6 percent per year.

B Textile and apparel manufacturing

Highlights

From 1978–2008:

- Output growth decreased by 1.4 percent annually. This decline was driven by continual labour shedding from 1985 onwards, with labour input contributing 2.7 percent annually to the decline in output.
- Labour productivity rose 2.3 percent annually.
- MFP rose 1.6 percent annually.

Introduction

In 2007, textile and apparel manufacturing made up 3.3 percent of the manufacturing industry. In terms of GDP, it was the smallest of the nine manufacturing sub-industries. At present, textile and apparel manufacturing contributes significantly less to the economy than it did in 1978, and was the only manufacturing sub-industry in which constant-price value added declined across the series. Included within this industry is the manufacturing of textile products, wearing apparel, and footwear.

With the removal of the majority of import licensing through the mid-to-late 1980s, the value of textile goods imported increased considerably (Statistics New Zealand, 2010). There was a substantial drop in jobs from 1986 onwards and a reduction in the number of firms operating in the industry (Statistics New Zealand, nd).

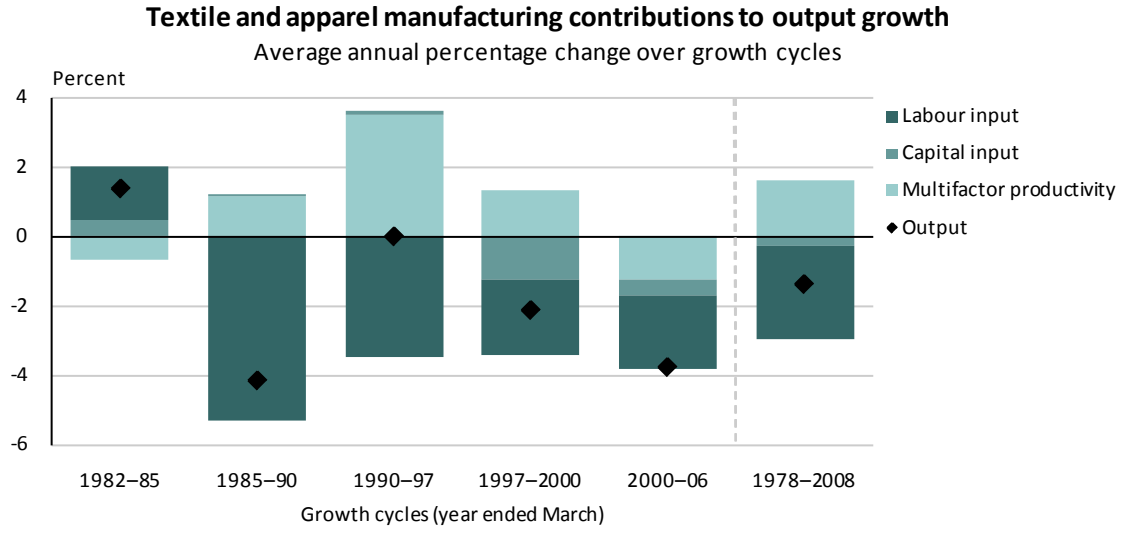
Contributions to output growth

MFP contributed 1.6 percent to output growth, while both labour input and capital input declined over the series (see figure 8.3). This increase in MFP was the strongest of all the manufacturing sub-industries. The average negative contributions of labour and capital inputs to output growth were 2.7 percent and 0.3 percent per year, respectively.

Output declined at a rate of 1.4 percent annually across the series, driven by a decrease in the contribution of labour input. The strongest period of labour shedding took place from 1985–90. Job counts from the labour volume series for textile and apparel manufacturing dropped by 30.2 percent from 1985–90. Since 1990 labour input continued to decline at a rate of more than 2 percent per year.

Capital input grew in the 1982–85 cycle, but was flat from 1985 to 1997. Since then, it also declined, and contributed negatively to output growth over the entire 1978–2008 period. Textile and apparel manufacturing is unique in that its level of capital input is lower in 2008 than it was in 1978.

Figure 8.3



Source: Statistics New Zealand

Productivity

Labour productivity growth averaged 2.3 percent annually across the series (see table 8.2), making textile and apparel manufacturing the second strongest of all manufacturing sub-industries. Labour productivity growth was particularly strong in 1990–97, averaging 5.0 percent annually.

Table 8.2

Textile and apparel manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	-0.7	-0.4	-0.7
1985–1990	3.0	-4.5	1.1
1990–1997	5.0	-0.3	3.5
1997–2000	0.8	2.3	1.3
2000–2006	-0.9	-2.0	-1.3
1978–2008	**2.3**	**-0.4**	**1.6**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

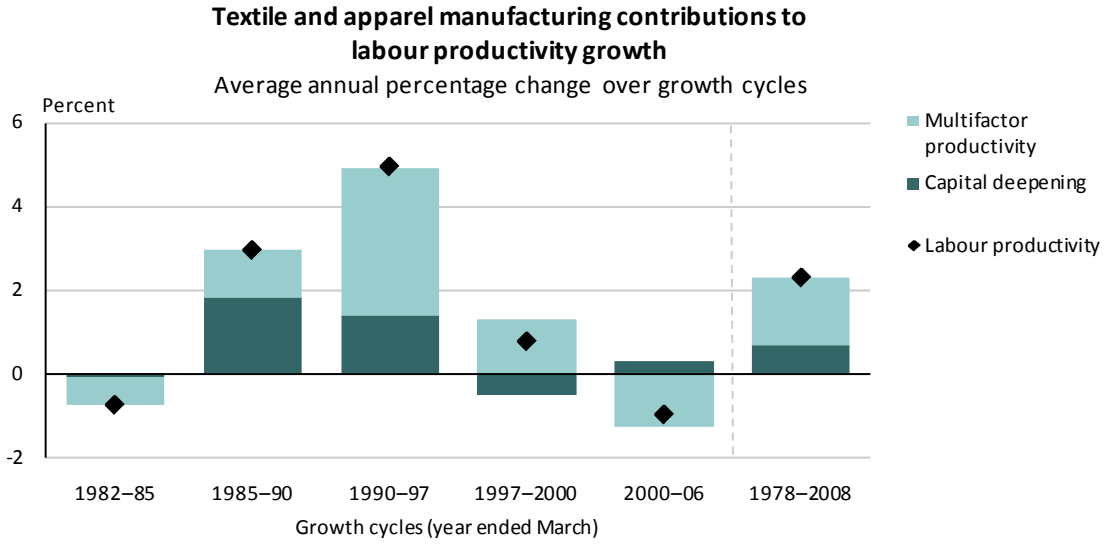
Capital productivity declined by 0.4 percent annually across the series. However, there was a decline in all nine manufacturing sub-industries, and the decrease for this industry is in fact the smallest within manufacturing, equal with wood and paper manufacturing. Capital productivity in the 1985–90 cycle declined by 4.5 percent annually. This decrease coincided with increases in capital input over this period.

Despite the falling volumes in textile and apparel manufacturing, labour input within the industry declined faster than output, meaning that its productivity performance was relatively strong.

Contributions to labour productivity

Across the series, most of the labour productivity growth in textile and apparel manufacturing was due to MFP (see figure 8.4). The average contribution from MFP was 1.6 percent, while capital deepening contributed an average of 0.7 percent annually.

Figure 8.4



Source: Statistics New Zealand

Labour productivity growth was at its highest in the 1990–97 cycle. During this time, MFP grew by 3.5 percent per year. The industry became more capital intensive during this period, as well as the previous cycle from 1985–90. This was only because capital input remained flat during these periods, while labour input declined significantly.

In the latest complete cycle (2000–06) labour productivity recorded its most significant decline. This was driven by a fall in MFP as capital deepening contributed positively.

C Wood and paper product manufacturing

Highlights

From 1978–2008:

- Output growth in the wood and paper product manufacturing industry rose 2.1 percent annually. This was driven by MFP growth, which contributed 1.3 percent annually.
- Labour productivity rose 2.5 percent annually, and had risen in every cycle.
- MFP rose 1.3 percent annually.

Introduction

In 2007, wood and paper product manufacturing made up 9.7 percent of the manufacturing industry in terms of GDP, making it the fifth largest manufacturing sub-industry. It has played an important part in the New Zealand economy, processing output from the forestry and logging industry.

The sub-industry is made up of wood product, pulp, paper, and paperboard manufacturing. The majority of its output is exported, and its main markets include China, Japan, Korea, Australia, and the United States. The major export items are wood pulp, wood chips, sawn timber, and logs (Statistics New Zealand, 2009).

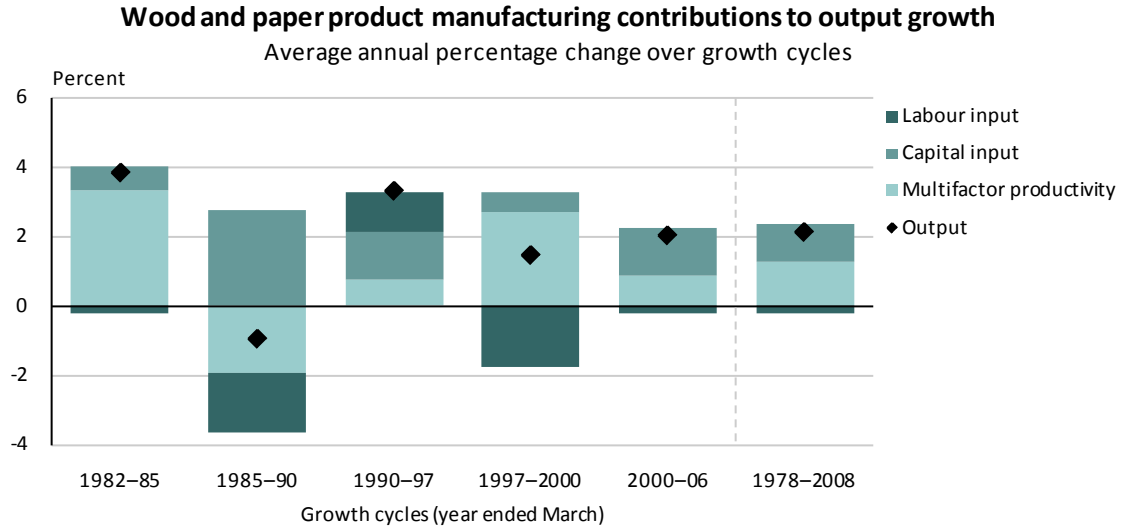
Contributions to output growth

The greatest contribution to output growth came from MFP, closely followed by capital input. The contribution of labour input declined slightly over the entire series (see figure 8.5).

Over the entire 1978–2008 series, output increased at a rate of 2.1 percent annually. Output growth was at its strongest in the 1982–85 cycle, rising by 3.8 percent per year. This was driven by strong MFP growth, which rose 3.3 percent per year, while the contribution from labour input was slightly negative over the series.

The 1985–90 cycle was the only cycle in which output declined. As with other manufacturing industries, there was very strong capital input growth over this time. Growth in capital was driven by investment in assets such as general purpose machinery, electronic and electrical equipment, and heavy machinery. However, these were offset by declines in contributions from labour input and MFP.

Figure 8.5



Source: Statistics New Zealand

Since 1990, growth in output was more consistent, ranging from 1.5 percent to 3.3 percent across the various cycles. During all three cycles from 1990–2006, capital input contributed positively. From 1990–97, labour input and MFP also contributed positively, resulting in solid output growth of 3.3 percent annually. Output growth slowed to 1.5 percent per year from 1997–2000, driven by negative contributions from labour input.

The output performance during the 2000–06 cycle closely mirrors that of the total period. There was a slight decline in the contribution of labour input, however, capital input and MFP both contributed positively, resulting in output rising at an average of 2.0 percent per year.

Productivity

Labour productivity growth averaged 2.5 percent across the series (see table 8.3). Of the growth rates for all the manufacturing sub-industries, this was the strongest and well above the average of 1.7 percent. Labour productivity grew in all five cycles, and was particularly strong from 1982–85, and again from 1997–2000.

Capital productivity declined at an average of 0.4 percent across the series. This was driven by a very significant decline in the 1985–90 cycle, which aligns with capital productivity performance in other manufacturing sub-industries during the same period.

MFP increased by 1.3 percent per year, the second strongest growth rate of the nine manufacturing sub-industries, behind only textile and apparel manufacturing.

Table 8.3

Wood and paper manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	4.0	1.8	3.3
1985–1990	1.8	-7.8	-1.9
1990–1997	1.3	0.0	0.7
1997–2000	4.3	-0.1	2.7
2000–2006	2.4	-0.8	0.9
1978–2008	**2.5**	**-0.4**	**1.3**

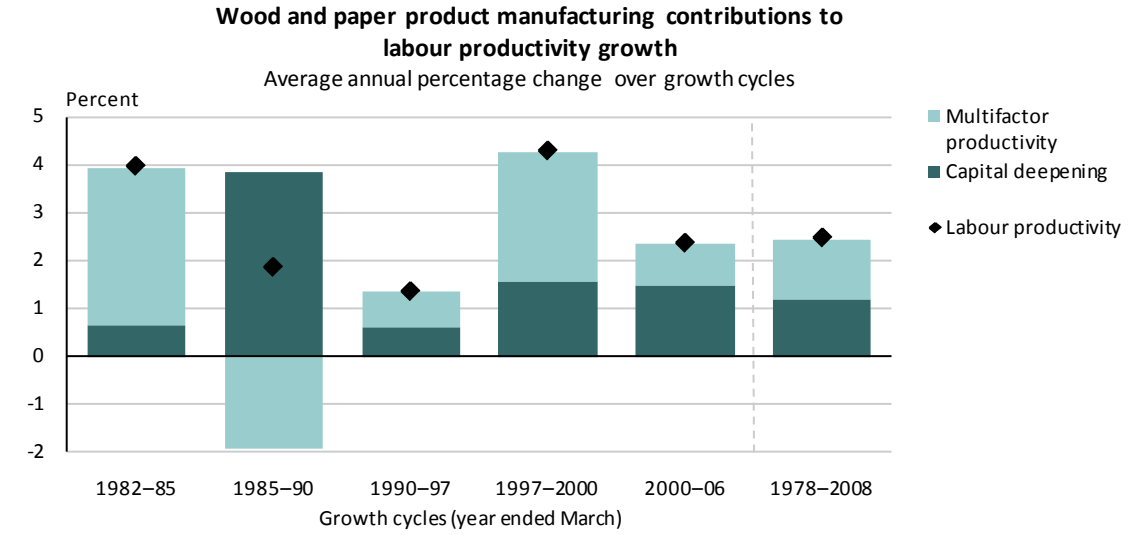
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity

Across the series, labour productivity rose at an average of 2.5 percent annually (see figure 8.6). The contribution of MFP was slightly higher than that of capital deepening, with growth rates of 1.3 percent and 1.2 percent, respectively.

Figure 8.6



Source: Statistics New Zealand

Labour productivity rose in each of the cycles from 1982 to 2006. From 1982–85, labour productivity growth was strong, at 4.0 percent per year. MFP contributed significantly during this time, averaging 3.3 percent each year.

From 1985–90, MFP declined at an average of 1.9 percent per year. There was a significant amount of capital deepening during this period that drove growth in labour productivity. From 1990 onwards, both capital deepening and MFP contributed positively in each cycle. Labour productivity peaked in the 1997–2000 period, growing 4.3 percent annually.

In the latest complete cycle from 2000–06, labour productivity performance was similar to that of the entire 1978–2008 period. Capital deepening contributed 1.5 percent to the growth in labour productivity, while MFP contributed 0.9 percent annually over these six years.

D Printing, publishing, and recorded media

Highlights

From 1978–2008:

- Output growth in printing, publishing, and recorded media rose 1.0 percent each year. This growth was almost entirely due to capital input, which contributed 0.9 percent per year.
- Labour productivity growth averaged 0.8 percent per year.
- MFP growth was minimal across the series.

Introduction

In 2007, printing, publishing, and recorded media made up 7.3 percent of the manufacturing industry in terms of GDP, making it the fourth smallest sub-industry in manufacturing. This sub-industry had a relatively constant share of the manufacturing industry across the series.

The printing, publishing, and recorded media industry includes the manufacturing or publishing of newspapers, magazines, audio tapes, computer tapes or disks, records, phonographs, compact disks, video tapes, and magnetic tapes.

Internationally the industry was revolutionised by the developments in information technology, which created a number of electronic alternatives to traditional printing and enabled smaller and more flexible print-runs (Stawinska, 2010).

Contributions to output growth

The growth of 1.0 percent per year in output was almost entirely due to capital input, which contributed 0.9 percent annually (see figure 8.7). Labour input provided a small contribution of 0.1 percent a year while the contribution of MFP was negligible.

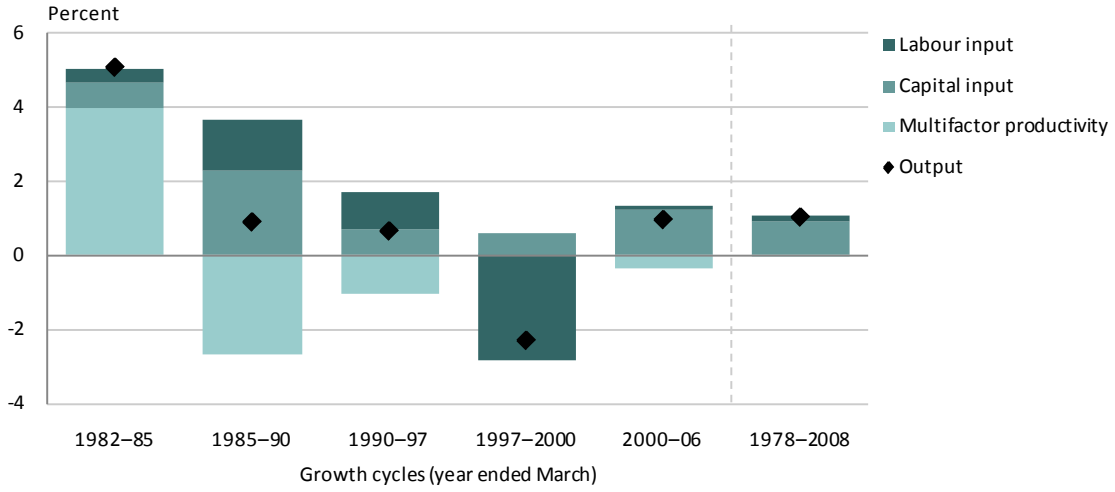
Output growth was at its strongest in the 1982–85 cycle, averaging 5.1 percent per year. This was driven by a strong annual contribution from MFP of 4.0 percent. The next highest period of output growth occurred during 2000–06 at a rate of 1.0 percent per year.

From 1985–97, both labour input and capital input contributed positively to output growth. However, these contributions were partly offset by a decline in MFP, which was particularly evident from 1985–90. Output grew by 0.9 percent on an annual basis.

Figure 8.7

Printing, publishing, and recorded media contributions to output growth

Average annual percentage change over growth cycles



Source: Statistics New Zealand

From 1997–2000, a considerable amount of labour shedding led to a negative contribution from labour input. There were small offsetting contributions from capital input and MFP, but output declined by 2.3 percent annually.

Productivity

Across the entire 1978–2008 period, labour productivity increased by 0.8 percent per year (see table 8.4). This is the second-weakest growth of the nine manufacturing sub-industries, ahead of only furniture and other manufacturing.

The 1982–85 cycle marked the highest period of productivity growth. Labour, capital, and MFP all grew at their strongest rates. This was the only cycle in which capital productivity and MFP recorded positive growth.

From 1985, labour productivity declined at an average of 0.1 percent annually, and MFP declined by 1.1 percent each year. Furthermore, capital productivity fell in each cycle from 1985 onwards. The worst-performing cycle was from 1985–90 where all three productivity measures recorded their largest declines.

Table 8.4

Printing, publishing, and recorded media productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	4.3	3.3	4.0
1985–1990	-1.4	-5.3	-2.7
1990–1997	-1.0	-1.2	-1.0
1997–2000	2.3	-3.8	0.0
2000–2006	0.8	-2.2	-0.3
1978–2008	**0.8**	**-1.4**	**0.0**

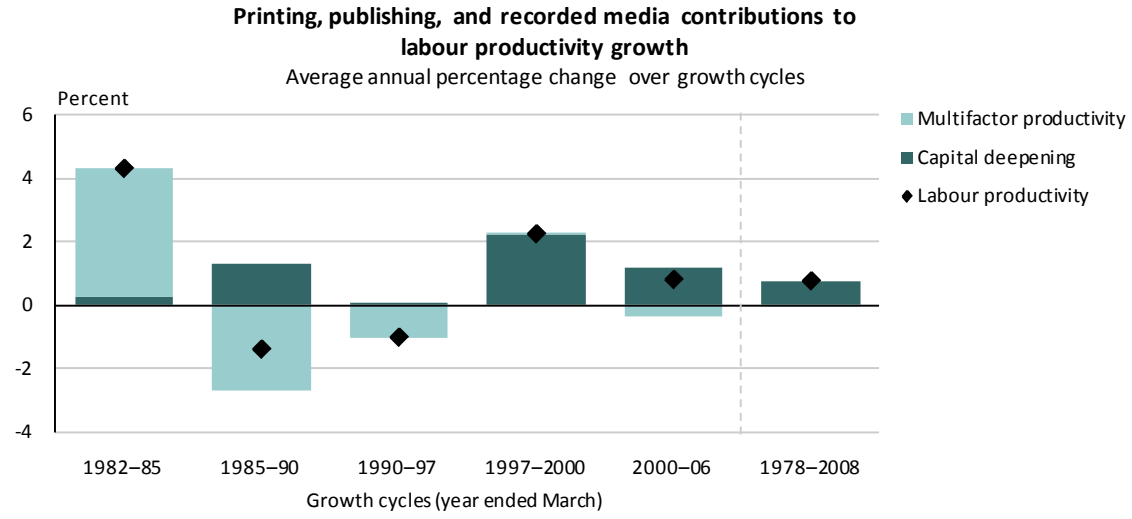
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity

Across the series, all growth in labour productivity was due to capital deepening, while the contribution from MFP was minimal (see figure 8.8).

Figure 8.8



Source: Statistics New Zealand

Labour productivity growth was at its strongest in the 1982–85 cycle, driven by very strong MFP growth. In this period, a small amount of capital deepening complemented MFP growth.

There was some degree of capital deepening within every cycle. In all cycles from 1985 onwards, however, capital deepening was offset by declines in MFP. The exception to this was the 1997–2000 cycle, where there was no growth in MFP.

Within the industry, the key capital asset is general purpose machinery, such as printing presses, although its importance has diminished over time. Non-residential buildings are also a key capital input. However, the industry has become more technology-intensive, with computers and electronic and electrical equipment being the fastest growing assets.

E Petroleum, chemical, plastic, and rubber product manufacturing

Highlights

From 1978–2008:

- Output growth in the petroleum, chemical, plastic, and rubber product manufacturing industry rose 1.1 percent annually. This growth was driven by capital input, which contributed 1.5 percent annually.
- Labour productivity rose 1.8 percent annually.
- MFP declined by 0.1 percent annually.

Introduction

In 2007, petroleum, chemical, plastic, and rubber product manufacturing made up 11.3 percent of the manufacturing industry in terms of GDP. The third largest sub-industry in manufacturing, it is one of only two sub-industries that increased its contribution to total manufacturing from 1978–2007.

The sub-industry comprises petroleum refining and the manufacturing of petroleum and coal products; fertiliser; rubber and plastic products; and other chemicals. Rubber, plastic, and other chemical manufacturing made up the largest proportion of the sub-industry over the series, up from 45 percent in 1987 to 66 percent in 2007.

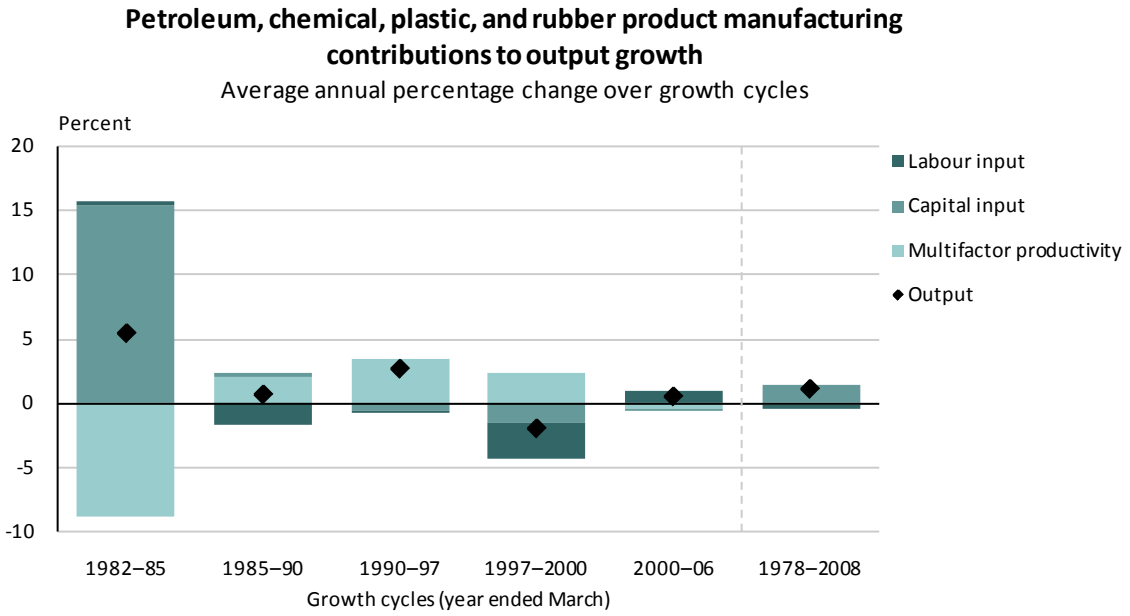
The government's 'Think Big' schemes in the early 1980s resulted in major capital investment in the industry between 1982 and 1984. These investments included the Motunui synthetic petrol plant, the Waitara methanol plant, and the Kapuni ammonia plant.

Contributions to output growth

The greatest contribution to output growth came from capital input, which contributed an average 1.5 percent annually across the series (see figure 8.9). Both labour input and MFP contributed negatively to output over the series, down by 0.3 percent and 0.1 percent, respectively. Output growth averaged 1.1 percent annually from 1978–2008.

Output growth was relatively volatile across the 30-year time series, particularly in the 1980s. In the 1982–85 cycle, output growth was at its highest, averaging 5.5 percent. The contribution of capital input to output growth was massive over this cycle, averaging 15.4 percent annually. This is the single biggest contribution from capital input to output growth for any cycle in any industry. MFP declined strongly, by 8.8 percent annually.

Figure 8.9



Source: Statistics New Zealand

Output growth slowed over the next two cycles, increasing by 0.7 percent annually from 1985–90, and 2.7 percent annually from 1990–97. These increases were driven by strong MFP growth of 2.1 percent and 3.4 percent, respectively, while labour and capital inputs both decreased over these cycles.

Output declined in only one cycle (1997–2000), driven by a fall in labour input.

Productivity

Labour productivity growth averaged 1.8 percent annually across the series (see table 8.5). This is close to the total manufacturing average of 1.7 percent. Labour productivity was particularly strong in the 1980s, averaging 4.7 percent annually between 1982–90 but the series declined post-2000.

The 22.8 percent annual decline from 1982–85 was the only cycle in which capital productivity declined. This decrease was enough to drive the entire series down, so that capital productivity across the series decreased 2.3 percent annually. This capital productivity performance was the strongest decline among all manufacturing sub-industries.

In 2008, the industry was the most capital intensive among all manufacturing sub-industries, with capital weighted at 52 percent compared with labour at 48 percent.

Table 8.5

Petroleum, chemical, plastic, and rubber product manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	4.7	-22.8	-8.8
1985–1990	4.7	0.0	2.1
1990–1997	2.9	4.1	3.4
1997–2000	3.3	1.5	2.4
2000–2006	-1.5	0.6	-0.4
1978–2008	**1.8**	**-2.3**	**-0.1**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

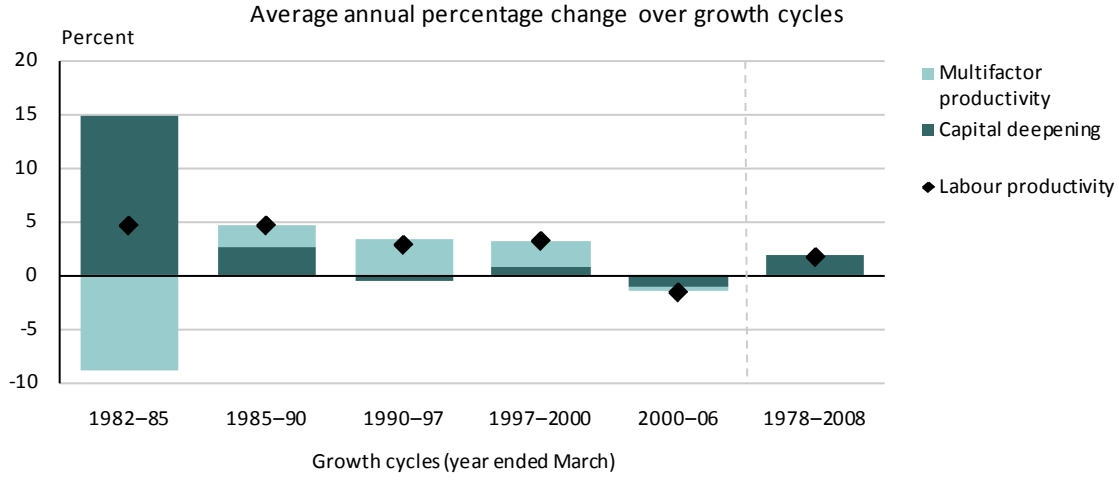
Source: Statistics New Zealand

Contributions to labour productivity

Across the series, most of the growth in labour productivity in petroleum, chemical, plastic, and rubber product manufacturing was due to capital deepening (see figure 8.10). The average contribution from capital deepening was 1.9 percent, while MFP had a -0.1 percent annual impact on labour productivity.

Figure 8.10

Petroleum, chemical, plastic, and rubber product manufacturing contributions to labour productivity growth
Average annual percentage change over growth cycles



Source: Statistics New Zealand

Capital deepening was the primary contributor to labour productivity growth in the 1982–85 cycle. Its 14.8 percent contribution made this cycle the largest period of capital deepening for any manufacturing sub-industry. Capital deepening's impact lessened considerably after 1990.

F Non-metallic mineral product manufacturing

Highlights

From 1978–2008:

- Output growth in non-metallic mineral product manufacturing rose 1.7 percent. This growth was driven by capital input, which contributed 1.1 percent annually.
- Labour productivity grew at an annual average rate of 1.5 percent.
- MFP grew at a rate of 0.7 percent per year.

Introduction

In 2007, non-metallic mineral product manufacturing made up 4.3 percent of the manufacturing industry as a proportion of GDP. At this time, it was larger only than furniture and other manufacturing; and textile and apparel manufacturing.

Non-metallic mineral product manufacturing includes the manufacturing of glass and glass products; ceramic products; and cement, lime, plaster, and concrete products. Overall, the sub-industry is relatively labour intensive.

The construction industry relies on non-metallic mineral product manufacturing for its materials such as glass, cement, and concrete.

Contributions to output growth

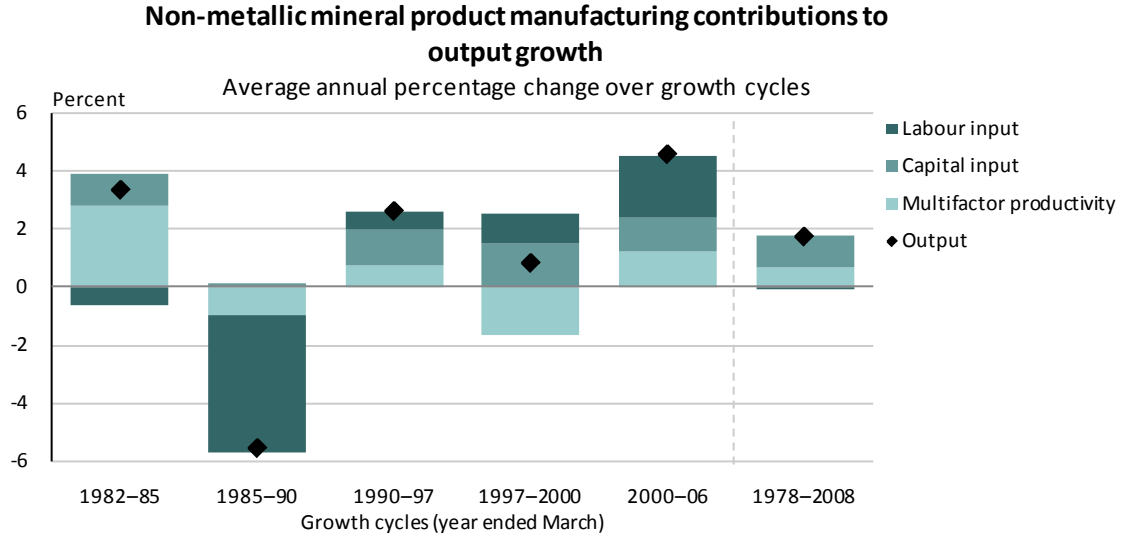
Output grew at a rate of 1.7 percent per year from 1978–2008 (see figure 8.11). Across the series, the greatest contribution came from capital input followed by MFP, at 1.1 percent and 0.7 percent, respectively. Labour input was slightly negative, at -0.1 percent per year.

From 1982–85, output grew at an average of 3.3 percent per year. It was during this cycle that MFP growth was strongest, contributing 2.8 percent annually. Capital input also contributed positively, while labour input provided a small offsetting contribution.

From 1985–90, the industry contracted considerably, and output declined at a rate of 5.5 percent a year. This fall was driven by a large amount of labour shedding, with labour input contributing 4.7 percent per year to the decline. MFP drove this decrease further, while the contribution of capital input was slightly positive. There was a similar decline in value added in the construction industry through to 1992.

Since 1990, output growth across cycles was positive, ranging from 0.8 percent to 4.6 percent annually. This rise was largely driven by input growth, while MFP fluctuated.

Figure 8.11



Source: Statistics New Zealand

Productivity

Labour productivity growth was strong from 1982–90, particularly in the first complete cycle from 1982–85 (see table 8.6). However, its growth has slowed since then, with the following three cycles being less than the 1978–2008 average.

Table 8.6

Non-metallic mineral product manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	4.6	1.2	2.8
1985–1990	2.1	-5.8	-1.0
1990–1997	1.2	0.0	0.7
1997–2000	-1.1	-2.2	-1.7
2000–2006	0.2	2.4	1.2
1978–2008	**1.5**	**-0.4**	**0.7**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

The 1982–85 cycle was the strongest for labour productivity and MFP, with capital productivity also growing during this time. However, capital productivity growth peaked in the most recent, growing by 2.4 percent annually from 2000–06.

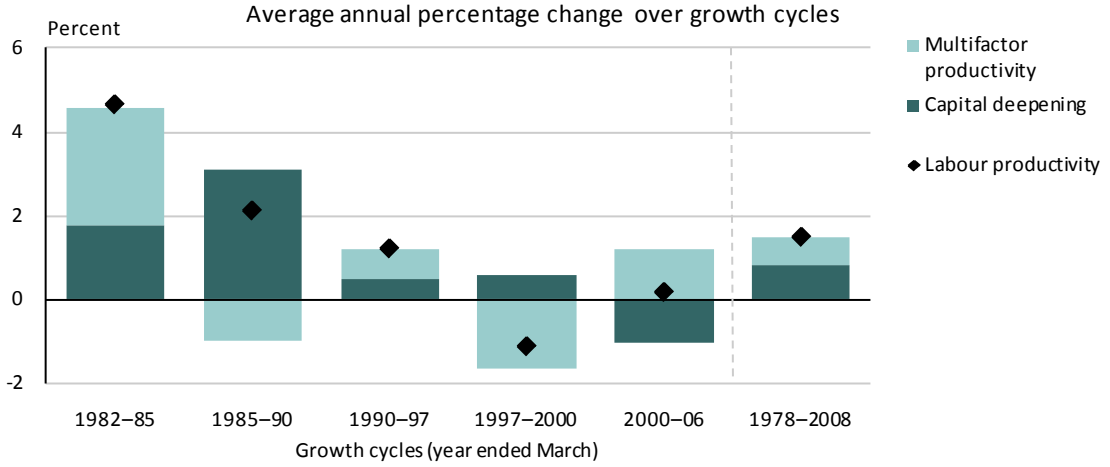
Contributions to labour productivity

Across the series, the growth in labour productivity was driven by both capital deepening and MFP, which contributed 0.8 percent and 0.7 percent per year, respectively (see figure 8.12).

Figure 8.12

Non-metallic mineral product manufacturing contributions to labour productivity growth

Average annual percentage change over growth cycles



Source: Statistics New Zealand

Labour productivity growth was at its strongest from 1982–85, averaging 4.6 percent annually. Both capital deepening and MFP made positive contributions during this time. This capital deepening was due to labour shedding. From 1985–90, capital deepening was at its strongest, contributing 3.1 percent annually, as capital input has remained stable. The job count during this period declined at a rate of 7.0 percent annually.

Throughout the first four cycles, labour productivity growth decelerated. In fact, it declined during the 1997–2000 cycle as the fall in MFP out-performed the positive contribution from capital deepening.

G Metal product manufacturing

Highlights

From 1978–2008:

- Output growth for the metal product manufacturing industry rose 1.5 percent. This growth was driven by capital input, which contributed 1.0 percent annually.
- Labour productivity rose 1.3 percent annually.
- MFP rose 0.6 percent annually.

Introduction

In 2007, metal product manufacturing made up 11.0 percent of the manufacturing industry as a proportion of GDP. The industry's share has remained fairly constant over the series, declining slightly from 12.0 percent in 1978. It is the fourth largest manufacturing sub-industry in terms of GDP.

Metal product manufacturing includes firms engaged in the manufacturing of iron and steel; basic non-ferrous metal; non-ferrous metal products; structural metal products; sheet metal products; and fabricated metal products.

The government's 'Think Big' scheme in the early 1980s resulted in major capital investment in the industry between 1982 and 1984. These investments included the expansion of the Tiwai Point Aluminium Smelter.

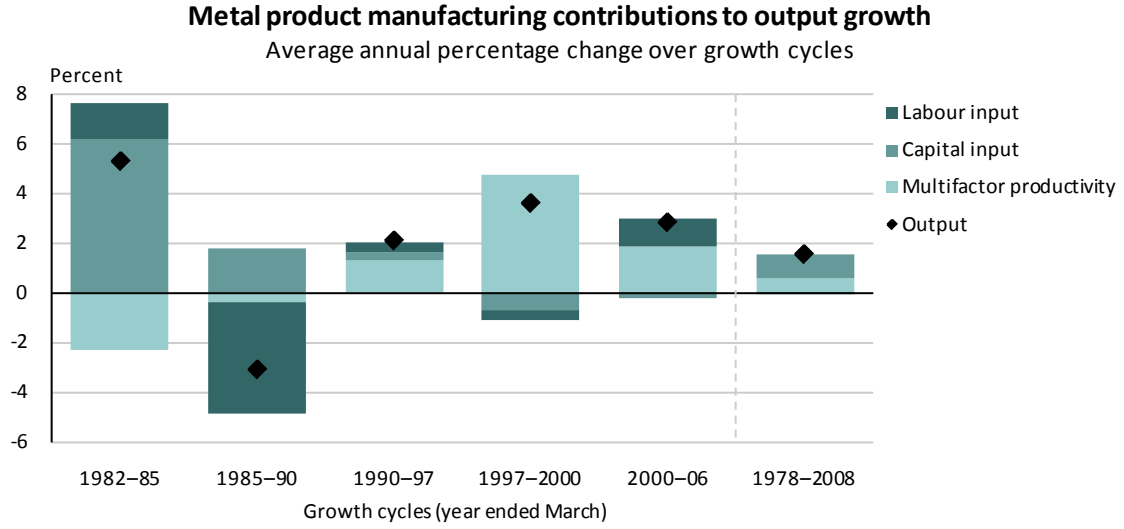
Contributions to output growth

The greatest contribution to output growth came from capital input followed by MFP, contributing 1.0 percent and 0.6 percent per year, respectively (see figure 8.13).

The metal product manufacturing industry's output increased at a rate of 1.5 percent per year across the series. Its strongest period of growth was during 1982–85, at 5.3 percent per year. Capital input was the main contributor to output growth, with 6.2 percent.

From 1985–90 output declined by 3.1 percent annually, mainly due to significant labour shedding in the industry. During this cycle the job count recorded a decrease of 23.8 percent. However, from 1990 onwards, output growth recovered, with MFP being the main driver. MFP recorded its highest contribution during the 1997–2000 cycle, at an average rate of 4.8 percent annually.

Figure 8.13



Source: Statistics New Zealand

Productivity

Labour productivity growth averaged 1.3 percent per year across the series (see table 8.7), below the average growth of 1.7 percent for total manufacturing. Labour productivity was particularly strong in the 1997–2000 cycle, averaging 4.3 percent annually.

Table 8.7

Metal product manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	2.7	-10.3	-2.3
1985–1990	2.6	-8.4	-0.4
1990–1997	1.0	1.4	1.3
1997–2000	4.3	5.7	4.8
2000–2006	1.1	3.4	1.9
1978–2008	**1.3**	**-1.2**	**0.6**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Declining capital productivity and MFP in the 1980s was due to rapid growth in capital input, with no associated strong gains in output. However, this turned around from 1990 onwards. Capital input growth was negligible from 1990–2008.

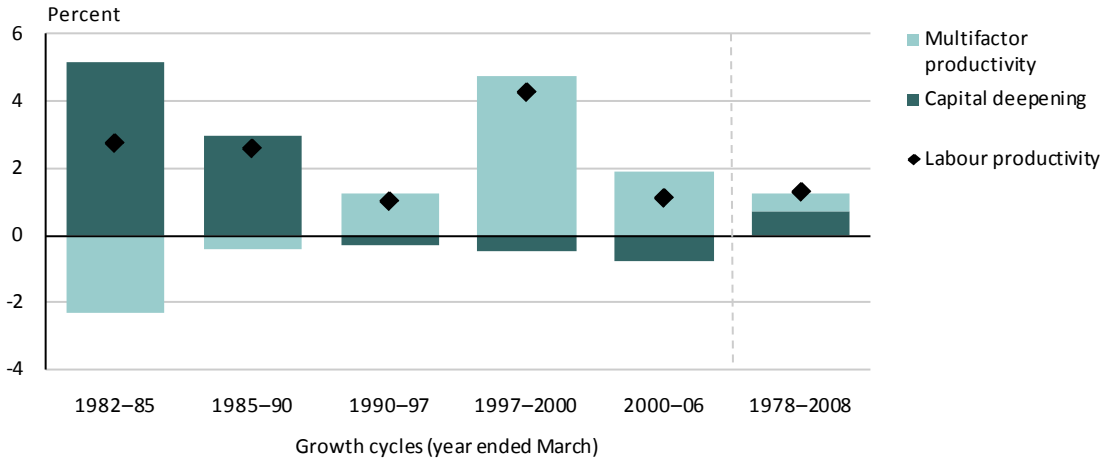
Contributions to labour productivity

Growth in labour productivity was due to both capital deepening and MFP (see figure 8.14). The average contribution from capital deepening and MFP were 0.7 percent and 0.6 percent, respectively.

Figure 8.14

Metal product manufacturing contributions to labour productivity growth

Average annual percentage change over growth cycles



Source: Statistics New Zealand

In the 1982–85 cycle, rapid growth in capital input drove a high degree of capital deepening, which contributed positively to labour productivity growth. From 1985–90, it was labour shedding that caused capital deepening to occur.

From 1990 onwards, the industry experienced capital shallowing. However, MFP increased, resulting in labour productivity rises for each cycle.

H Machinery and equipment manufacturing

Highlights

From 1978–2008:

- Output growth for the machinery and equipment manufacturing industry rose 1.1 percent per year. This growth was driven by capital input, which contributed 0.8 percent annually.
- Labour productivity rose 1.1 percent annually.
- MFP rose 0.3 percent annually.

Introduction

In 2007, machinery and equipment manufacturing made up 14.2 percent of the manufacturing industry in terms of GDP, making it the second largest sub-industry in manufacturing. This was, however, a decline from its 18.2 percent share in 1978.

Machinery and equipment manufacturing is made up of motor vehicles and parts, other transport equipment, photographic and scientific equipment, electronic equipment, electrical equipment and appliances, and industrial machinery and equipment manufacturing.

The manufacturing of industrial machinery, electrical appliances, electronic, and scientific equipment dominate production. The importance of vehicle assembly has declined over time. There were 15 vehicle assembly plants operating in New Zealand in the 1980s, but last four of these closed in 1998 (Ministry of Economic Development, nd).

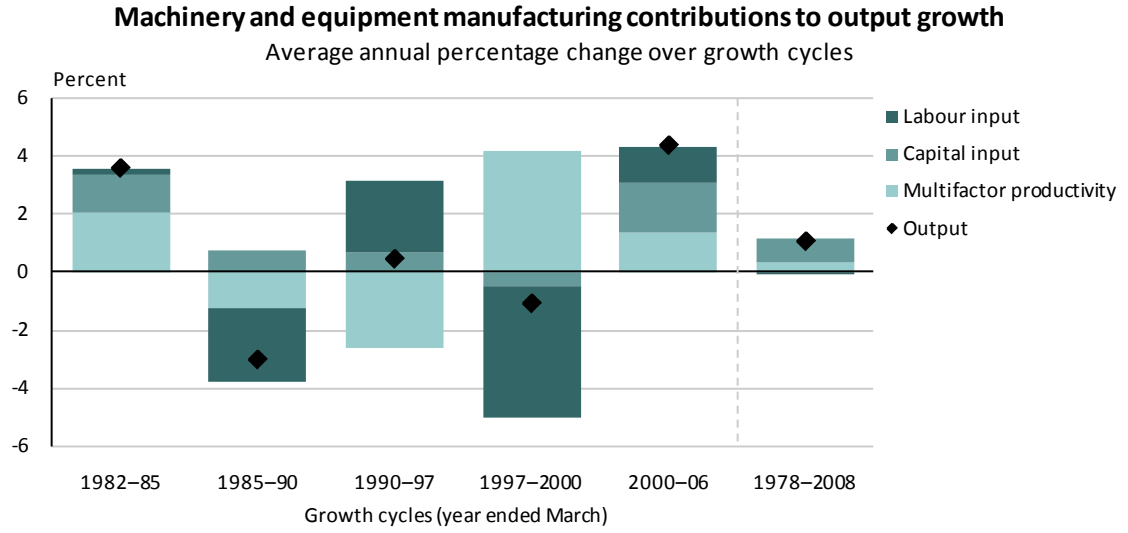
Contributions to output growth

The greatest contribution to output growth came from capital input followed by MFP, with 0.8 percent and 0.3 percent per year, respectively (see figure 8.15).

From 1978–2008, output increased at a rate of 1.1 percent per year. Output growth was strongest in the 2000–2006 cycle, rising by 4.4 percent per year.

The largest decline in output was recorded during the 1985–1990 cycle. The main contributor to this decline was labour input followed by MFP, with negative contributions of 2.5 percent and 1.2 percent per year, respectively.

Figure 8.15



Source: Statistics New Zealand

The 1997–2000 period was a low point for labour input, as it contributed -4.5 percent per year. This decline was balanced out by the strongest growth in MFP, at 4.2 percent per year.

Productivity

Labour productivity growth averaged 1.1 percent across the series (see table 8.8). This is below the total manufacturing average of 1.7 percent. Labour productivity was at its strongest from 1997–2000, averaging 5.5 percent annually.

Table 8.8

Machinery and equipment manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	3.3	-1.4	2.1
1985–1990	0.1	-6.1	-1.2
1990–1997	-3.0	-1.8	-2.6
1997–2000	5.5	0.8	4.2
2000–2006	2.6	-1.4	1.4
1978–2008	**1.1**	**-1.9**	**0.3**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Capital productivity declined at an average of 1.9 percent across the series, driven by a very strong fall in the 1985–90 cycle. This decline aligns with capital productivity performance in other manufacturing sub-

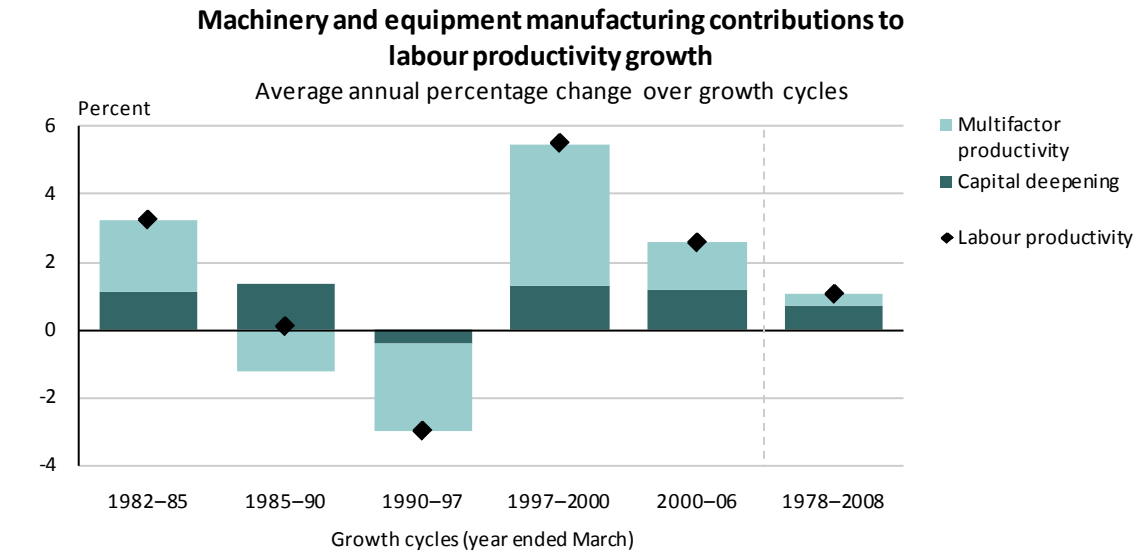
industries during the same period. However, in this industry the decrease in capital productivity was mainly caused by a fall in output.

MFP increased by 0.3 percent per year, the fourth lowest growth rate of the nine manufacturing sub-industries.

Contributions to labour productivity

Across the series, labour productivity increased at an average of 1.1 percent annually (see figure 8.16). Capital deepening contributed more than MFP, with growth rates of 0.7 percent and 0.3 percent, respectively.

Figure 8.16



Source: Statistics New Zealand

Labour productivity growth slowed down in each of the cycles from 1982 to 1997, driven by a decline in MFP. Following this, labour productivity turned around, recording its strongest growth of 5.5 percent annually from 1997–2000. Capital deepening's contribution to labour productivity growth was consistent throughout the series, apart from the 1990–97 cycle. During this cycle, when labour input growth was at its strongest, and the industry underwent slight capital shallowing.

I Furniture and other manufacturing

Highlights

From 1978–2008:

- Output growth in the furniture and other manufacturing industry rose 0.5 percent per year. This growth was driven by capital input, which contributed 0.4 percent annually.
- Labour productivity rose 0.2 percent annually.
- MFP declined by 0.1 percent annually.

Introduction

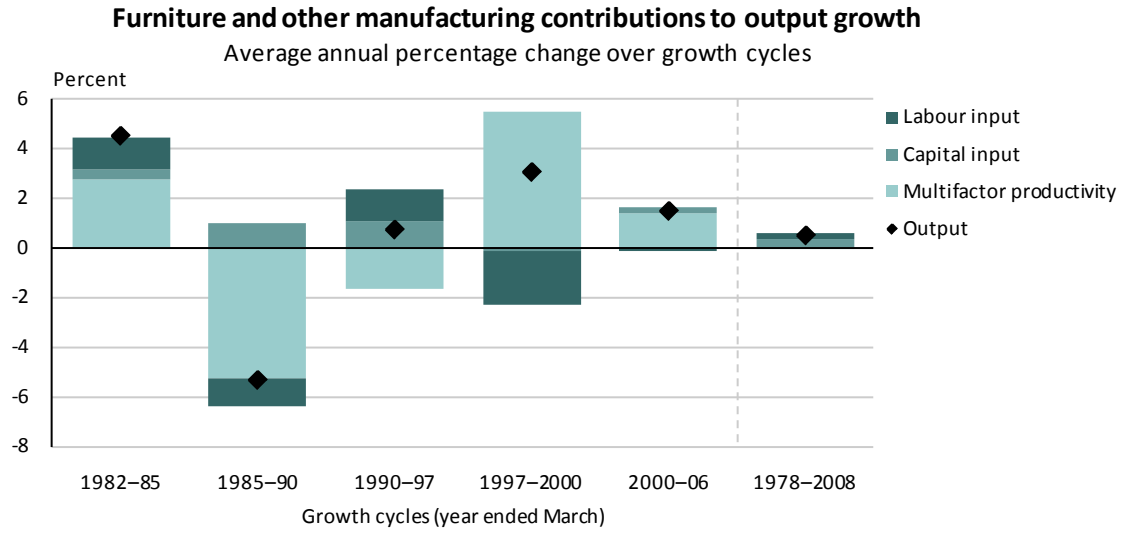
In 2007, furniture and other manufacturing made up 3.4 percent of the manufacturing industry in terms of GDP, making it the second smallest manufacturing sub-industry, slightly ahead of textile and apparel manufacturing. Across the series, the industry had a relatively constant share of the manufacturing industry, between 3 and 4 percent.

Furniture and other manufacturing include a wide range of activities that fall out of the scope of other sub-industries. Included are the manufacturing of prefabricated buildings; furniture; jewellery and silverware; toys and sporting goods; and other personal goods.

Contributions to output growth

The greatest contribution to output growth came from capital input followed by labour input, contributing 0.4 percent and 0.2 percent per year, respectively (see figure 8.17).

Figure 8.17



Source: Statistics New Zealand

The furniture and other manufacturing industry's output increased at a rate of 0.5 percent across the series. Output growth was strongest in the 1982–85 cycle, but was fairly volatile across the series.

The drivers of output growth fluctuated throughout the cycles, with capital input contributing positively in four of the five cycles. The contribution of capital input was at its strongest in the 1990–97 cycle, contributing 1.0 percent per year.

Labour input's contribution to output growth was strong in both the 1982–85 and 1990–97 cycles, contributing 1.3 percent per year each in both cycles. However, it contributed negatively over the other three cycles.

MFP declined slightly over the series, decreasing at a rate of 0.1 percent per annum. Growth in MFP was particularly strong in the 1997–2000 cycle, increasing at 5.4 percent per year. However, this was offset by a strong decline in the 1985–90 cycle, at 5.2 percent annually.

Productivity

Labour productivity showed the weakest average annual increase of any manufacturing industry, with 0.2 percent shown across the series. However, it was particularly strong in the 1997–2000 cycle, averaging 5.9 percent annually (see table 8.9).

Table 8.9

Furniture and other manufacturing productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	2.5	3.4	2.8
1985–1990	-3.9	-8.7	-5.2
1990–1997	-1.0	-3.7	-1.6
1997–2000	5.9	3.7	5.4
2000–2006	1.8	0.7	1.4
1978–2008	**0.2**	**-0.9**	**-0.1**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Capital productivity declined at a rate of 0.9 percent annually across the series. It was particularly strong in the 1982–85 and 1997–2000 cycles, averaging 3.4 percent and 3.7 percent per year, respectively.

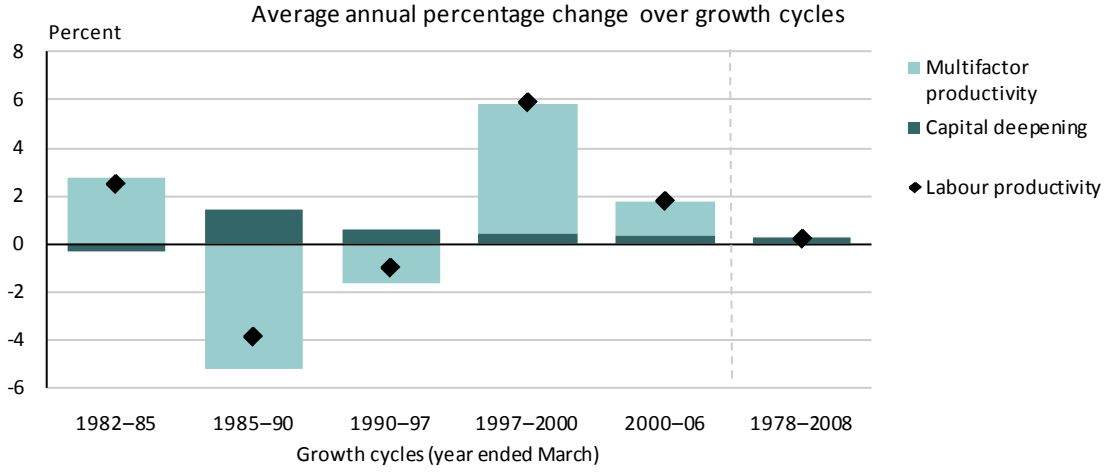
Contributions to labour productivity

Across the series, most of the growth in labour productivity was due to capital deepening (see figure 8.18). The average contribution from capital deepening was 0.3 percent, while MFP growth contributed negatively to labour productivity growth, declining at an average of 0.1 percent annually.

Figure 8.18

Furniture and other manufacturing contributions to labour productivity growth

Average annual percentage change over growth cycles



Source: Statistics New Zealand

9 Electricity, gas, and water supply

Highlights

From 1978–2008:

- Output growth in the electricity, gas, and water supply industry averaged 2.1 percent per year. Capital input was the major driver of this growth, contributing 1.9 percent annually.
- The industry had the second highest annual average labour productivity growth in the measured sector, increasing at a rate of 4.4 percent per year.
- MFP growth averaged 0.7 percent per year.

Introduction

In 2007 the electricity, gas, and water supply industry contributed 2.9 percent to total GDP. This remained fairly constant over the time series, with an average contribution also of 2.9 percent, and a peak of 3.2 percent in 1987.

The industry comprises the generation, transmission, and distribution of electricity and gas, and the storage and supply of water. The electricity, gas, and water supply industry in New Zealand is dominated by electricity generation and supply services for both input and output. Electricity generation and supply accounted for 87 percent of total labour input, while gas and water supply made up the remaining 13 percent of labour input in 2008. The industry is very capital intensive, with capital weighted heavily compared with labour, contributing well over 80 percent.

The industry underwent by significant reforms over the time series, including corporatisation, privatisation, and the division of electricity utilities. Historically, the government controlled most of New Zealand's electricity generation. The enactment of the State-Owned Enterprise Act in December 1986 marked the start of major reforms in the electricity sector. These reforms began with the deregulation of the generation and wholesaling parts of the electricity industry as the government acted to remove legislative and regulatory barriers to competition in 1987. This culminated in the formation of the Electricity Corporation of New Zealand (ECNZ) as a state-owned enterprise (SOE) (Spicer, Bowman, Emanuel, & Hunt, 1991). ECNZ was soon followed by the formation of Transpower as a subsidiary to run the electricity transmission network in New Zealand. Transpower progressed to becoming a separate SOE by 1994.

The first new entrant in the electricity industry came in 1996 with the formation of Contact Energy as an SOE. The Electricity Industry Reform Act passed in 1998 required ownership of line companies to be separated from generation and retail businesses (Electricity Group, Energy and Communications Branch, 2008). This resulted in the split up of ECNZ into three competing SOEs – Mighty River Power, Genesis, and Meridian Energy. Contact Energy was also sold by the government in 1999. Following the ownership split in 1999, the majority of energy companies retained their distribution businesses and sold their retail customer base. The number of retailers operating in the market reduced from around 40 to 11 by May 2000. The split also resulted in a sizable overnight reduction in wholesale electricity prices (Ministry of Economic Development, 2000).

Due to the nature of electricity generation in New Zealand, where approximately 65 percent is produced from renewable sources (the majority hydroelectrically), the output of the industry can be susceptible to drought (Electricity Group et al, 2008). The Electricity Commission was set up in September 2003 to regulate the electricity industry. It was also established to take over governance of the electricity industry, and make significant changes to the electricity sector to ensure long-term electricity supply security and to curb extreme price volatility in drought years (Electricity Group et al, 2008).

In recent years there has been an increasing amount of sustainable electricity generation from geothermal and wind-powered alternatives, to go with the already prominent hydroelectric power stations.

As electricity cannot be stored on a large-scale basis, supply and demand in the industry are determined on a moment-by-moment basis. This is very different from other industries where inventories of output can be accumulated (Dupuy, 2006). At any one time, both the utilisation of capital and the demand for output can fluctuate widely due to the volatility of consumer demand and the uncertainty of supply due to weather conditions. Capital productivity will not reflect these fluctuations in capacity utilisation, which will instead be reflected in the MFP residual.

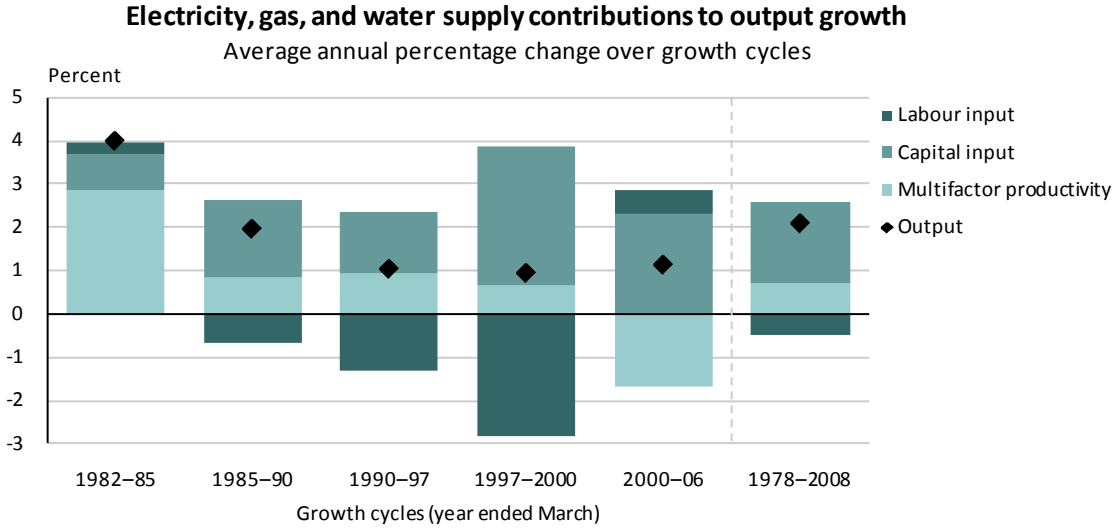
Contributions to output growth

Across the series, the greatest contribution to output growth came from capital input, followed by MFP, contributing 1.9 and 0.7 percent per year, respectively (see figure 9.1).

Output for the electricity, gas, and water supply industry increased at a rate of 2.1 percent a year from 1978–2008. The strongest period of growth in output occurred in the first complete cycle from 1982–85, increasing at a rate of 4.0 percent per year.

Output growth decelerated through the late 1980s and 1990s, declining to a rate of 1.1 percent per year in the last cycle (2000–06). Labour input declined steadily from 1987 to 2000, driving output growth down through this period of restructuring. The Household Labour Force Survey (HLFS) showed that job counts in the industry declined at an average of 13.9 percent annually from 1997–2000, which is reflected in the decrease in labour input. The industry's restructure resulted in a large-scale shift of electricity generators and retailers from government sector ownership into the private market.

Figure 9.1



Source: Statistics New Zealand

Labour input contributed positively to output in 1982–85 and 2000–06. The only cycle where MFP contributed negatively to output was 2000–06. Capital input consistently contributed positively to output growth across all cycles.

Productivity

Labour productivity in the electricity, gas, and water supply industry grew at a high rate compared with the measured sector average over the time series, increasing at a rate of 4.4 percent per year (see figure 9.2). This growth in labour productivity was second only to that of communication services. Labour productivity grew in all of the cycles except from 2000–06, with the strongest periods of growth from 1990–97 and 1997–2000.

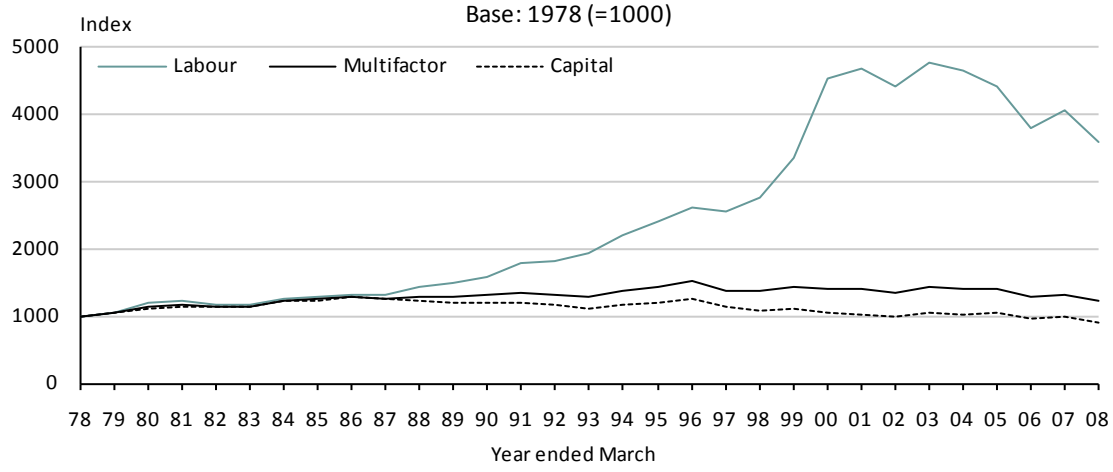
As the industry is highly capital intensive, MFP growth over the total time series tracks capital productivity much more closely than labour productivity, increasing at an annual average rate of 0.7 percent from 1978–2008. Strong periods of growth in MFP coincided with periods where capital productivity accelerated.

Figure 9.2

Electricity, gas, and water supply productivity indexes

Year ended March, 1978–2008

Base: 1978 (=1000)



Source: Statistics New Zealand

Capital productivity declined slightly over the time series, decreasing at an annual average rate of 0.3 percent from 1978–2008. Following a strong period of growth in the first part of the series, capital productivity decreased across cycles for the remainder of the series.

Table 9.1

Electricity, gas, and water supply productivity

Average annual growth rates[1]

Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	3.1	2.8	2.9
1985–1990	4.3	-0.6	0.8
1990–1997	7.0	-0.8	0.9
1997–2000	21.0	-2.8	0.7
2000–2006	-3.0	-1.5	-1.7
1978–2008	**4.4**	**-0.3**	**0.7**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

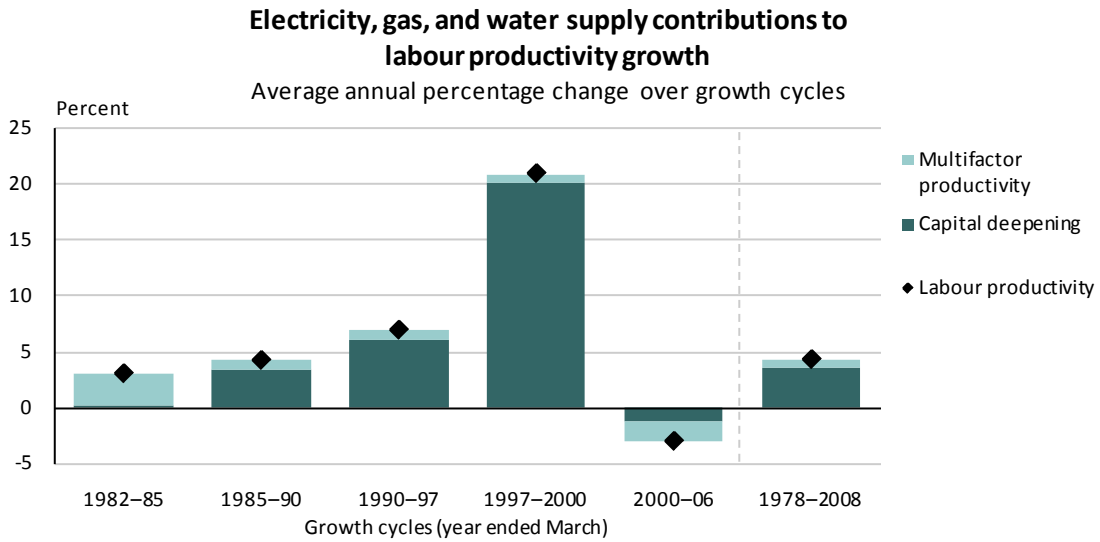
Source: Statistics New Zealand

Contributions to labour productivity growth

The electricity, gas, and water supply industry has historically been very capital intensive, with the contribution of capital to total income increasing from 67 percent to 86 percent from 1978 to 2008.

This is evident in its contributions to growth in labour productivity of 4.4 percent per year over the total time series, with capital deepening contributing 3.6 percent annually from 1978–2008, compared with MFP's contribution of only 0.7 percent per year (see figure 9.3).

Figure 9.3



Source: Statistics New Zealand

Capital deepening's contribution to labour productivity growth is evident across most of the series. From the late 1980s to the 1990s, it contributed strongly to labour productivity growth. Labour productivity growth was positive for all cycles except from 2000–06. This decline was driven by a negative contribution from MFP, and to a lesser extent capital shallowing. From 2000 capital shallowing was due to labour input increasing at a higher rate than capital input.

The construction of infrastructure such as dams, waterways, pipelines, and power lines dominated capital investment in the industry, rising steadily greater than 60 percent of total productive capital stock by the end of the series.

10 Construction

Highlights

From 1978–2008:

- Output growth in the construction industry averaged 1.7 percent per year, with both labour and capital input driving this growth, contributing 0.9 percent and 0.8 percent per year, respectively.
- Labour productivity growth was the second lowest of all measured sector industries, rising at 0.5 percent per year.
- MFP growth was negligible.

Introduction

In 2007 the construction industry contributed 5.7 percent to total GDP. This fluctuated from a peak of 6.0 percent in 1978 to a low of 3.6 percent in 1993. Over the series, the industry's contribution to GDP averaged 4.9 percent. It is very labour intensive and is one of the largest employing industries.

The construction industry in New Zealand is made up of two major sub-industries, general construction and construction trade services. General construction includes both building and non-building construction, and incorporates the construction of roads and bridges. Construction trade services are dominated by trades people such as plumbers and electricians. Construction trade services make up the bulk of the industry's labour input, contributing over half of its employees (Statistics New Zealand, 2010b).

The construction industry is influenced by many external factors. In New Zealand for example, there has traditionally been a close relationship between international migrant flows and the housing market. Waves of positive net migration tend to be associated with increasing real house prices and rising construction activity; conversely, waves of net emigration have been associated with declining real house prices and falling construction activity (Coleman & Landon-Lane, 2007).

There was increased construction activity from the 'Think Big' projects implemented by the government during the late 1970s and early 1980s, which involved strong investment in several large-scale industrial projects. In the late 1980s, there was also an increasing demand for commercial buildings driven by the deregulation of the financial sector, along with government restructuring and corporatisation increasing the demand for office buildings. There was a decrease in building activity in the recessionary period in the early 1990s (Statistics New Zealand, 2010a).

Contributions to output growth

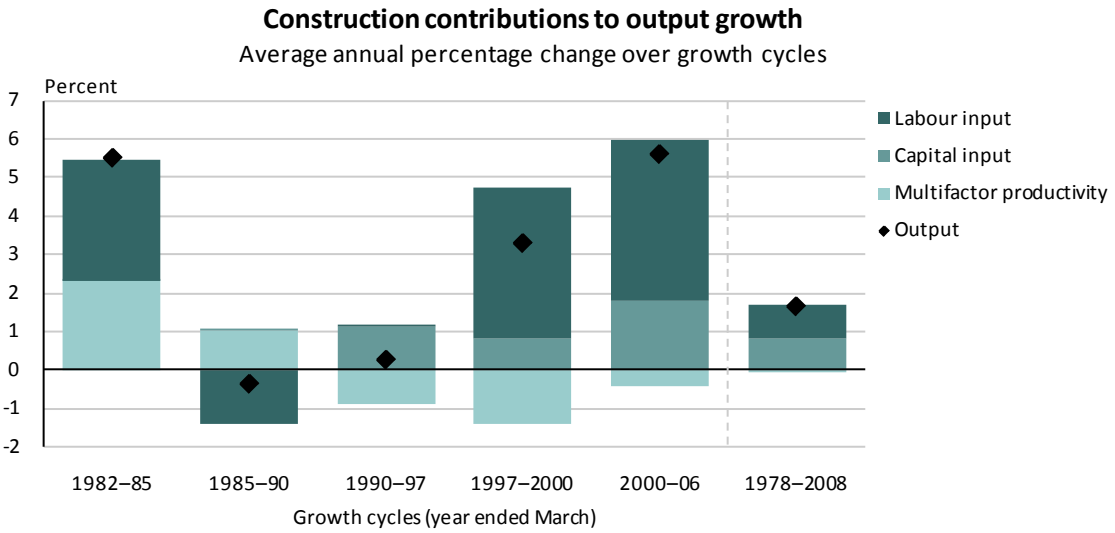
Across the series, both labour and capital input had a relatively equal contribution to output growth, contributing 0.9 percent and 0.8 percent per year, respectively (see figure 10.1). MFP has had a minimal contribution to output over the total time series.

Output growth fluctuated throughout the series, with strong growth from 1982–85, driven by labour input and MFP, followed by two cycles of negative or minimal growth. There is an evident

turnaround in the contribution of MFP to output growth through this middle period, with the last three cycles showing negative contributions. The 1997–2000 cycle marks the start of strong gains in output, with growth of 3.3 percent per year, driven by a 3.9 percent annual contribution from labour input.

The strongest period of output growth in the construction industry was from 2000–06, at a rate of 5.6 percent per year. This was largely driven by a high annual contribution of 4.2 percent from labour input, and to a lesser extent, of 1.8 percent from capital input. Output in the construction industry rose at an annual average of 1.7 percent over the total time series.

Figure 10.1



Source: Statistics New Zealand

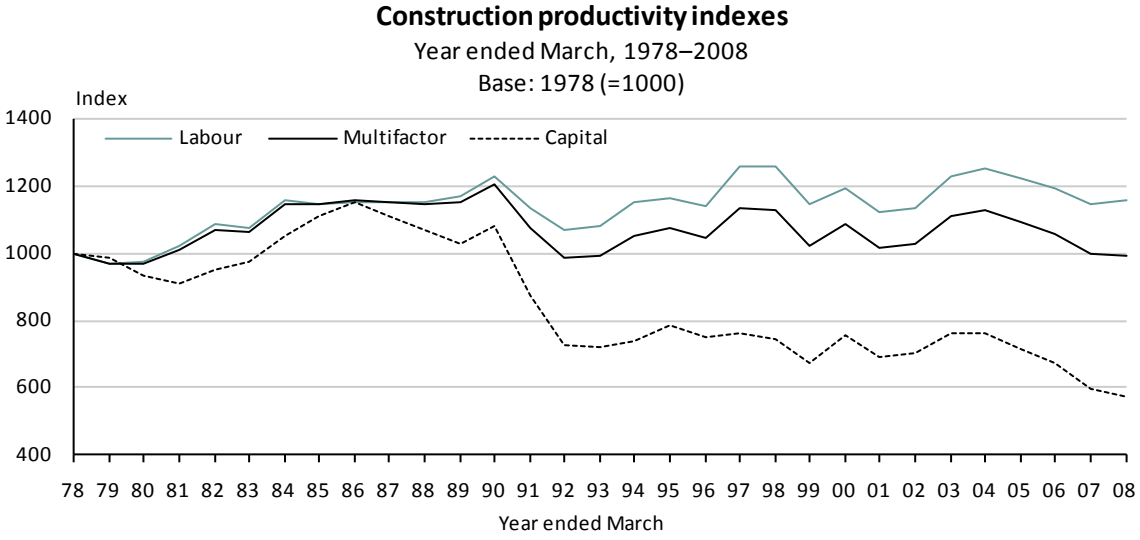
Productivity

Labour productivity rose at an annual average rate of 0.5 percent from 1978 to 2008 (see figure 10.2). This is the second lowest 30-year growth rate for measured sector industries. Labour productivity and MFP showed similar growth patterns over the series, especially before 1990.

The strongest period of growth for all productivity measures was from 1982–90. There was a surge in output through this period, with increasing commercial and industrial construction during this time. After this period, a large drop-off in all productivity indexes followed, corresponding with a decrease in building consents issued (Statistics New Zealand, nd).

MFP growth was negligible from 1978–2008. Because the industry is highly labour intensive, the trends in MFP growth follow growth in labour productivity quite closely.

Figure 10.2



Source: Statistics New Zealand

Capital productivity fell at an annual rate of 1.9 percent over the time series (see table 10.1). The only cycle with positive growth in capital productivity was between 1982 and 1985, at a rate of 5.3 percent. This increase was driven by slow growth in capital input and strong growth in output.

Table 10.1

Construction productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	1.7	5.3	2.3
1985–1990	1.4	-0.5	1.0
1990–1997	0.3	-4.8	-0.9
1997–2000	-1.7	-0.4	-1.4
2000–2006	0.0	-1.8	-0.4
1978–2008	**0.5**	**-1.9**	**0.0**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

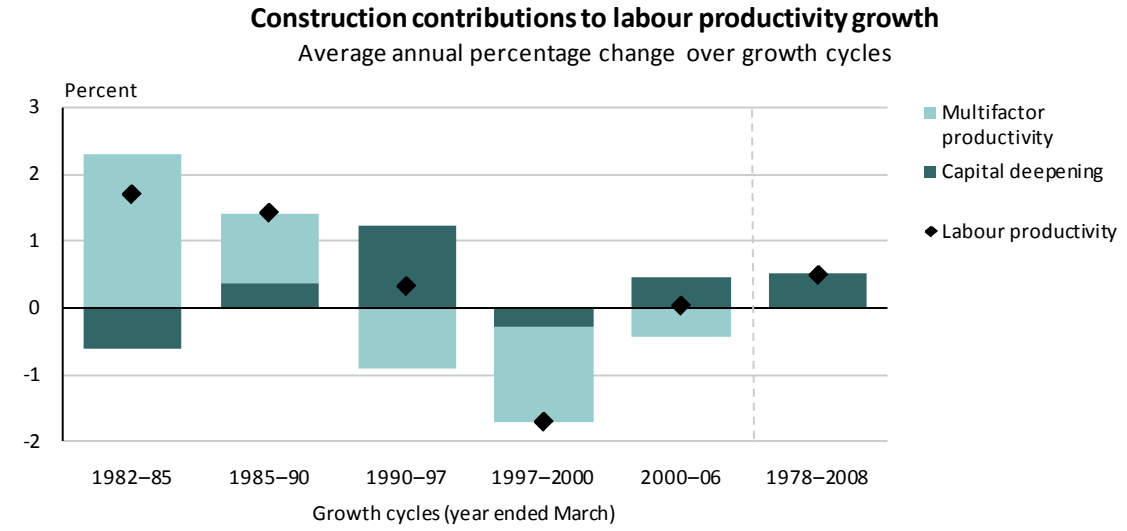
Contributions to labour productivity growth

The construction industry in New Zealand is highly labour intensive, with capital income contributing only around 20 percent to total income in 2008. Capital investment is made largely on plant, machinery, and equipment, which includes assets such as trucks, utility vehicles, and trailers. Over the total time series from 1978–2008, capital deepening was the main contributor to labour productivity growth, providing 0.5 percent a year to growth in labour productivity. MFP averaged out to have no growth from 1978–2008.

Labour productivity growth of 1.7 percent and 1.4 percent per year, respectively, for the first two cycles was largely driven by MFP growth, with contributions of 2.3 percent and 1.0 percent, respectively (see figure 10.3). Labour productivity growth dropped off significantly for the remaining cycles, mainly due to falls in MFP. The cycle from 1990–97 marked the strongest contribution of capital deepening to labour productivity growth, with an increase of 1.2 percent per year. This rise was driven by an increase of 5.4 percent annually in capital investment throughout this cycle.

Labour productivity growth recovered slightly in the 2000–06 cycle. Here, capital deepening grew at a rate of 0.5 percent per year – there was a strong increase in labour input, but an even stronger increase in capital input. MFP declined 0.4 percent per year for this period.

Figure 10.3



Source: Statistics New Zealand

11 Wholesale trade

Highlights

From 1978–2008:

- Output growth in the wholesale trade industry averaged 1.7 percent per year. Capital input was the main driver of this growth, contributing 0.9 percent annually.
- Labour productivity growth was moderate, rising at an average annual rate of 0.7 percent across the series.
- MFP growth was weak across the series, rising at an annual average rate of 0.2 percent per year.

Introduction

The wholesale trade industry is the third largest industry in the New Zealand economy in terms of GDP. Its contribution to total economy GDP was 10.5 percent in 1978 and 7.1 percent in 2007.

The term 'wholesale trade' includes the resale of new or used goods to businesses and/or institutional (including government) users. The industry therefore acts as an intermediary between primary producers, manufacturers, and secondary processors (suppliers) and consumers, for both importers and exporters. It consists of the wholesaling of unprocessed primary products; petroleum products; builders' supplies; machinery and equipment; motor vehicles; food, drink, and tobacco; and personal and household goods. In 2008, machinery and equipment wholesaling was the largest in terms of employment, closely followed by personal and other household goods wholesaling.

In the year to March 2008, the food, drink, and tobacco wholesaling was the largest sub-industry in terms of operating income (which is income from total sales (see figure 11.1)). This was followed by machinery and equipment wholesaling, and personal and household goods wholesaling (Statistics New Zealand, 2010).

The output of the wholesale trade industry is influenced by industry-specific supply and demand factors. However, it is an intermediary industry, so the retail trade and construction industries are heavily reliant on its output for inputs into their own production. This means that wholesale trade can be influenced by factors affecting 'downstream' industries.

Figure 11.1

Source: Statistics New Zealand

Positive demand-side factors for wholesale trade include improved general economic conditions, favourable terms of trade, and growth in consumers' purchasing power. Supply is also dependent on economic activity and terms of trade. Terms of trade were affected by reforms in the mid-1980s. In December 1984, all controls on both outward and inward foreign exchange transactions were removed which allowed wholesalers to freely import and export. The cessation of import licensing in July 1988 facilitated more direct importing. From June 1984–89, the terms of trade increased by 18.3 percent, implying a drop in the price of imports relative to exports to and from New Zealand (Statistics New Zealand, 2009). In March 1985, the New Zealand dollar was floated for the first time. The diverse nature of the wholesale trade industry, however, means that market forces may not impact on all parts of the industry equally. As such, it is difficult to pinpoint specific events that have led to movements in productivity.

Contributions to output growth

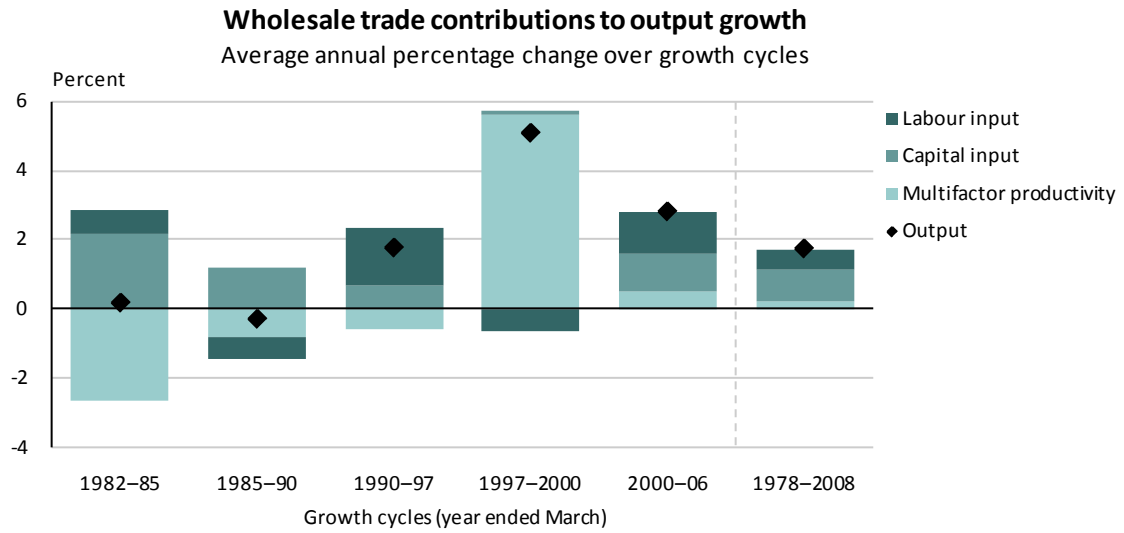
Across the series, the greatest contribution to output growth came from capital input, followed by labour input (see figure 11.2). The average contributions of capital and labour inputs to output growth were 0.9 percent and 0.6 percent per year, respectively.

Output for the wholesale trade industry increased steadily across the series at an annual average growth rate of 1.7 percent.

Output growth during the 1982–85 cycle reached only 0.2 percent per year as a decline in MFP of 2.6 percent annually offset the contributions of labour and capital input. The decline in MFP continued until the late 1980s, coupled with a declining contribution from labour input, led to a fall in overall output growth between 1985 and 1990.

Since 1990, output growth has been positive in all cycles. Strong output growth of 5.1 percent per year between 1997 and 2000 was mainly due to MFP (which contributed 5.6 percent). Capital input continued to make positive contributions to output growth through the 1990s.

Figure 11.2



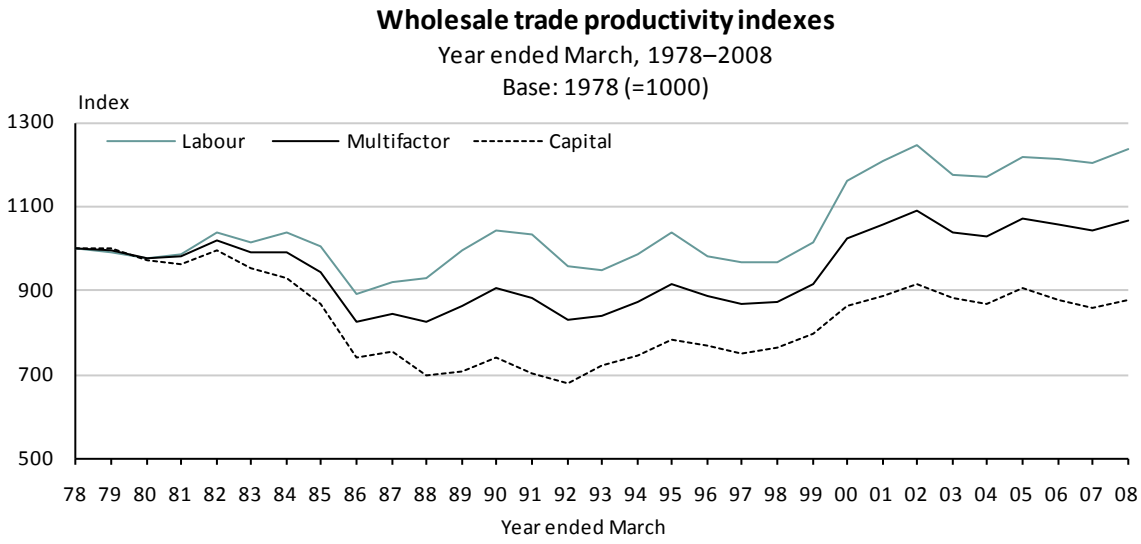
Source: Statistics New Zealand

Labour input, capital input, and MFP all contributed positively to output growth during the 2000–06 cycle. Labour input provided the greatest average contribution (1.2 percent), followed closely by capital input (1.1 percent).

Productivity

Labour productivity in the wholesale trade industry fluctuated across the series, and it grew at a rate of 0.7 percent per year (see figure 11.3). Productivity from 2002 onwards was almost flat.

Figure 11.3



Source: Statistics New Zealand

While productivity growth in all three measures diverged during the mid 1980s, the indexes followed a similar cyclical pattern across the series. Average growth rates in all three productivity indexes were greatest during the 1997–2000 cycle (see table 11.1).

Table 11.1

Wholesale trade productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	-1.1	-4.4	-2.6
1985–1990	0.8	-3.2	-0.8
1990–1997	-1.0	0.2	-0.6
1997–2000	6.2	4.8	5.6
2000–2006	0.7	0.2	0.5
1978–2008	**0.7**	**-0.4**	**0.2**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

MFP's average contribution to labour productivity between 1978 and 2008 was 0.2 percent, while capital deepening contributed an average of 0.5 percent annually (see figure 11.4). The contributions of capital deepening reflected the industry's increased investment in information technology.

Capital deepening's contribution was positive in all cycles except 1990–97. MFP had a negative effect on labour productivity between 1982 and 1997, but provided positive contributions after that. The annual contribution of MFP varied notably across the series, ranging from 5.6 percent in the 1997–2000 cycle to -2.6 percent from 1982–85.

Figure 11.4

Source: Statistics New Zealand

12 Retail trade

Highlights

From 1978–2008:

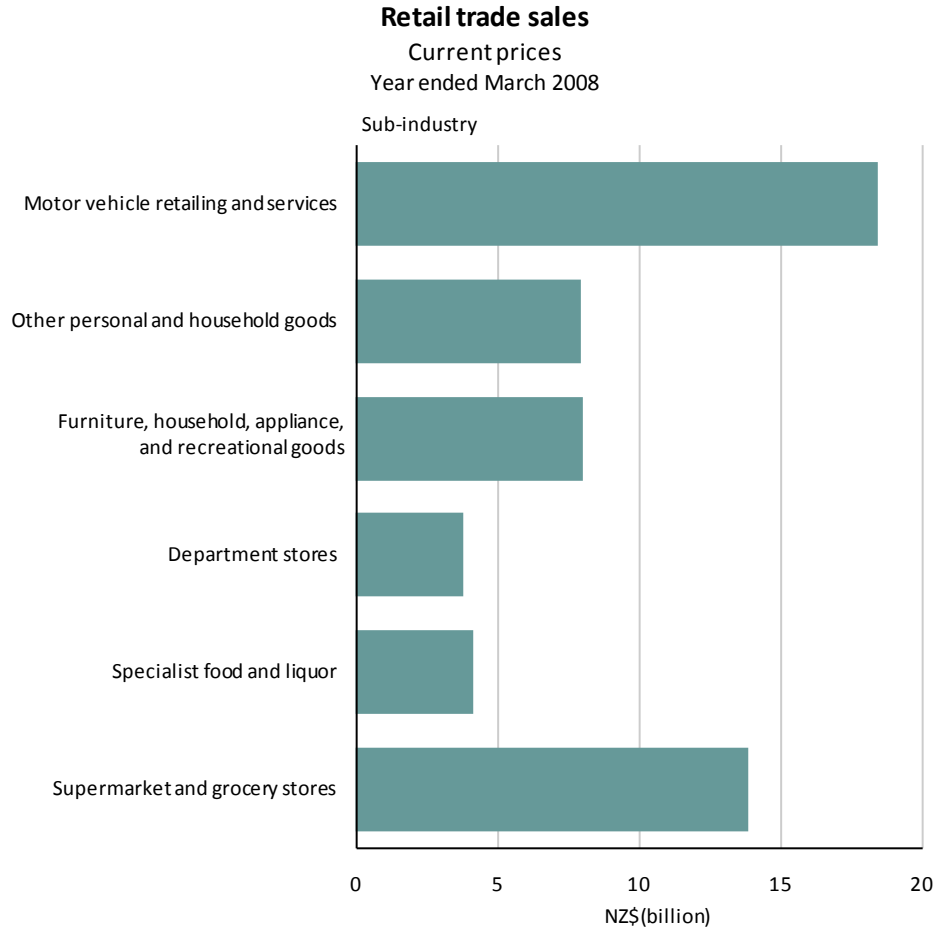
- Output growth in the retail trade industry averaged 2.2 percent per year with capital input the main driver of this growth, contributing 1.0 percent annually.
- Labour productivity grew at 1.0 percent per annum in the retail trade industry. Labour productivity growth increased moderately but steadily since 1987.
- Multifactor productivity followed a similar pattern to labour productivity across the series, but its growth was weaker at 0.3 percent per annum

Introduction

Retail trade contributed 7.1 percent to total economy GDP in 1978 and 6.2 percent in 2007.

The retail trade industry consists of supermarket and grocery stores, department stores, and the retailing of specialised food; furniture, houseware, appliance, and recreational goods; other personal and household goods; and motor vehicles. Of these, the motor vehicle retailing sub-industry is the largest in terms of hours paid, accounting for 30 percent in 1978, but dropping to 24 percent by 2008. However, employee counts are greatest for other personal and household goods retailing due to its higher share of part-time staff. In 2008, sales were greatest in motor vehicle retailing, followed by supermarkets and grocery stores (see figure 12.1). Department stores were the smallest by sales revenue in this year (Statistics New Zealand, 2010b).

Figure 12.1



Source: Statistics New Zealand

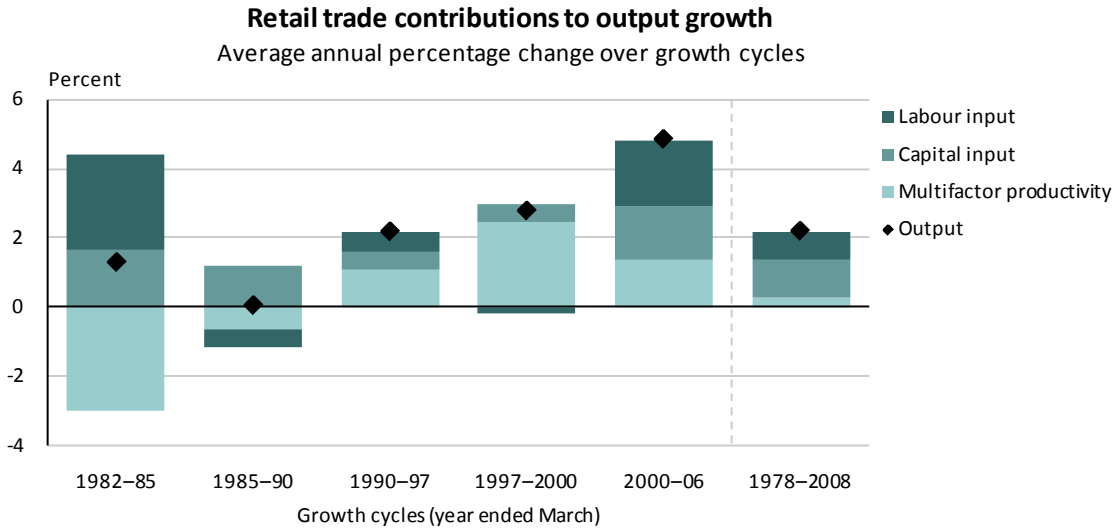
The retail trade industry has been characterised by the introduction of online retailing, and the growth of large department stores and shopping malls in recent years.

Legislative changes during the period allowed retailers to trade for a greater number of hours during the week. Trading on Saturdays was reintroduced in 1980, after it was ceased in 1945. Since 1990, both Sunday trading and the ability to be open 24 hours for seven days a week has been possible. After these changes, most shops were only required to close for three-and-a-half days during the year (Walrond, 2010). This has allowed for increased use of capital in the industry; however, the productivity measurement framework assumes constant capacity utilisation of capital, for example retail premises, over time. Variations in capacity utilisation are not reflected in capital productivity but instead in the MFP residual.

Contributions to output growth

Across the series, the greatest contribution to output growth came from capital inputs, followed by labour input (see figure 12.2). The average contributions of labour and capital inputs to output growth were 0.8 percent and 1.0 percent per year respectively. MFP contributed an average of 0.3 percent annually.

Figure 12.2



Source: Statistics New Zealand

After a flat period in the 1980s, output growth accelerated during the 1990–97 cycle. In fact, the upswing in output began in 1993 as the economy recovered from the recession that occurred in the first half of 1991. The full-time unemployment rate decreased from its peak of 11.3 percent in 1992 and employment began to grow (Statistics New Zealand, 2010a). This output growth was largely due to the contribution of MFP growth, which turned from being significantly negative in the 1980s, to significantly positive from 1990 onwards.

From 1982–85, output growth averaged 1.3 percent per year. The contributions of both labour input and capital input were at their strongest over this cycle, averaging 2.7 percent and 1.7 percent, respectively. The contribution of labour input was due to growth in hours paid in furniture, houseware, appliance, and recreational goods retailing, which rose at 5.1 percent per year. However, MFP reduced sharply by 3.0 percent on an annual basis.

Output growth was at its lowest in the 1985–90 cycle, averaging just 0.1 percent per year. Capital input contributed positively, but there was a small amount of labour shedding that also affected other industries. The contribution from MFP was again negative.

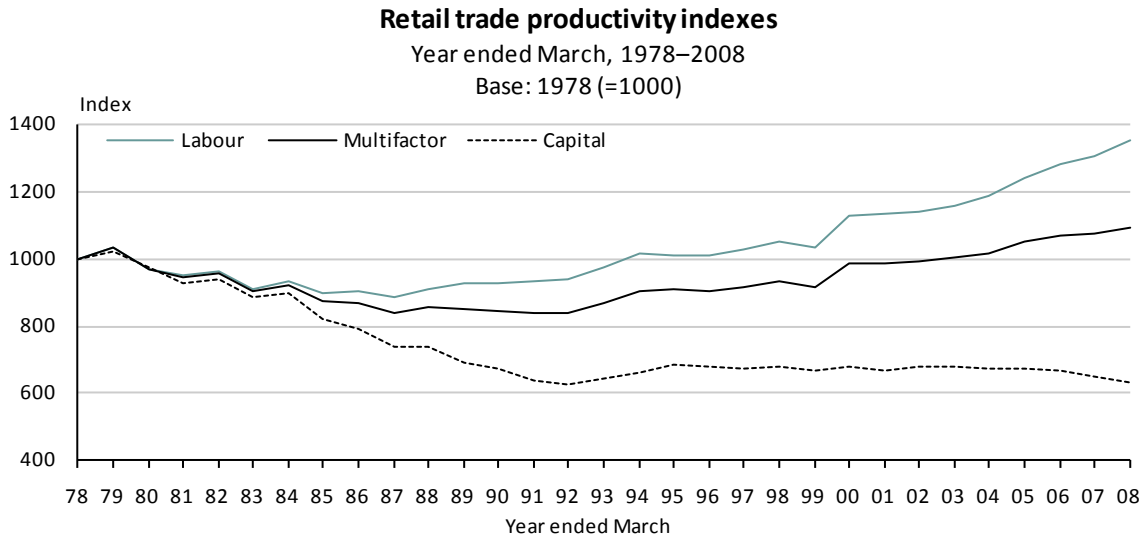
Throughout the 1990s, output growth was driven by a strong contribution from MFP, particularly in the 1997–2000 cycle, where it averaged 2.5 percent annually. Capital input grew, but contributed less than in other decades. Averaged over the entire decade, labour input contributed positively, but its growth was relatively slow compared with capital input and MFP.

From 2000–06, output growth was at its strongest, averaging 4.9 percent annually. The contribution from labour input grew significantly compared with previous cycles back to 1985, and there was also solid growth in capital input and MFP.

Productivity

The industry demonstrated below-average labour productivity growth of 1.0 percent per year over the series (see figure 12.3).

Figure 12.3



Source: Statistics New Zealand

There was a uniform decline in all three indexes until 1984, after which labour productivity and MFP growth diverged from that of capital productivity. MFP followed a similar pattern to labour productivity across the series, which is attributable to the retail trade industry being heavily labour intensive. In the most recent cycle, the divergence in labour productivity and MFP growth rates was at its largest, and this divergence continued until 2008.

Growth in all three productivity measures was greatest during the 1997–2000 cycle, the only period where all three indexes were positive (see table 12.1).

Table 12.1

Retail trade productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	-2.4	-4.2	-3.0
1985–1990	0.7	-3.9	-0.6
1990–1997	1.5	-0.1	1.1
1997–2000	3.1	0.4	2.5
2000–2006	2.1	-0.3	1.4
1978–2008	**1.0**	**-1.5**	**0.3**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

Labour productivity accelerated from the beginning of the series until the 1997–2000 cycle, from a decline of 2.4 percent annually in the 1982–85 period, to a rise of 3.1 percent annually in the 1997–2000 period (see figure 12.4).

Figure 12.4

Source: Statistics New Zealand

Across the entire 1978–2008 series, most of the growth in labour productivity was due to capital deepening. The average contribution from capital deepening was 0.7 percent, while MFP growth contributed an average of 0.3 percent annually. However, the dominance of capital deepening relative to MFP was driven by the 1982–90 period. From 1982–85, the retail trade industry

underwent a small amount of capital deepening, but MFP reduced sharply by 3.0 percent annually. In the second half of the 1980s, MFP continued to decline, albeit at a slower rate.

From 1990, MFP was the dominant contributor to labour productivity growth. Over the 1997–2006 period, MFP averaged 1.7 percent annually, while capital deepening contributed 0.7 percent. From 2003 on, investment in electrical equipment machinery and information technology assets rose significantly, highlighting the increasing importance of technology within the industry.

13 Accommodation, cafés, and restaurants

Highlights

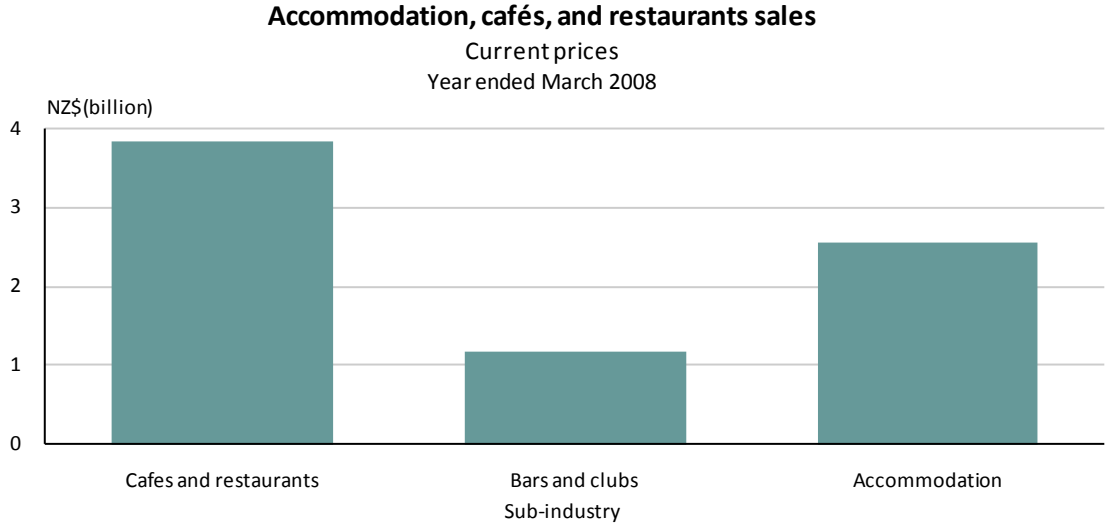
From 1978–2008:

- Output in the accommodation, cafés, and restaurants industry rose 1.8 percent per year. Labour input was the main driver of this growth, contributing 2.4 percent annually.
- This industry showed the largest decrease in the measured sector for labour, capital, and multifactor productivity.
- This is the only industry where labour productivity declined from 1978, decreasing at a rate of 1.3 percent per year.
- MFP decreased at a rate of 1.5 percent.

Introduction

The accommodation, cafés, and restaurants industry includes firms mainly engaged in providing hospitality services in the form of accommodation, meals, and drinks. In 2007, the accommodation, cafés, and restaurants industry contributed 2.0 percent to total GDP. Its contribution to GDP ranged between 1.5 percent and 2.0 percent from 1978–2007. The cafés and restaurants sub-industry dominated the industry in terms of labour input (Statistics New Zealand, 2010c) and was also the highest sales performer in this industry in 2008 (Statistics New Zealand, 2010d, see figure 13.1).

Figure 13.1



Source: Statistics New Zealand

The accommodation, cafés, and restaurants industry is highly labour intensive, with labour relatively heavily weighted in 2007, at 73 percent compared with capital at 27 percent. The industry is characterised by a high proportion of part-time employees, around 61 percent of total employees in 2008, down from a high of 67 percent in 2001 (Statistics New Zealand, nd). The

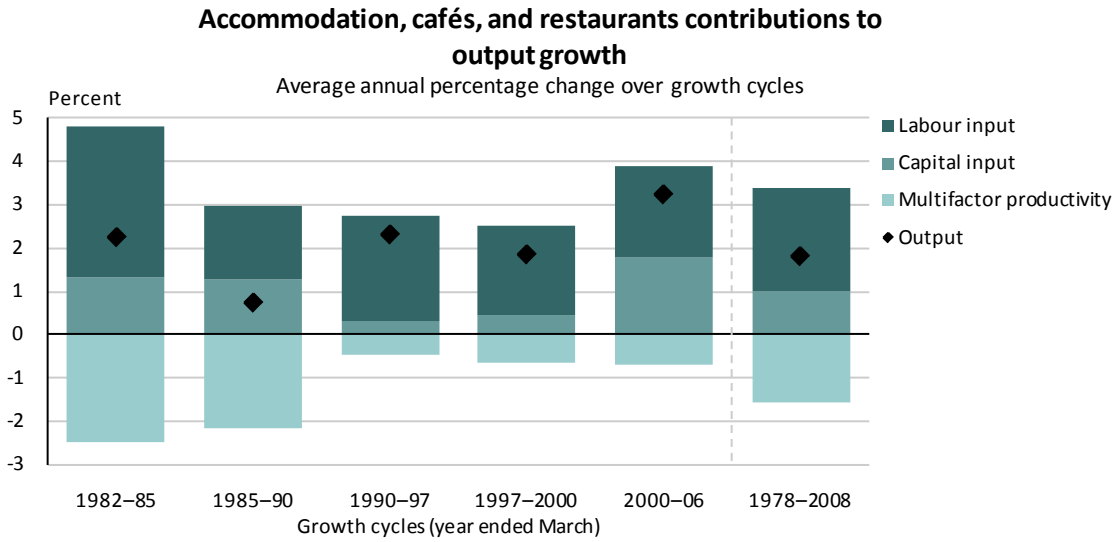
industry also has a labour force characterised by a very high turnover rate (Statistics New Zealand, 2010b).

The accommodation, cafés, and restaurants industry is highly dependent on tourism in New Zealand, and the discretionary income of local residents. Specifically, around 95 percent of the output of accommodation services, and over 40 percent of food and beverage services are consumed by tourists (Statistics New Zealand, 2009).

Contributions to output growth

The greatest contribution to output growth came from labour input, followed by capital input (see figure 13.2). The average contributions of labour and capital inputs to output growth were 2.4 percent and 1.0 percent per year, respectively.

Figure 13.2



Source: Statistics New Zealand

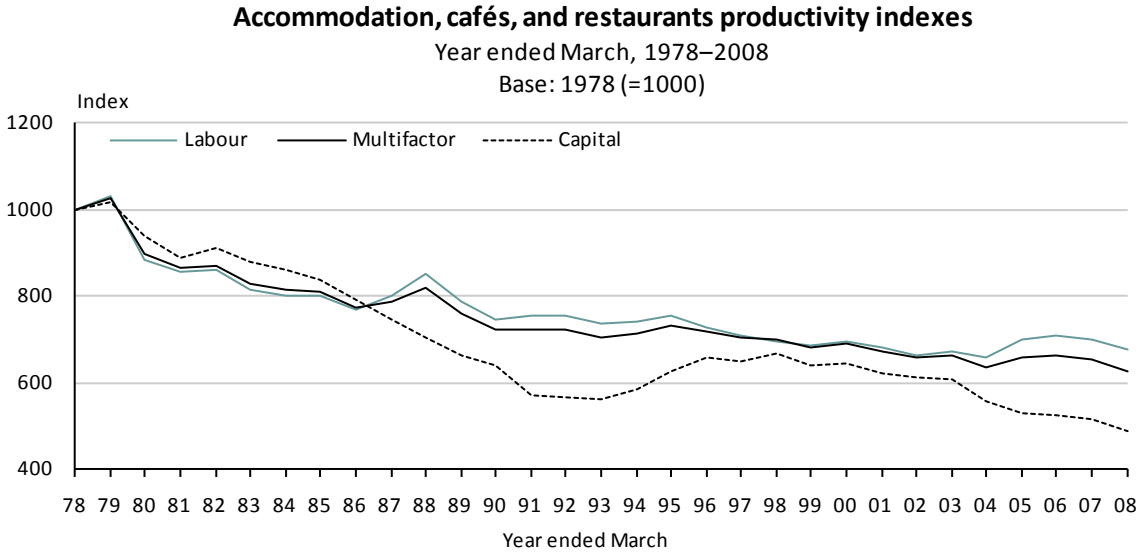
From 1978–2008, the industry's output rose at an annual average rate of 1.8 percent. The strongest growth in output occurred from 2000–2006, at an annual average of 3.2 percent. This coincided with an increase in the number of building consents issued for hotels, shops, restaurants, and taverns (Statistics New Zealand, 2010a). Both labour and capital input contributed to the output growth, at 2.1 percent and 1.8 percent per year, respectively.

A positive contribution to output from both labour and capital input for every cycle is a highlight of this industry. However, MFP made a negative contribution to output growth across the series.

Productivity

Labour productivity in the accommodation, cafes and restaurant industry declined by 1.3 percent annually from 1978–2008 (see figure 13.3).

Figure 13.3



Source: Statistics New Zealand

This is the lowest-performing industry in the measured sector in terms of labour productivity growth over the 30-year time series. However, the decline in labour productivity growth has lessened over the series. The only positive growth in labour productivity over a cycle occurred from 2000–06, at a rate of 0.4 percent per year (see table 13.1). This was driven by the strongest period of output growth for the entire series.

MFP also declined across the time series at an annual average rate of 1.5 percent. As this is a highly labour-intensive industry, MFP tracks similarly to labour productivity. Accommodation, cafés, and restaurants is the lowest performing industry in terms of MFP growth across the time series, with declines every cycle.

Capital productivity also declined at an annual average rate of 2.4 percent from 1978–2008, making it the lowest performing industry in the measured sector. Capital productivity can be influenced by fluctuating occupancy rates in accommodation, which implies capital is not consistently being utilised. As the underlying assumption for measuring productivity assumes constant capacity utilisation of capital, variations in occupancy are not reflected in capital productivity but instead in the MFP residual.

Low productivity growth in this industry is similar to many developed economies performances. To some degree, zero or negative productivity growth in the industry might be linked to labour-intensive production and small firm sizes. Small firms, for instance, are not able to exploit economies of scale and often lack the access to financial capital to invest into expensive or risky cost-reducing technologies (Wölfl, 2003).

Table 13.1

Accommodation, cafes, and restaurants productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	-2.3	-2.8	-2.5
1985–1990	-1.4	-5.2	-2.2
1990–1997	-0.7	0.2	-0.4
1997–2000	-0.8	-0.3	-0.6
2000–2006	0.4	-3.3	-0.7
1978–2008	**-1.3**	**-2.4**	**-1.5**

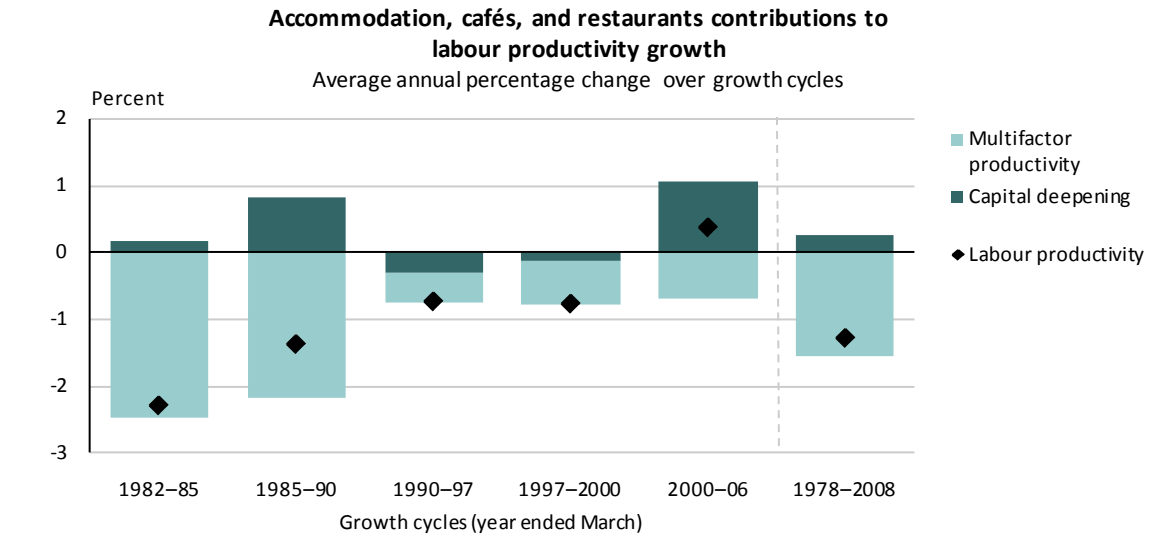
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

As discussed earlier in the chapter, labour productivity decreased in all but one cycle (see figure 13.4). The only cycle in which labour productivity grew was 2000–06. This was driven by growth in capital deepening, at 1.1 percent per year.

Figure 13.4



Source: Statistics New Zealand

Labour productivity declined 1.3 percent per year from 1978–2008. This was driven by an annual decline of 1.5 percent per year in MFP. Capital deepening slightly increased at a rate of

0.3 percent per year for the total time series. As with its contribution to output growth, MFP contributed negatively to labour productivity growth in every cycle.

14 Transport and storage

Highlights

From 1978–2008:

- Output growth in the transport and storage industry averaged 3.2 percent with MFP the main driver of this growth, contributing 3.4 percent annually. This is the third highest MFP growth rate of the measured sector industries, behind communication services and agriculture.
- Labour productivity grew strongly at 3.6 percent per year.
- Transport and storage showed the strongest capital productivity growth of all the measured sector industries, rising 3.1 percent per year.

Introduction

In 2007 the transport and storage industry contributed 4.4 percent to total GDP. This proportion fluctuated from a high of 5.5 percent in 1978 and 1979 to a low of 4.2 percent in 2002. In terms of GDP, the road and rail transport sub-industries made up a combined 44.2 percent, while services to transport contributed 35.1 percent. The remaining 20.7 percent can be attributed to water and air transport. Historically, transport and storage is a labour intensive industry, with labour accounting for 61 percent of total income in 2008.

The make-up of the transport and storage industry has changed since 1978. For example, international and domestic aviation were opened to competition from 1985 to 1987. The Airways Corporation of New Zealand was established as a state-owned enterprise (SOE) in 1987 to provide air traffic services on a user-pays basis. Air New Zealand was privatised in 1989 but subsequently re-nationalised in 2001. Regulatory barriers were loosened in 1990, where safety certification became the only barrier to market entry. All existing international airports and several regional airports were also corporatised in the early 1990s. The independent regulatory body known as the Civil Aviation Authority was created in the early 1990s to regulate safety standards and provide policy advice.

Deregulation of the road transport industry began in 1983 with the removal of road transport licensing, which enabled easier entry into the industry. With reduced barriers to entry for road freight operators, competition increased for national freight. Transit New Zealand (now known as the New Zealand Transport Agency) was established in 1989 to ensure safe and efficient land transport systems.

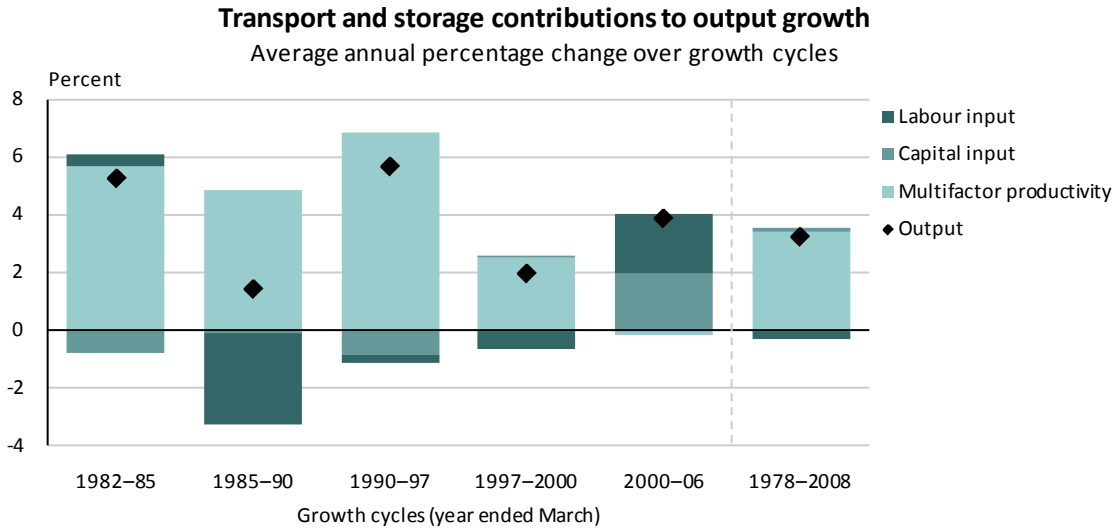
The Railways Department and the Interisland ferry service were formed into a government-owned corporation – The New Zealand Railways Corporation – in 1982. It was made an SOE in 1986 and privatised in 1994. The staff reduction programmes in the rail industry resulted in a decrease in employee numbers between 1983 and 1991, from around 20,000 to 5,000 (New Zealand Institute for the Study of Competition and Regulation Inc, 1999).

Port reforms that took place during the late 1980s provided for the corporatisation of the regional harbour boards, along with the formation of separate port companies in each port. Thirteen port companies were established in 1988 (New Zealand Institute for the Study of Competition and Regulation Inc, 1999).

Contributions to output growth

Output for the transport and storage industry rose 3.2 percent per year over the time series. The greatest contribution to output growth came from MFP, at 3.4 percent annually (see figure 14.1). The average contributions of labour and capital inputs to output growth were -0.3 percent and 0.1 percent per year, respectively.

Figure 14.1



Source: Statistics New Zealand

The strongest period of growth in output was from 1990 to 1997, increasing at 5.7 percent annually. This growth was driven by a very strong contribution from MFP, at 6.9 percent per year.

More recently, from 2000–06 both capital and labour input made significant contributions to output growth, having previously had minimal contribution. They contributed at a rate of 2.1 percent and 2.0 percent per year, respectively.

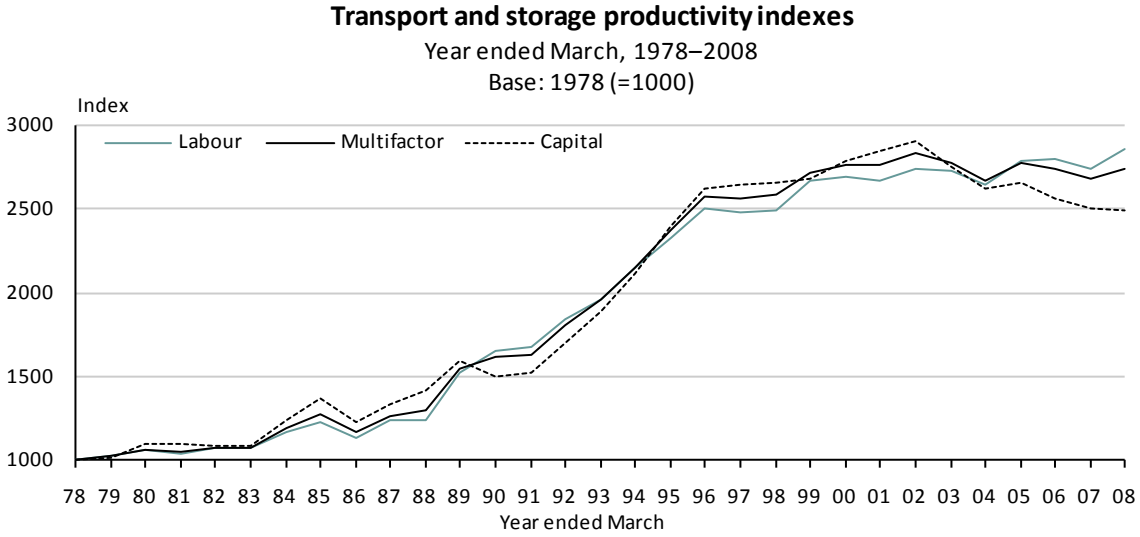
Over the 30-year time series, the industry had the third highest MFP growth rate of all measured sector industries, behind communication services and agriculture. MFP performance for the 2000–06 cycle, however, was well below the growth observed before 2000, and was the only cycle in which MFP declined.

The transport and storage industry had the second lowest rate of capital input growth over the time series for all measured sector industries, with a slight increase of 0.1 percent per year.

Productivity

The three productivity indexes track very closely, highlighting the similar patterns of growth in the capital and labour input series (see figure 14.2).

Figure 14.2



Source: Statistics New Zealand

Historically, labour productivity has grown strongly in the industry, increasing at an annual rate of 3.6 percent over the time series. It has however levelled off towards the end. Growth in labour productivity was strong in the late 1980s and early 1990s, at 6.1 percent per year from 1985 to 1990, and 5.9 percent annually from 1990 to 1997. Compared with earlier cycles, labour productivity growth was slower in 2000–06, rising at an annual rate of 0.6 percent.

There was solid growth across the time series in MFP, increasing at an annual average of 3.4 percent from 1978–2008.

The industry had the fastest capital productivity growth rate in the measured sector, at 3.1 percent per year over the 30-year series. All of the cycles before 2000 exhibited positive growth, the strongest of these occurring in the 1990–97 cycle (up 8.4 percent annually).

Table 14.1

Transport and storage productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	4.6	8.1	5.7
1985–1990	6.1	1.8	4.8
1990–1997	5.9	8.4	6.9
1997–2000	2.9	1.8	2.5
2000–2006	0.6	-1.4	-0.2
1978–2008	**3.6**	**3.1**	**3.4**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

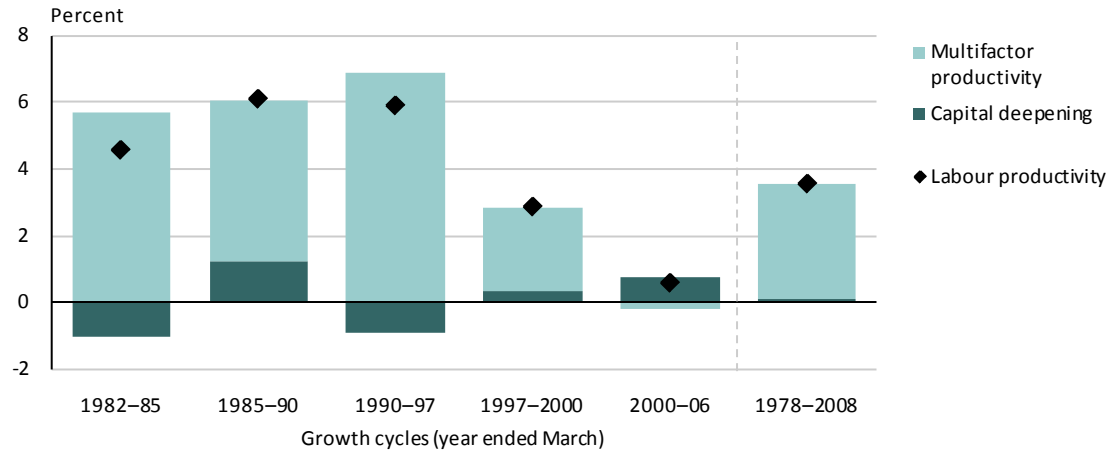
Source: Statistics New Zealand

Contributions to labour productivity growth

Labour productivity grew in all of the cycles (see figure 14.3). This was largely influenced by MFP growth before 2000 and capital deepening post-2000. From 2000, capital input grew at a faster rate than labour input, resulting in capital deepening. Labour productivity growth of 0.6 percent per year from 2000–2006 was much lower compared with previous cycles.

Figure 14.3

Transport and storage contributions to labour productivity growth
Average annual percentage change over growth cycles



Source: Statistics New Zealand

Overall, capital investment growth was fairly subdued, highlighted by the relatively low/negative contribution of capital deepening to labour productivity growth. Capital input growth was similar

to that of labour input over the series, implying a low level of capital to labour substitution in the industry. Across the 1978–2008 time series, MFP contributed 3.4 percent per year to labour productivity growth, while capital deepening contributed 0.1 percent annually.

15 Communication services

Highlights

From 1978–2008:

- Output in the communication services industry grew at a rate of 8.0 percent per year. This was driven by increases in MFP and to a lesser extent, capital input, at 5.2 percent and 3.3 percent per year, respectively.
- The industry was the highest performer in terms of labour and multifactor productivity growth in the measured sector.
- Labour productivity rose at an annual average of 9.3 percent.

Introduction

In 2007 the communication services industry contributed 3.1 percent to total GDP. This proportion peaked in 1992, at 3.8 percent, and averaged 3.2 percent to GDP from 1978–2008.

The industry comprises firms providing postal, courier, and telecommunication services. The last includes wired and mobile communication services, and Internet services, while postal and courier services include standard pick up, transport and delivery services, package and parcel delivery, and express door-to-door courier services.

The industry underwent restructuring in the late 1980s and early 1990s. Following the State-Owned Enterprise Act in December 1986, Telecom Corporation of New Zealand, New Zealand Post, and Postbank Limited were created from the New Zealand Post Office (New Zealand Post, 2010). Before 1988, the New Zealand Post Office monopolised the provision of public telecommunications. April 1989 saw the completion of the deregulation of the telecommunications market, which opened up the industry to competition. Many firms have since entered the market in New Zealand, beginning with Clear Communications in 1990, which was the first network to compete with Telecom. In 1991, Telecom was sold by the New Zealand Government (Ross & Bamber, 1998). The launch of Telecom's Internet service provider (Xtra) in 1996 (Telecom New Zealand, 2010), and the entry of telecommunications company Telstra New Zealand in the same year launched a period of technological development, with widespread Internet and cellular phone availability.

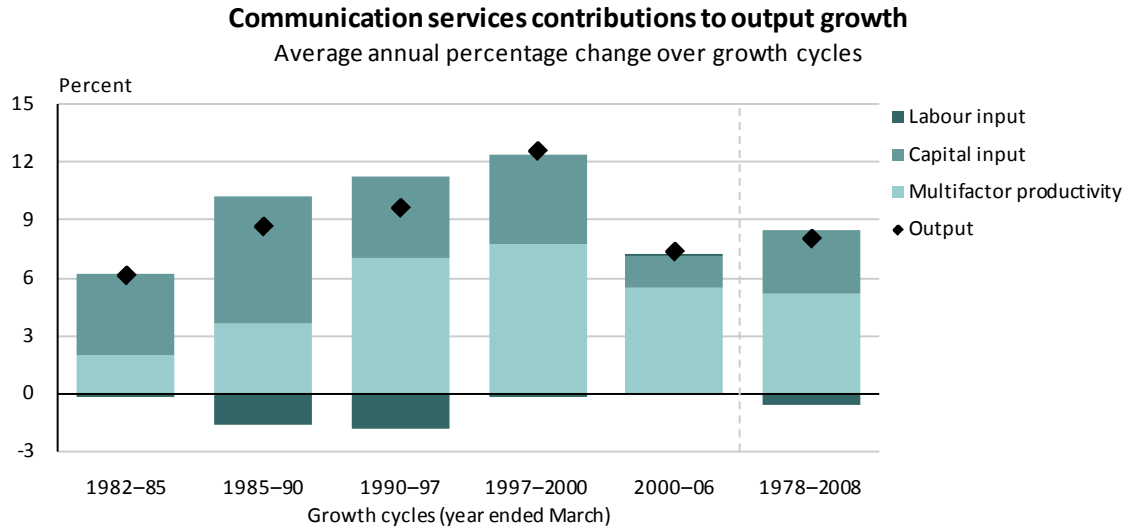
The restructure of the industry also had an impact on the postal service, with significant job losses occurring after the formation of New Zealand Post as a state-owned enterprise in 1987. The Postal Services Act 1998 completed the deregulation of postal services in New Zealand, opening it to competition for the first time in 150 years (New Zealand Post, 2010).

The communication services industry underwent significant change in the composition of both outputs and inputs over the time series. With technological development, the industry has become much more capital intensive, producing complex outputs requiring high levels of capital infrastructure. Labour input has declined due to the automation of many activities. With many new developments over time, such as mobile telephone services, wired and wireless Internet services, and other satellite communication technologies, the communication services industry has changed substantially.

Contributions to output growth

The greatest contribution to output growth came from MFP (averaging 5.2 percent a year), followed by capital input (averaging of 3.3 percent a year) (see figure 15.1). Labour input contributed negatively to output growth over the total series.

Figure 15.1



Source: Statistics New Zealand

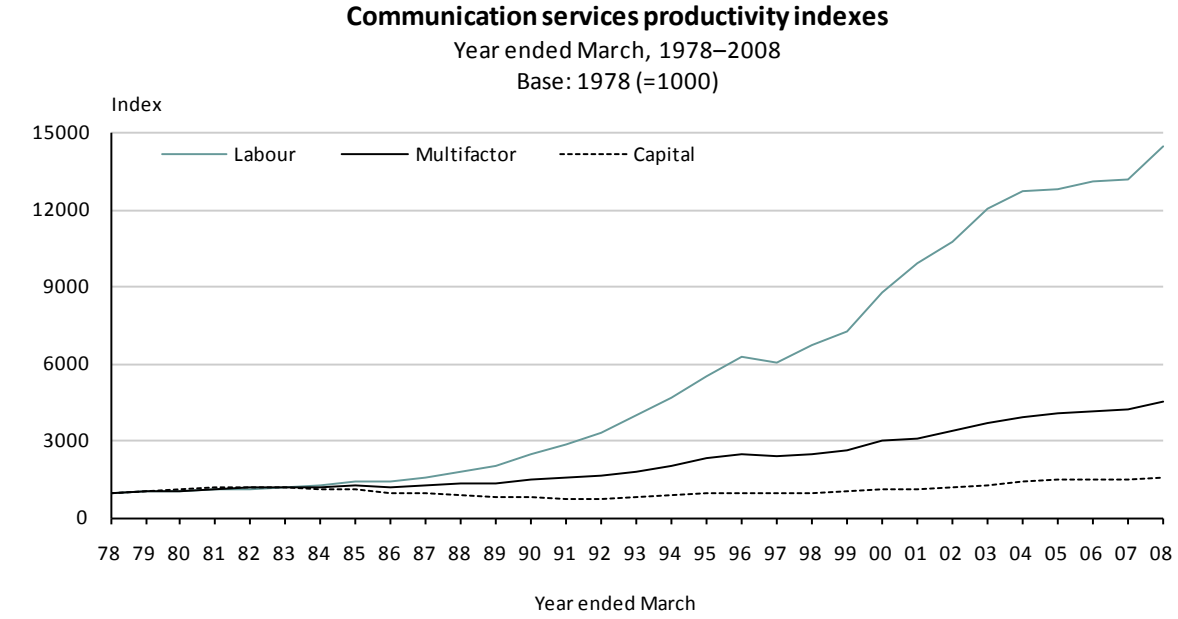
Output in the industry grew stongly at an annual average of 8.0 percent over the entire time series. This is the highest growth rate for any industry in the measured sector. The strongest period of growth in output occurred between 1997 and 2000, at 12.5 percent annually. This was mainly driven by growth in MFP of 7.8 percent per year, but capital input also made a significant contribution of 4.7 percent annually. In the industry, output grew every year as well as across all the cycles.

While output growth was mainly driven by MFP over the total time series, there was a definite shift from capital-driven output growth in the 1980s, to MFP-driven output growth during the 1990s and 2000s.

Productivity

Overall, all three productivity indexes increased over the time series, with labour productivity showing the strongest gains (see figure 15.2).

Figure 15.2



Source: Statistics New Zealand

This industry exhibited the highest annual average labour productivity growth in the measured sector, increasing at a rate of 9.3 percent from 1978–2008. Labour productivity rose every year except for 1997. In this year, an increase in labour volume (up 15.0 percent) outstripped output growth (up 10.5 percent).

MFP also grew strongly from 1978–2008, at an annual average rate of 5.2 percent – the highest growth rate of all industries in the measured sector. MFP growth accelerated in 1990–97 and 1997–2000, increasing at an annual average rate of 7.1 percent and 7.8 percent, respectively.

Capital productivity rose 1.6 percent annually from 1978–2008. The strongest periods of growth in capital productivity occurred from 1997–2000 and 2000–06, increasing at an annual rate of 4.9 percent. The largest fall occurred from 1985–1990, with an annual decline of 5.3 percent.

Table 15.1

Communication services productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	6.3	-3.9	2.0
1985–1990	12.3	-5.3	3.6
1990–1997	13.6	2.2	7.1
1997–2000	13.2	4.9	7.8
2000–2006	6.8	4.9	5.5
1978–2008	**9.3**	**1.6**	**5.2**

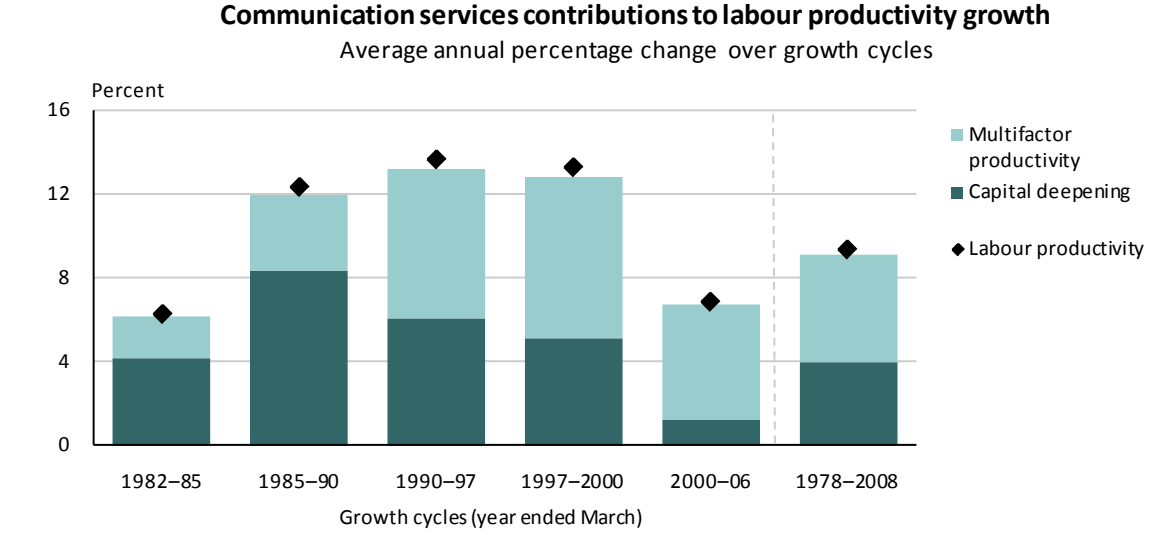
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

The communication services industry is the strongest performer in the measured sector in terms of labour productivity growth over the time series (9.3 percent annually). There is a very high contribution from MFP to labour productivity growth for most cycles (see figure 15.3).

Figure 15.3



Source: Statistics New Zealand

Capital deepening contributed strongly in the 1980s and 1990s, indicating high levels of capital investment relative to labour input during these periods. From 1978–2008, the contribution to labour productivity growth from both capital deepening and MFP was high, at 4.0 percent and 5.2 percent per year, respectively. The strongest period of labour productivity growth was from

1990–97, at 13.6 percent per year. This was driven by both MFP and capital deepening, rising at 7.1 percent and 6.1 percent per year, respectively.

Large capital investments were primarily due to the changing nature of telecommunication services throughout the series, with capital-intensive infrastructure (such as fibre optic cabling) required to run this service effectively, along with the large amount of capital required for competitors entering the market.

The changing nature of the industry is further highlighted by the compositional change in productive capital stocks. In recent times, information and communications technology (ICT) equipment, such as computers, software, and electrical and electronic machinery, have replaced assets such as general purpose machinery and transport equipment, which dominated capital investment at the start of the time series. This change was driven by the difference in the nature of the services provided, from postal and wired telecommunication services at the start of the series, to more mobile and satellite-based communication services at the end.

16 Finance and insurance

Highlights

From 1978–2008:

- Output growth in the finance and insurance industry averaged 4.4 percent with capital input the main driver of this growth, contributing 2.6 percent annually.
- Labour productivity growth was strong across the series, rising at 3.4 percent annually, with most of this growth occurring after 1997.
- MFP growth was moderate, at 1.3 percent per year.

Introduction

The finance and insurance industry contributed an average of 5.8 percent to the total economy during 1978 to 2007, with its share ranging between 4.1 percent and 7.3 percent.

The finance sub-industry accounted for 71.0 percent of the total output of the industry in 2007. Of all measured sector industries, average hourly wages were highest in finance and insurance (Statistics New Zealand, 2010) and worker turnover rates were the second lowest (Statistics New Zealand, nd).

This industry consists of banking and other financiers, financial asset investors, life insurance, superannuation fund operation, health insurance, general insurance, and services to finance and insurance. Of these seven, banking and other financiers is the largest component in terms of hours paid.

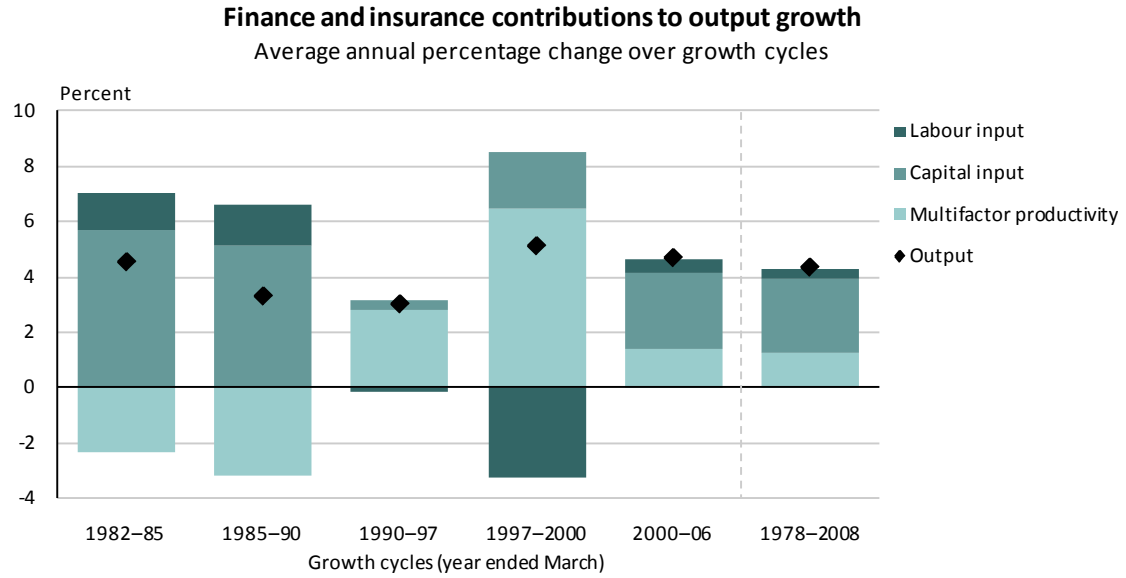
The industry has become relatively more capital intensive since 1978. Investments in information technology and non-residential buildings reflected the changing nature of service delivery over the series.

Between 1993 and 1999, for example, the number of ATM's increased by 34.9 percent, while the number of bank branches and staff fell by 43.9 percent and 14.3 percent, respectively (Cleland, 2000). The increased use of direct banking, such as telephone and Internet banking, allowed firms to reduce costs (Rodgers, 1998). Privatisation of Postbank took place in 1989. Superannuation providers were affected by the reforms as the Superannuation Schemes Act 1989 required their schemes to be registered. Similar steps were taken in the insurance industry, with the introduction of the Insurance Companies (Ratings and Inspections) Act 1994. This required most insurers to obtain, register, and disclose a rating from an approved rating agency, before entering into, or renewing, a contract of insurance.

Contributions to output growth

Output in the finance and insurance industry rose at an annual average rate of 4.4 percent across the series. The greatest contribution to output growth came from capital inputs, followed by MFP (see figure 16.1). The average contributions of capital input and MFP to output growth were 2.6 percent and 1.3 percent per year, respectively.

Figure 16.1



Source: Statistics New Zealand

From 1982–90, capital input drove output growth. MFP made strong offsetting contributions during this time.

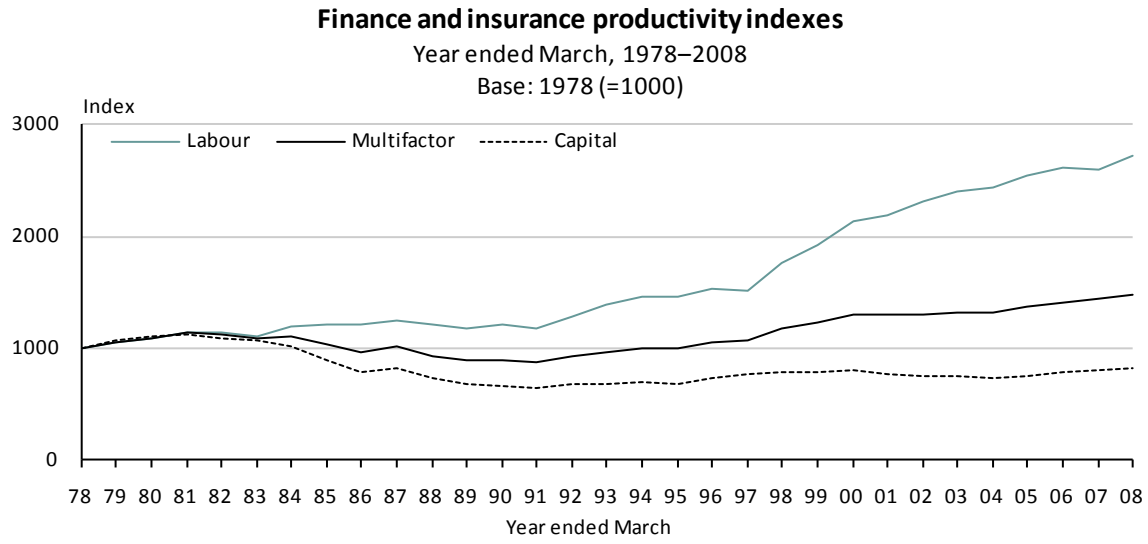
The main contributors to growth changed after 1990. Through the 1990s, MFP made positive contributions while labour input declined. Growth in output was strongest during the 1997–2000 cycle, rising at an annual average of 5.2 percent. This growth was driven by MFP, which contributed 6.5 percent annually. Capital input was, however, the main contributor to output growth during the 2000–06 cycle.

Productivity

The industry recorded high labour productivity growth of 3.4 percent annually over the series, with most of this due to its strong performance from 1997 (see figure 16.2).

The declines in capital productivity growth in the 1980s followed from strong increases in capital input growth during the same period.

Figure 16.2



Source: Statistics New Zealand

Productivity growth was greatest for labour and MFP during the 1997–2000 cycle (see table 16.1). Labour productivity growth was positive in all cycles, and the 1990s stands out as the decade with the strongest growth in productivity for all measures.

Table 16.1

Finance and insurance productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1982–1985	1.9	-6.2	-2.3
1985–1990	0.1	-6.1	-3.2
1990–1997	3.2	2.4	2.8
1997–2000	12.3	1.0	6.5
2000–2006	3.3	-0.1	1.4
1978–2008	**3.4**	**-0.7**	**1.3**

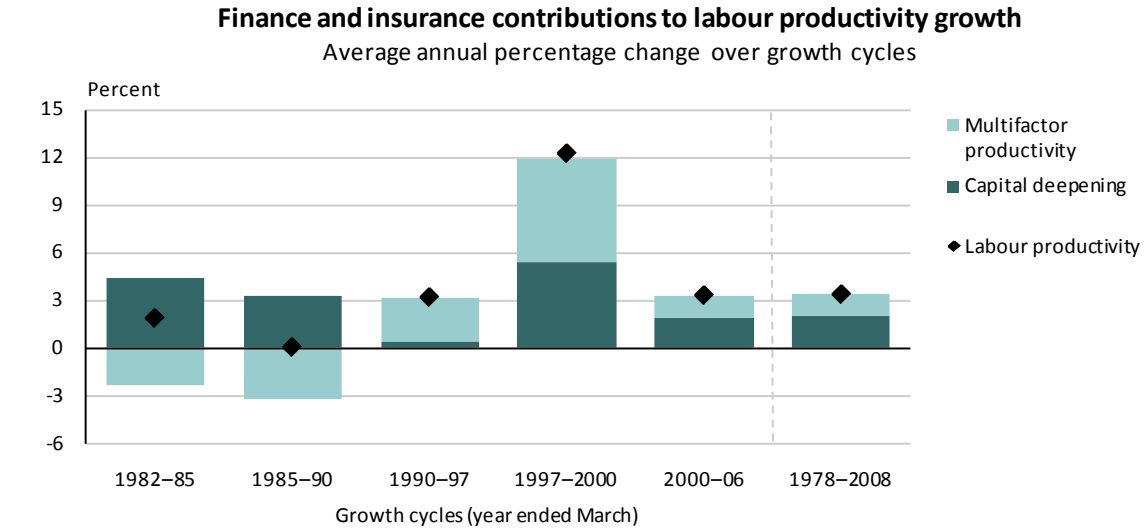
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1982–85 average annual growth does not include the movement for 1982.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

Growth in labour productivity was due to contributions from capital deepening and to a lesser extent, MFP (see figure 16.3). The average contribution from capital deepening was 2.1 percent, while MFP contributed 1.3 percent annually to labour productivity growth. Capital deepening made a positive contribution to labour productivity in all cycles. MFP made positive contributions to labour productivity in all cycles after 1990, and its contribution was greater than that of capital deepening between 1990 and 2000.

Figure 16.3



Source: Statistics New Zealand

17 Business services

Highlights

From 1996–2008:

- Output growth in the business services industry averaged 4.8 percent. Labour input was the main driver of this growth, contributing 3.7 percent annually.
- Labour productivity growth was weak, declining at an annual average of 0.2 percent.
- MFP growth was also low, decreasing at an annual average of 1.0 percent.

Introduction

The business services industry grew strongly between 1996 and 2008, and was the second largest industry in the economy by 2007. Between 1996 and 2007, the average contribution of the business services industry to the total economy was 8.5 percent, its share ranging between 7.2 percent (1996) and 9.2 percent.

Business services is a diverse industry, consisting of scientific research (including Crown Research Institutes) and technical services; computer services; legal and accounting services; and other business services. Within other business services are recruitment agencies, advertising, secretarial, and cleaning services. Other business services are the largest component in terms of employment in 2008, while the greatest growth from 2000 was in technical services, followed by computer services (Statistics New Zealand, 2010).

The diversity in business services means that there is significant heterogeneity in outputs. In terms of labour input, there is diversity among skill types. Employees in professional, scientific and technical services (eg accountants, lawyers, and scientific researchers) have a much higher proportion of employees with a bachelor degree or higher, than the rest of the workforce. However, those employed in administration and support services (eg personal assistants and cleaners) have a higher proportion of employees with no qualification than the total economy (Statistics New Zealand, 2006). This heterogeneity means that it can be difficult to identify events that contribute to output and productivity growth.

Alternative measures of productivity suggest that there are small pockets within business services that are performing well. For example the OECD (2008) noted that New Zealand's "biotechnology sector is rapidly accumulating patentable knowledge in several important market niches, and scientific publications per capita are well above the OECD average". The number of biotechnology patents granted increased from 189 in 2005 to 225 in 2007. The number of organisations active in biotechnology also increased markedly, from 126 in 2005 to 168 in 2007 (Statistics New Zealand, 2008). While this is a very small proportion of firms in the business services industry, the development of scientific knowledge can be important in determining MFP in industries that use research and development.

The industry is highly labour intensive, as approximately three-quarters of income was attributable to labour across the series. However, there are signs of capital deepening as capital per worker increased from 1996—2008.

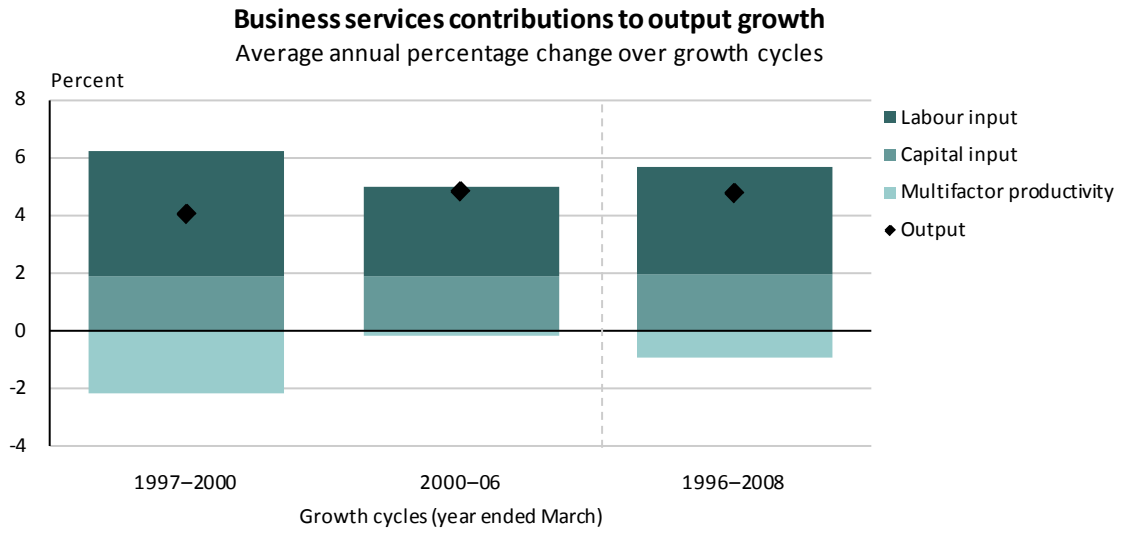
The industry's firm turnover rate (the number of firms entering the industry relative to the number exiting the industry) is above average. This is because there are relatively low entry and exit costs for firms in this industry (Law & McLellan, 2005). While new firms provide an important source of innovation and growth, competitive pressures lead to less innovative firms leaving the industry. Labour productivity growth can theoretically be decomposed further into contributions from continuing and entering firms less the contribution from exiting firms. Therefore, continual change in firm composition will impact on productivity.

Productivity series for the business services industry are only available from 1996, as inputs are not distinguished independently from outputs in the national accounts before this date. Due to this, growth rates across cycles are only available for the last two cycles.

Contributions to output growth

Output in the business services industry increased strongly across the series at an annual rate of 4.8 percent. The greatest contribution to output growth came from labour input, followed by capital input, contributing 3.7 percent and 2.0 percent per year respectively (see figure 17.1).

Figure 17.1



Source: Statistics New Zealand

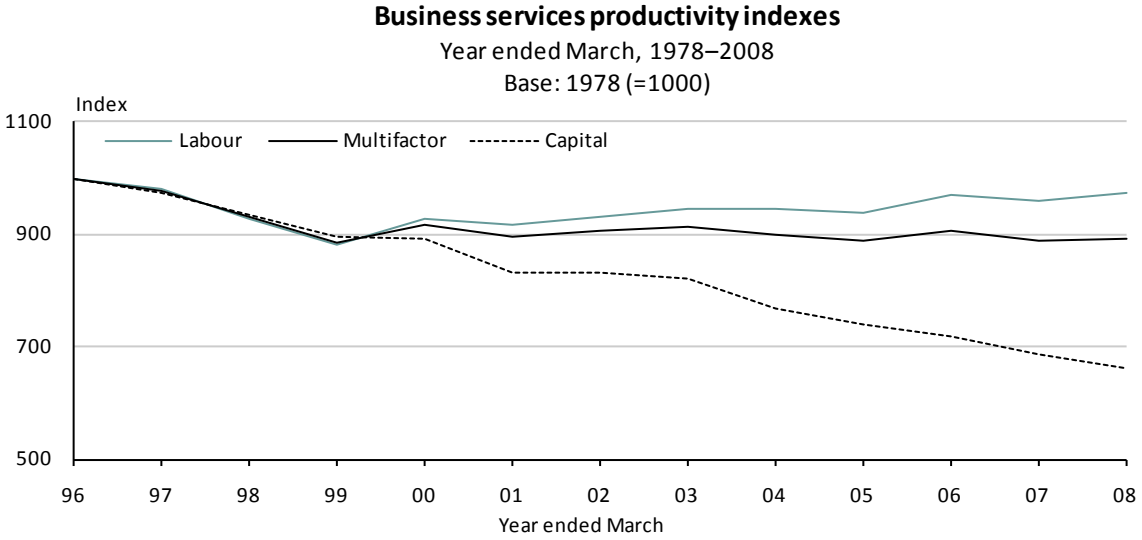
From 2000–06, output growth increased at an annual average rate of 4.8 percent. Labour input was the main contributor to output growth during this cycle, but its contribution was less than that of the previous cycle. The contribution of MFP improved during the latter cycle but still made a negative (albeit small) contribution of 0.2 percent annually.

The labour productivity series for the business services industry is an example of the 'productivity paradox'. This paradox arises where an industry has undertaken substantial investment in information technology but records minimal productivity growth. In the 'Contributions to labour productivity growth' section of this chapter, it is shown that increased amounts of capital per worker, such as software and computers, have made positive contributions to labour productivity, especially since 2000, but this effect was offset by declining MFP.

Productivity

Labour productivity declined at an average of 0.2 percent per year (see figure 17.2). From 2000, the trend in labour productivity was similar to that of the measured sector. Labour productivity growth for the business services industry was third lowest for all measured sector industries between 1996 and 2008.

Figure 17.2



Source: Statistics New Zealand

MFP declined at an annual average rate of 1.0 percent per year between 1996 and 2008. After a period of negative growth from 1996–1999, the level of MFP stabilised growing at an annual average rate of 0.1 percent between 1999 and 2008.

Capital productivity declined at an average of 3.4 percent each year, recording negative growth rates during both cycles (see table 17.1). Compared with all other measured sector industries between 1996 and 2008, average capital productivity growth in business services was the lowest.

Table 17.1

Business services productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1997–2000	-1.9	-2.9	-2.1
2000–2006	0.8	-3.5	-0.2
1996–2008	**-0.2**	**-3.4**	**-1.0**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1997–2000 average annual growth does not include the movement for 1997.
2. Percentage changes are calculated on unrounded index numbers.

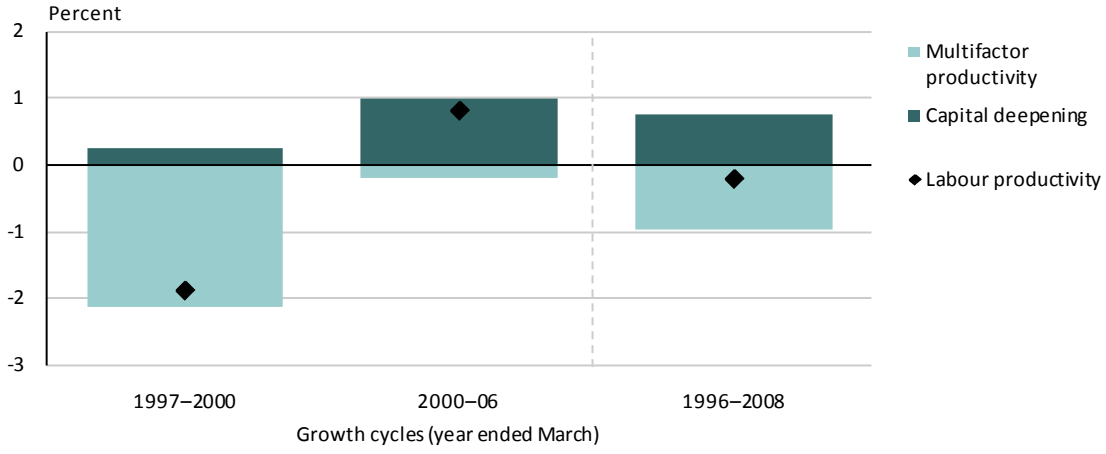
Source: Statistics New Zealand

Contributions to labour productivity growth

The average contribution of capital deepening to labour productivity was 0.7 percent, while MFP contributed -1.0 percent (see figure 17.3). The offsetting effect of MFP offers an explanation for the productivity paradox. This arises where an industry has undertaken substantial investment in information technology but records minimal labour productivity growth.

Figure 17.3

Business services contributions to labour productivity growth
Average annual percentage change over growth cycles



Source: Statistics New Zealand

All of the decline in labour productivity between 1997 and 2000 was attributed to MFP. Capital deepening, however, offset some of the negative impact of MFP during this cycle. Labour productivity growth was positive during the 2000–06 cycle due to capital deepening increasing at a greater rate than the fall in MFP.

The contribution of capital deepening reflects the growth of capital inputs, at an average rate of 8.4 percent per year. This growth is the strongest in capital inputs across the 1996–2008 period for any industry. Driving this growth was software, which became an increasingly important asset to the business services industry from 1996–2008.

18 Cultural and recreational services

Highlights

From 1996–2008:

- Output for the cultural and recreational services industry rose at an annual average rate of 2.3 percent. Labour input was the main driver of this growth, contributing 2.8 percent annually.
- The industry's labour productivity growth was the lowest of all industries, declining at an average of 2.9 percent per year.
- MFP growth also declined at an average of 2.9 percent per year.

Introduction

The cultural and recreational services industry is a small industry in the New Zealand economy. In 2007, its contribution to GDP was 2.4 percent. The industry consists of three sub-industries, namely, motion picture, radio and TV services; libraries, museums and the arts; and sport and recreation (includes both small and large sporting clubs, racing, and gambling). Sport and recreation is the largest sub-industry, accounting for around 53 percent of hours paid in the industry.

Within the cultural and recreational services industry, there is a balance of market and non-market services provided. Market output is based on sales of services, while non-market output consists of services that are supplied free, or at prices that are not economically significant. Non-market output is commonly valued at cost. In 2007, approximately 15 percent of the output of cultural and recreational services was recorded as non-market. Of the sub-industries, libraries, museums and arts had the highest ratio of non-market to market output.

A number of casinos opened during this period, generating significant economic activity within the gambling industry. Until 2003, casino licensing in New Zealand was governed by the Casino Control Act 1990, under which two licenses were required to operate a casino in New Zealand. This legislation was repealed under the Gambling Act 2003, which prevented the establishment of any new casinos, or the expansion of any existing ones, in an attempt to curb the growth in gambling (The Department of Internal Affairs, 2005). Also included in the industry are the New Zealand Racing Board, which was established in 2003 with the purpose of promoting the racing industry, and facilitating and promoting racing and sports betting (The Department of Internal Affairs, 2008).

New jobs and roles were created when rugby union became a professional sport in 1996. Te Papa, which opened in 1998, is now a major tourist attraction with over 1.25 million visitors a year (Maclean, 2009). The filming and associated production work of the *Lord of the Rings* trilogy between October 1999 and December 2000 was the largest project of its kind in New Zealand (New Zealand Institute of Economic Research, 2002).

More economic benefits were gained with the hosting of the America's Cup in 1999/2000 and 2003. After accounting for wider flow-on effects, McDermott Fairgray Group and Ernst & Young (2000) calculated that the 1999/2000 America's Cup regatta generated $640 million in value

added to the New Zealand economy, with $33 million of this due to the entertainment and leisure sector.

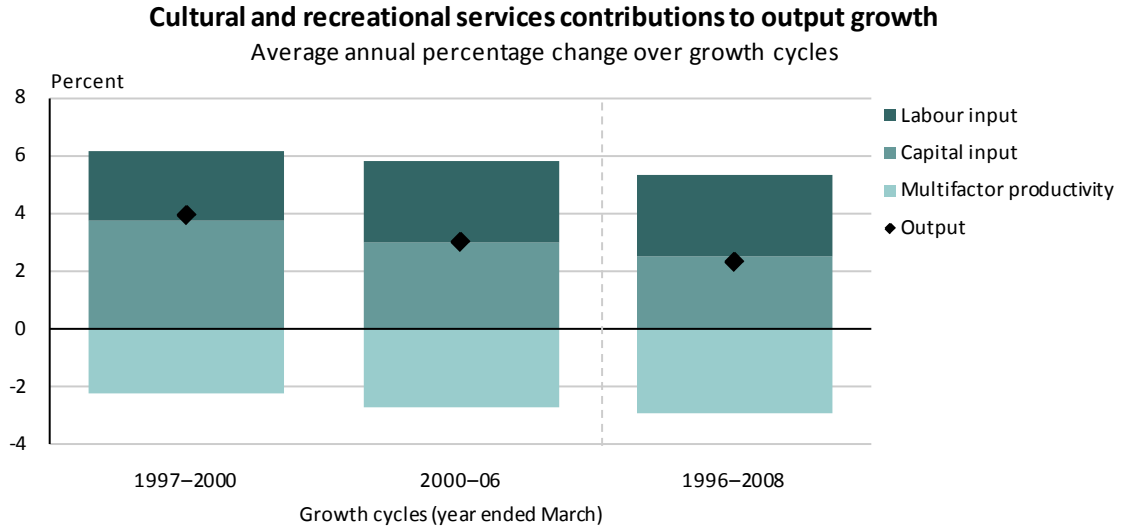
Arts and culture are often used as examples of 'Baumol's cost disease' (Heilbrun, 2003). This theory argues that an increase in productivity is impossible as a time-invariant fixed number of inputs are required to produce certain output. For example, a brass band requires the same number of musicians and instruments to produce the same piece of music today as it did at the start of the 1900s. As wages of performers need to increase in line with general wages (to attract new labour to the industry), additional costs unrelated to productivity increases are incurred. Arts and culture, however, provides social and intangible benefits that may not be captured in the output measure, such as social connectedness, culture, identity, health, and well-being (Ministry of Social Development, 2009).

Productivity series for the cultural and recreational services industry are only available from 1996, as inputs are not distinguished independently from outputs in the National Accounts before this date. Due to the growth rates across cycles are only available for the last two cycles.

Contributions to output growth

The greatest contribution to output growth came from labour input, followed by capital input, at 2.8 percent and 2.5 percent per year, respectively (see figure 18.1).

Figure 18.1



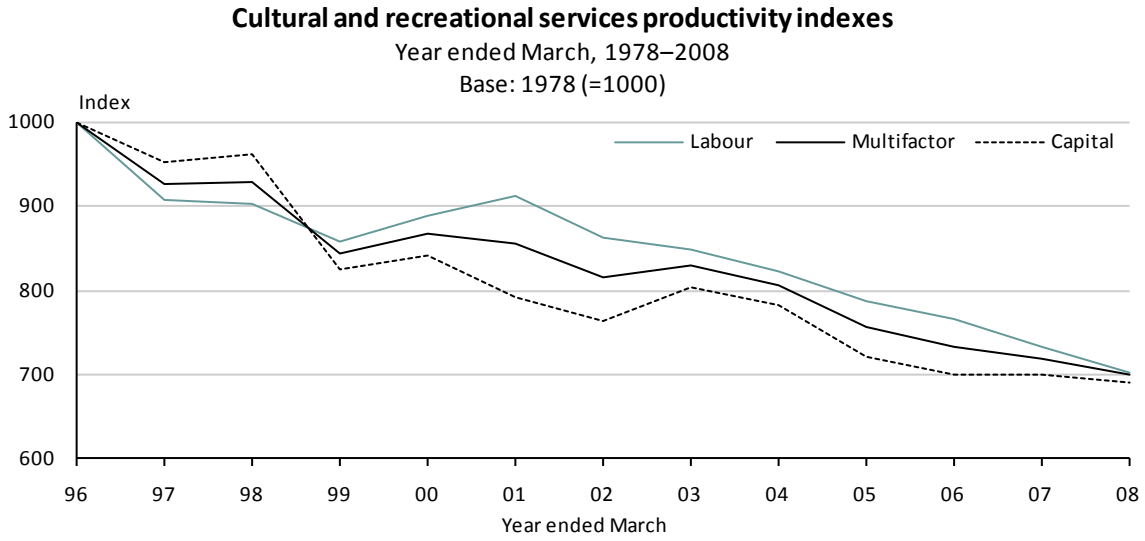
Source: Statistics New Zealand

Output growth and its contributors were similar between the two cycles. Capital and labour inputs provided positive contributions during both cycles, while multifactor productivity made negative contributions.

Productivity

All three productivity measures declined between 1996 and 2008 (see figure 18.2).

Figure 18.2



Source: Statistics New Zealand

Labour productivity declined at an average of 2.9 percent per year across the series. The cultural and recreational services industry recorded the lowest labour productivity growth of all industries over the 1996–2008 period.

The average annual change of -2.9 percent in MFP was the lowest of all measured industries over the 1996–2008 period. The decline of 3.0 percent each year in capital productivity growth was the second lowest growth of all industries during this period. Average growth rates in all three productivity measures were negative in both cycles and were roughly equal across the series (see table 18.1).

Table 18.1

Cultural and recreational services productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1997–2000	-0.6	-4.1	-2.2
2000–2006	-2.5	-3.0	-2.7
1996–2008	**-2.9**	**-3.0**	**-2.9**

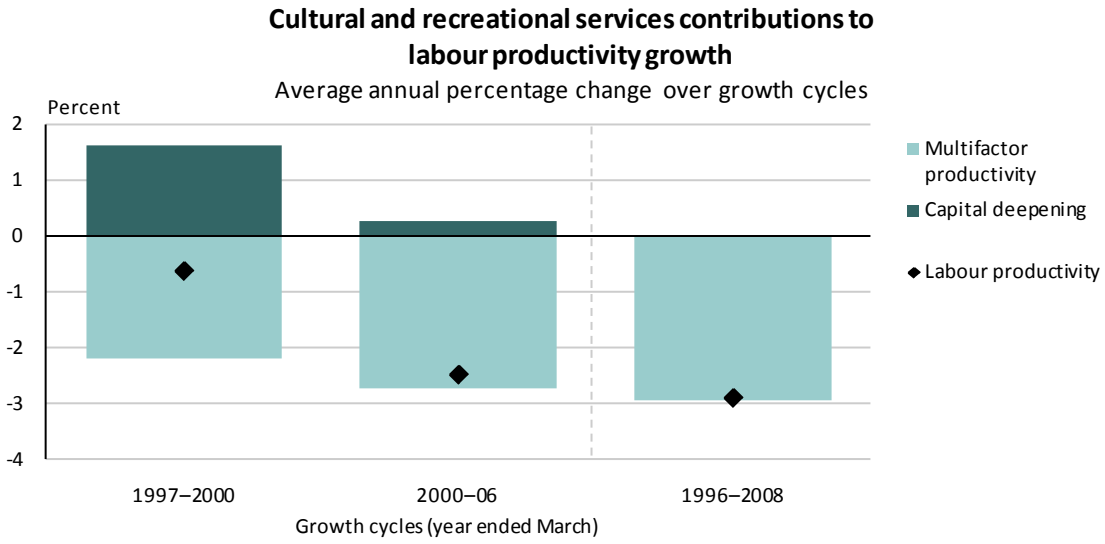
1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1997–2000 average annual growth does not include the movement for 1997.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

Contributions to labour productivity growth

The long-term decline in labour productivity can be entirely explained by the negative contribution from MFP (see figure 18.3). MFP had a negative effect on labour productivity in the industry in both cycles, and outweighed the contributions of capital deepening.

Figure 18.3



Source: Statistics New Zealand

19 Personal and other community services

Highlights

From 1996–2008:

- Output for the personal and other community services industry grew at an annual average rate of 5.4 percent. Labour input was the main driver of this growth, contributing 2.3 percent annually.
- Labour productivity growth was strong, rising at an annual rate of 2.3 percent.
- MFP grew moderately, at an annual average of 1.4 percent.

Introduction

The personal and other community services industry is one of the smallest industries in the economy from an output perspective, comparable in size to mining. From 1996–2007, its average contribution to GDP was 1.5 percent, ranging between 1.2 percent and 1.6 percent. This industry includes personal and household services; religious organisations; interest groups; waste disposal services; sewerage and drainage services; and private households employing staff.

Personal and household services include a variety of activities. The largest contributors include hairdressing and beauty salons, household goods hiring, funeral directors and crematoria, and landscaping services. Other activities include photographic services, DVD and video hiring, and gardening services. Such a broad series of contributors means that market forces may not impact on all parts of the industry equally.

Within the personal and other community services industry, there is a balance of market and non-market services provided. Market output is based on sales of services, while non-market output consists of services that are supplied free, or at prices that are not economically significant. Non-market output is commonly valued at cost. In 2007, approximately 38 percent of the output of personal and other community services was recorded as non-market. Of the sub-industries, private households employing staff, and religious organisations were entirely non-market. Interest groups also had a significant proportion of its output recorded as non-market.

The industry is made up of a high proportion of firms employing few staff (Statistics New Zealand, 2010a). It has proportionately more small firms than the economy average, and is characterised by a higher proportion of working proprietors than most other service industries.

The personal and other community services industry is highly labour-intensive. The proportion of income attributable to labour inputs is the highest of any industry over the 1996–2008 period, at an average of 78 percent.

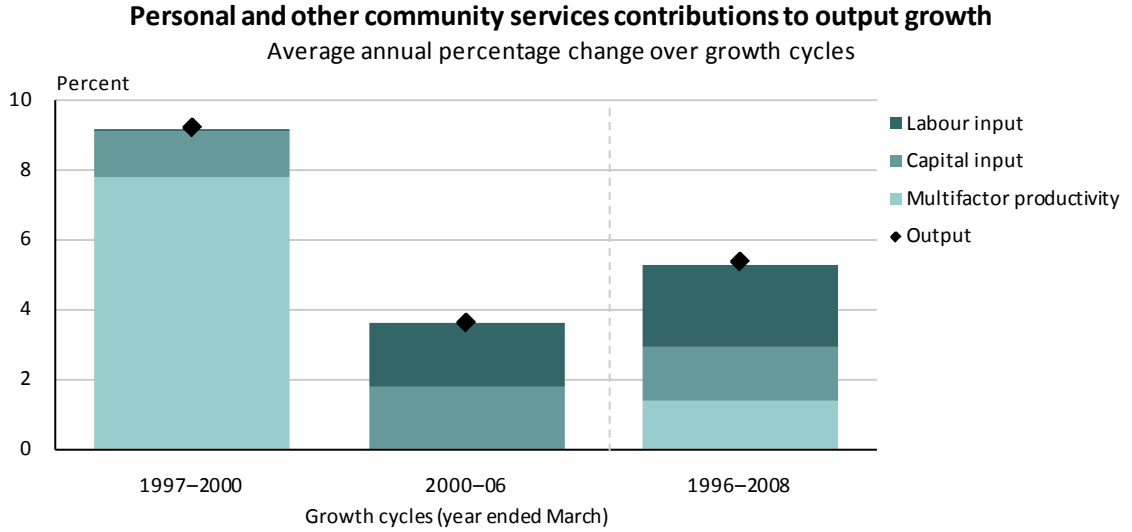
Since the beginning of the series, strong output growth in personal and other community services was likely to have been affected by a shift toward families with two working parents (Statistics New Zealand, 2010b). Services such as gardening and landscaping, and private households employing staff may have been influenced by this societal change.

Productivity series for the personal and other community services industry are only available from 1996, as inputs are not measured independently from outputs in the National Accounts before this date. Due to this growth rates across cycles are only available for the last two cycles.

Contributions to output growth

Across the series, the greatest contribution to output growth came from labour input, followed by capital input, averaging 2.3 percent and 1.6 percent per year, respectively. MFP contributed 1.4 percent to output growth on an annual basis across the series (see figure 19.1). The output for personal and other services industry trended upwards across the series, increasing at an annual average of 5.4 percent.

Figure 19.1



Source: Statistics New Zealand

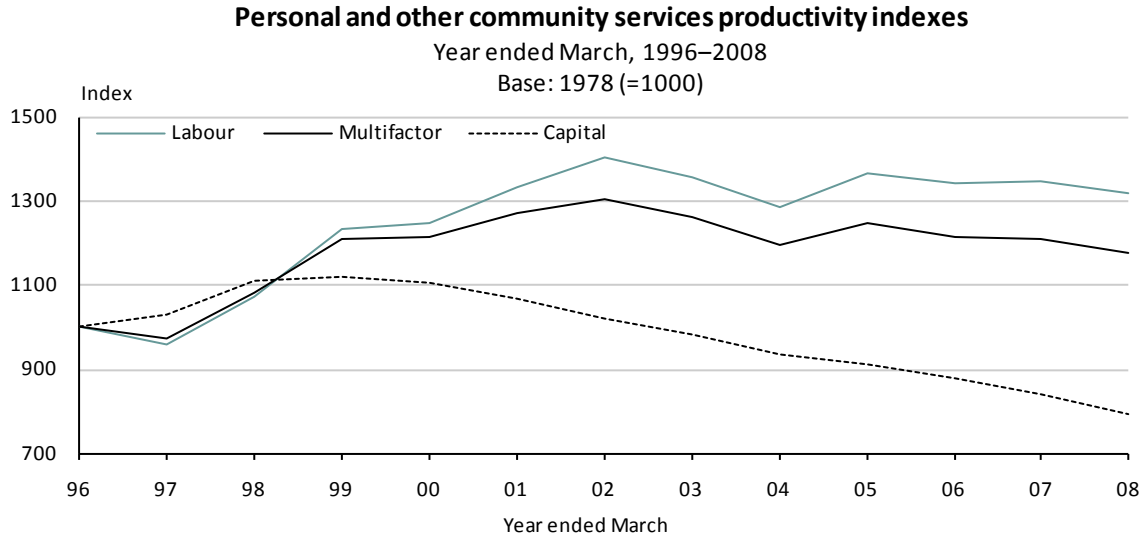
Output growth was strongest from 1997–2000, with a very strong annual rate of 9.2 percent. This is the second strongest output growth of all industries over this time period, behind that of communications services. Most of the growth in output was driven by MFP, which made an average contribution of 7.8 percent per year. Capital inputs also made a positive contribution to output growth, of 1.3 percent annually.

Major capital inputs to the industry have included non-residential buildings, commercial land (after inclusion in 1997), road vehicles, and electronic equipment. Non-residential buildings continued to contribute less to the industry, while the contribution of electronic goods rose strongly in the last three years of the period.

Productivity

The industry grew at a faster rate than the measured sector since the series began in 1996, at 2.3 percent per year. Labour productivity growth was strongest between 1997 and 2000, where an annual rise of 9.2 percent was recorded. Growth slowed after this cycle to 0.7 percent annually until the end of this series (see figure 19.2).

Figure 19.2



Source: Statistics New Zealand

Capital productivity growth was strong in the 1997–2000 cycle, but declined steadily thereafter. As the capital inputs index rose at a consistent rate across the series, the trend in capital productivity tended to follow that of the output (see table 19.1).

The annual increase of 1.4 percent in MFP between 1996 and 2008 was stronger than that of the measured sector over this time. The industry recorded strong MFP growth of 7.8 percent annually between 1997 and 2000; however MFP has remained relatively flat from 2000 due to acceleration in capital input growth compared with the earlier period.

Table 19.1

Personal and other community services productivity
Average annual growth rates[1]
Year ended March

Growth cycle	Labour productivity	Capital productivity	Multifactor productivity
	Percent[2]		
1997–2000	9.2	2.4	7.8
2000–2006	1.2	-3.8	0.0
1996–2008	**2.3**	**-1.9**	**1.4**

1. Average annual growth rates do not include the movement for the first year of each period, for example, the 1997–2000 average annual growth does not include the movement for 1997.
2. Percentage changes are calculated on unrounded index numbers.

Source: Statistics New Zealand

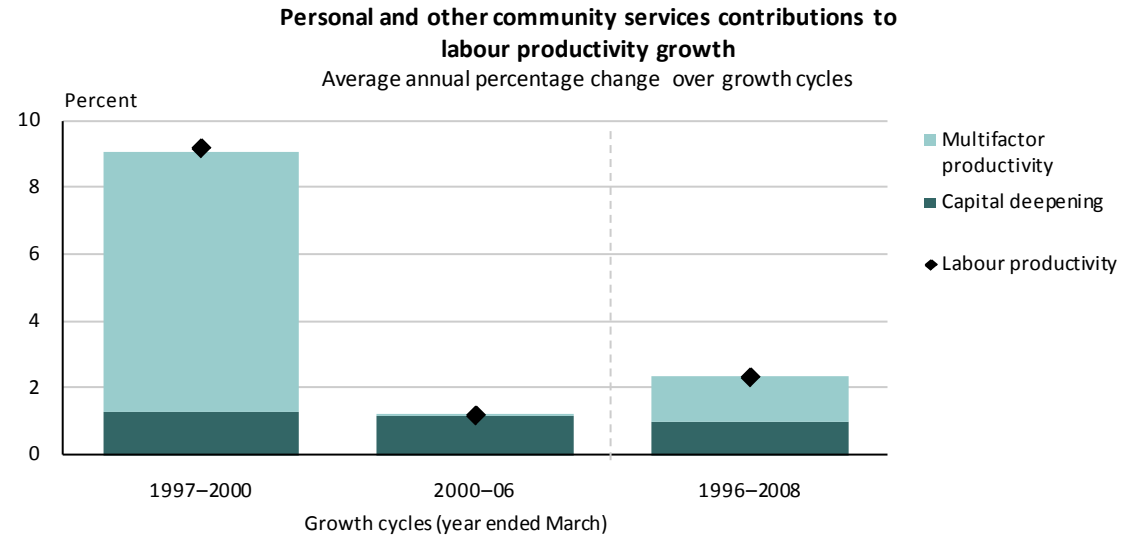
Contributions to labour productivity growth

Across the series, MFP and capital deepening have contributed similarly to labour productivity growth. The average contribution from capital deepening across the series was 1.0 percent, while MFP contributed 1.4 percent (see figure 19.3).

Between 1997 and 2000, MFP contributed 7.8 percent to labour productivity growth. This growth is high by industry standards, and is reflective of the cycle's strong output growth in the industry.

From 2000, MFPs contribution has been negative, while capital deepening remained consistent. This is reflected in the slowing of labour productivity growth.

Figure 19.3



Source: Statistics New Zealand

20 Comparison with Australia

Introduction

New official estimates of productivity growth for New Zealand at industry level allow fresh light to be cast on the debate about New Zealand's economic performance relative to Australia's. Since 2006, when Statistics New Zealand first published estimates of measured sector productivity growth for New Zealand, the two countries have been compared in aggregate for that portion of the economy. From 1978 onwards, New Zealand's labour, capital, and MFP growth rates have been slightly higher than Australia's for the measured sector of the economy.

This chapter takes the measured sector as a starting point, and disaggregates it into the 12 industries for which Statistics NZ and the Australian Bureau of Statistics (ABS) have commonly published industry productivity growth estimates. Due to data availability, the comparison commences in 1986, and runs through to 2008. During this time, the 12 industries comprised an average of 65 percent of the New Zealand economy, and 62 percent of Australia's (see table 20.1). Industries excluded from the comparison are property and business services; owner-occupied dwellings; government administration and defence; education; health and community services; personal and other community services. Please note that industry growth rates for New Zealand differ in this chapter compared to earlier chapters. This is due to the New Zealand Australian comparison commencing in 1986 rather than 1978.

As well as the use of a common industry-based classification system, New Zealand and Australia both have a statistical system that lends itself to a comparison of this nature. In both countries, the productivity estimates are integrated into the system of National Accounts, and employ best-practice concepts and methods outlined in *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth* (OECD, 2001). However, there are some notable methodology differences which are discussed in more detail in the 'overview of methodology differences' section.

Australia's most recent set of productivity statistics are based on an updated classification system, the Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC 2006). New Zealand has yet to implement ANZSIC 2006 into its National Accounts and productivity statistics, so comparison with Australia is carried out using ANZSIC 1996.

While the term 'measured sector' is used in this chapter, it is taken to mean the former measured sector in New Zealand. That is, the business services and personal and other community services industries are not included in this 12-industry trans-Tasman comparison. Also, the cultural and recreational services industry is only compared from 1996 onwards, due to the availability of the industry time series in New Zealand. In Australia, this aggregation of 12 industries was known as the 'market sector'.

Table 20.1

Average industry contribution to GDP
New Zealand and Australia
1990–2007

Industry	Average contribution to GDP 1990–2007 (%)	
	New Zealand	Australia
Agriculture, forestry and fishing	7.2	3.6
Mining	1.3	5.3
Manufacturing	17.2	13.5
Electricity, gas, and water supply	2.9	2.9
Construction	4.6	6.3
Wholesale trade	7.8	5.4
Retail trade	6.1	6.6
Accommodation, cafes, and restaurants	1.8	2.3
Transport and storage	4.7	5.2
Communication services	3.4	3.1
Finance and insurance	6.2	6.6
Property and business services[1]	13.8	11.7
Owner-occupied dwellings[1]	8.7	8.9
Government administration and defence[1]	5.1	4.3
Education[1]	4.2	4.7
Health and community services[1]	5.3	6.1
Cultural and recreational services	2.0	1.4
Personal and other community services[1]	1.4	2.0
Financial intermediation services indirectly measured (FISIM)[2]	-3.7	..
Measured sector	**65.2**	**62.2**
Total	**100**	**100**

1. Not included in this chapter's comparison.
2. In Australia FISIM is allocated across all industries.

Symbol:
.. figure not available

Source: Statistics New Zealand; Australian Bureau of Statistics

In both Australia and New Zealand, the manufacturing industry was the largest on average, followed by property and business services. Relative to total GDP, these industries are both larger in New Zealand than in Australia. There are some notable differences in the industry contributions to GDP. Firstly, agriculture's contribution is twice that in New Zealand than Australia. This comes as no surprise, as New Zealand has often been viewed as an agriculture-based economy. Offsetting this, Australia's mining contribution is four times as high as New Zealand's, driven by mineral resource availability, and extraction ability. The contribution of the manufacturing and wholesale trade industries is larger in New Zealand, while Australia's economy is more reliant on construction and retail trade. Outside of the measured sector, New Zealand's property and business services sector is considerably larger in relative terms, as is the core government administration and defence.

The rest of the chapter is outlined as follows: a brief summary of the similarities and differences between methodologies are presented, as this is crucial to understanding the numbers. This is followed by an overview of the measured sector growth comparison for New Zealand and

Australia. Comparisons are then made across the 12 industries for labour, capital, and multifactor productivity, as well as output, the capital to labour ratio, and income shares. The contributions to measured sector labour productivity growth are contrasted for both countries. Finally, the recent Australian shift to ANZSIC 2006 is commented on.

Overview of methodology differences

While both Australia and New Zealand are compiling productivity measures consistent with international best-practice outlined by the OECD, there are still some methodology differences between the two sets of estimates. The key differences are outlined below, with more detail provided at the end of the chapter. It is important to be aware of these, prior to conclusions being drawn on the comparison.

Output series:

- New Zealand has not allocated FISIM across industries. This difference will have a noticeable impact on the *level* of industry / measured sector productivity, but the impact on *growth rates* will be considerably less.

Labour input series:

- In New Zealand, the default unit of labour is hours paid, or usual hours. In Australia, the default unit is hours worked, or actual hours. This difference will have a noticeable impact on the level of industry / measured sector productivity (hours paid are fewer than hours worked at the aggregate level mainly due to sickness and holidays partly offset by unpaid overtime), but the impact on growth rates is unknown.

Capital input series:

- In New Zealand, apart from agricultural and forestry land, all other types of land are included only from 1996 onwards. In Australia, all land is included from the start of the series.
- When deriving user costs, which provide weights for each asset within an industry, New Zealand adopts an approach of no capital gains and an exogenous rate of return of 4 percent. Australia has one-year capital gains on all assets, and an endogenously determined industry rate of return. Australia places a floor on this rate of return, equivalent to 4 percent plus the growth rate of the consumers price index.

Industry weights

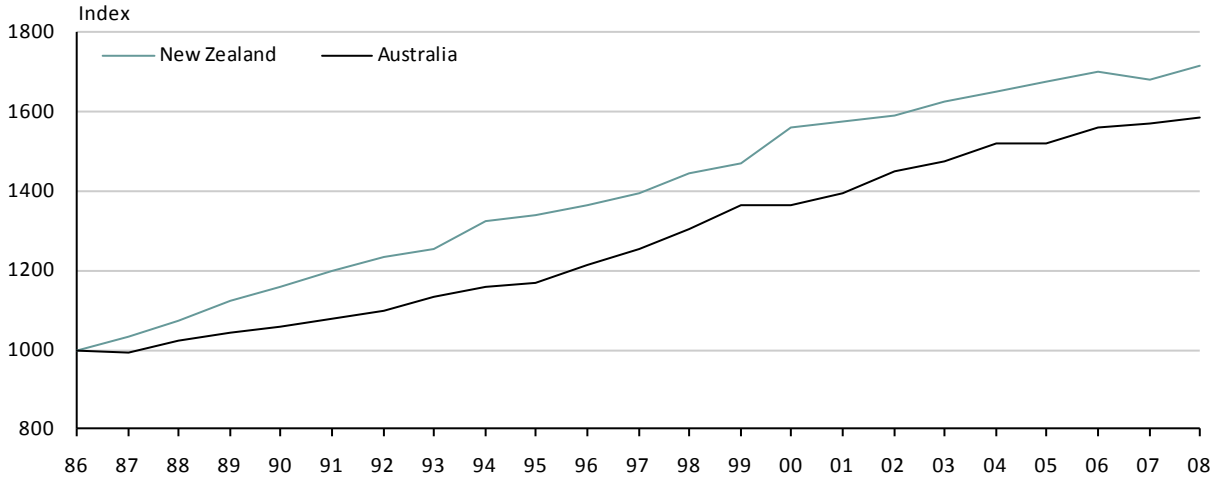
- New Zealand includes taxes less subsidies on production as part of the income-based weight for each industry. Australia excludes taxes less subsidies in their derivation of weights. This will not impact on any industry, but could have a very small impact on the measured sector aggregate.
- When aggregating from the industry labour input index to measured sector level, the industries are weighted using labour income shares in New Zealand. In Australia, the industry hours are simply summed to measured sector level.

Measured sector performance

Comparison between New Zealand and Australia at the measured sector level provides a benchmark on which to base the industry results.

Figure 20.1

New Zealand and Australia measured sector labour productivity
1986–2008
Base: 1986 (=1000)



Source: Statistics New Zealand and Australian Bureau of Statistics

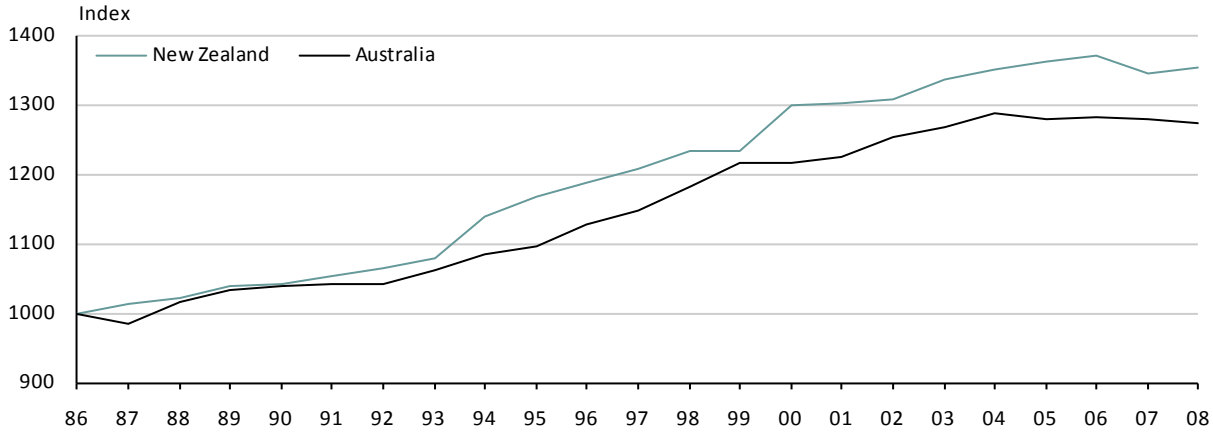
The labour productivity performances of the two countries were similar from 1986–2008, with New Zealand constantly ahead in growth from 1986 (see figure 20.1). In fact, from 1986–96, New Zealand's labour productivity grew at 3.2 percent per year, while Australia's growth rate was lower at 2.0 percent per year. From 1996–2008, the positions have been reversed, with New Zealand's growth slowing to 1.9 percent per year, while Australia has been catching up, growing at 2.3 percent a year. Over the entire 22 years, New Zealand has grown at 2.5 percent per year, compared with Australia's 2.1 percent.

Figure 20.2

New Zealand and Australia measured sector multifactor productivity

1986–2008

Base: 1986 (=1000)



Source: Statistics New Zealand and Australian Bureau of Statistics

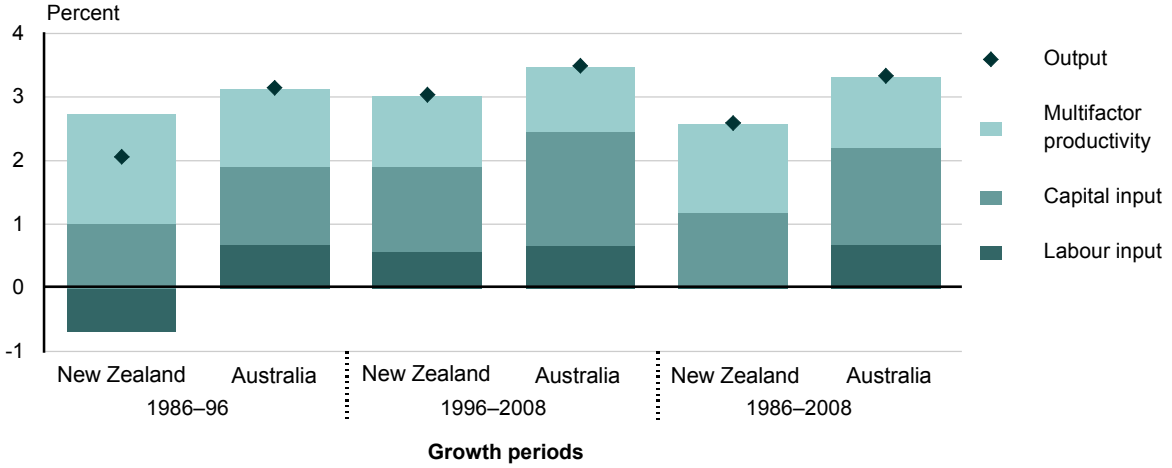
The MFP growth comparison is of a similar nature to the labour productivity comparison, although growth rates in both countries are lower (see figure 20.2). Both Australia and New Zealand were largely at level pegging until 1993, where New Zealand began to grow faster. However, by 1999 they were almost equivalent again, but New Zealand opened up a gap in 2000, which has remained. Over the entire 1986–2008 period, New Zealand's MFP grew at 1.4 percent per year, while Australia's growth rate was 1.1 percent. From 1996 onwards, New Zealand grew at 1.1 percent per year, with Australia slightly behind this at 1.0 percent.

Figure 20.3

Comparison of contribution to output growth

New Zealand versus Australia

1986–2008



Source: Statistics New Zealand

The contributions to output growth present a contrast (see figure 20.3). Across the 1986–2008 period, Australia's measured sector output growth was above New Zealand's: 3.4 percent annually against 2.6 percent. This disparity was entirely due to stronger contributions from inputs in Australia, both labour and capital. From 1986–2008, labour input contributed 0.7 percent towards output growth in Australia, but in New Zealand, it had a negligible contribution. The contribution of capital input was also higher in Australia. However, New Zealand's MFP performance was stronger, growing at 1.4 percent annually against Australia's 1.1 percent.

Of the two sub-periods, 1986–96 has the greatest difference in output growth. Australian output grew at 3.2 percent annually over those 10 years, driven by positive contributions from labour input (0.7 percent), capital input (1.2 percent), and MFP (1.2 percent). New Zealand's output growth was just 2.1 percent annually during this time, driven by 1.7 percent growth in MFP per year. For much of this period, labour was shed in the New Zealand economy, and the contribution of labour input was -0.7 percent annually.

Industry performance

Labour productivity

From 1986–2008, measured sector labour productivity in New Zealand grew by 2.5 percent annually, compared with 2.1 percent in Australia. However, there were some marked differences at the industry level (see figure 20.4). In both countries, the communications services industry was comfortably the strongest performer, growing at 11.0 percent per year in New Zealand, and 6.8 percent per year in Australia.

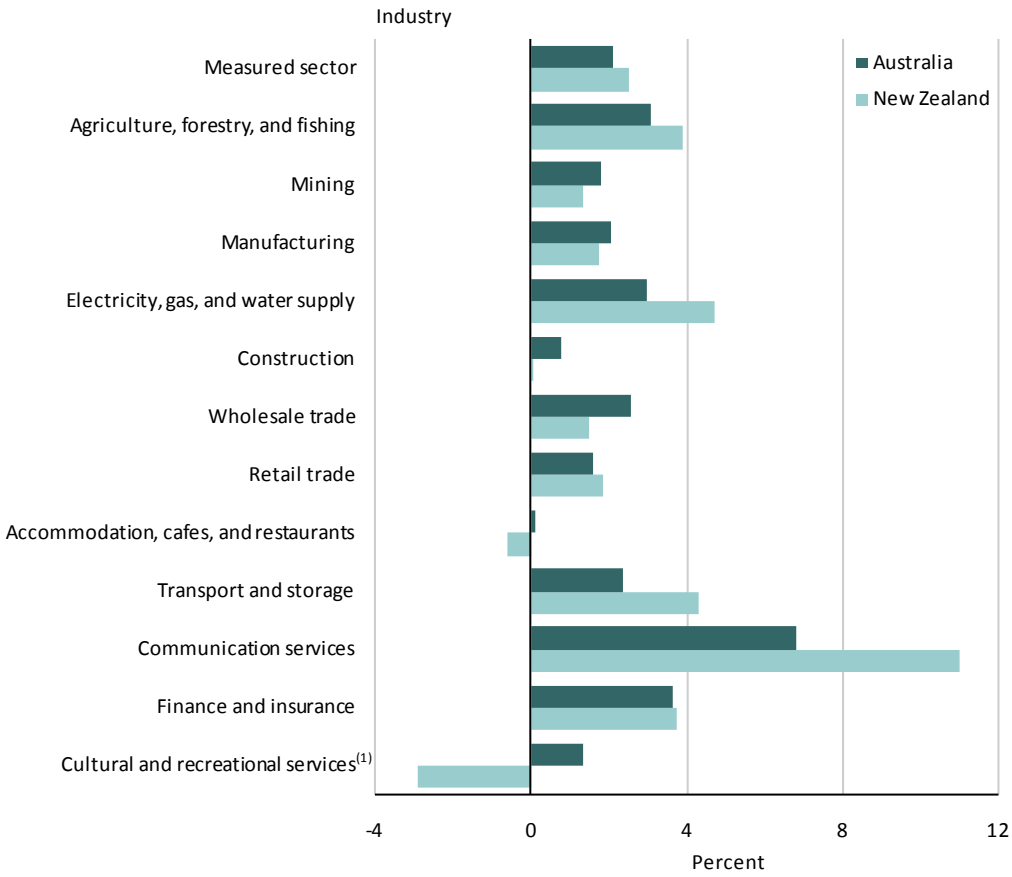
The other industries in which New Zealand outperformed Australia were transport and storage; electricity, gas, and water; agriculture, forestry, and fishing; finance and insurance; and retail trade. Aside from retail trade, these industries were among the strongest performers in both New Zealand and Australia. That is, New Zealand's productivity performance was very strong in these industries, but Australia's was still above its measured sector average.

Industries in which Australia outperformed New Zealand were mining; manufacturing; construction; wholesale trade; accommodation, cafés, and restaurants; and cultural and recreational services. As expected, these were the lowest-performing industries in New Zealand, all below the measured sector average of 2.5 percent. Aside from wholesale trade, the growth rates in all of these industries in Australia were below their measured sector average of 2.1 percent.

Figure 20.4

New Zealand and Australia labour productivity

Average annual growth rates 1986–2008



1. Average annual growth rates are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

Capital productivity

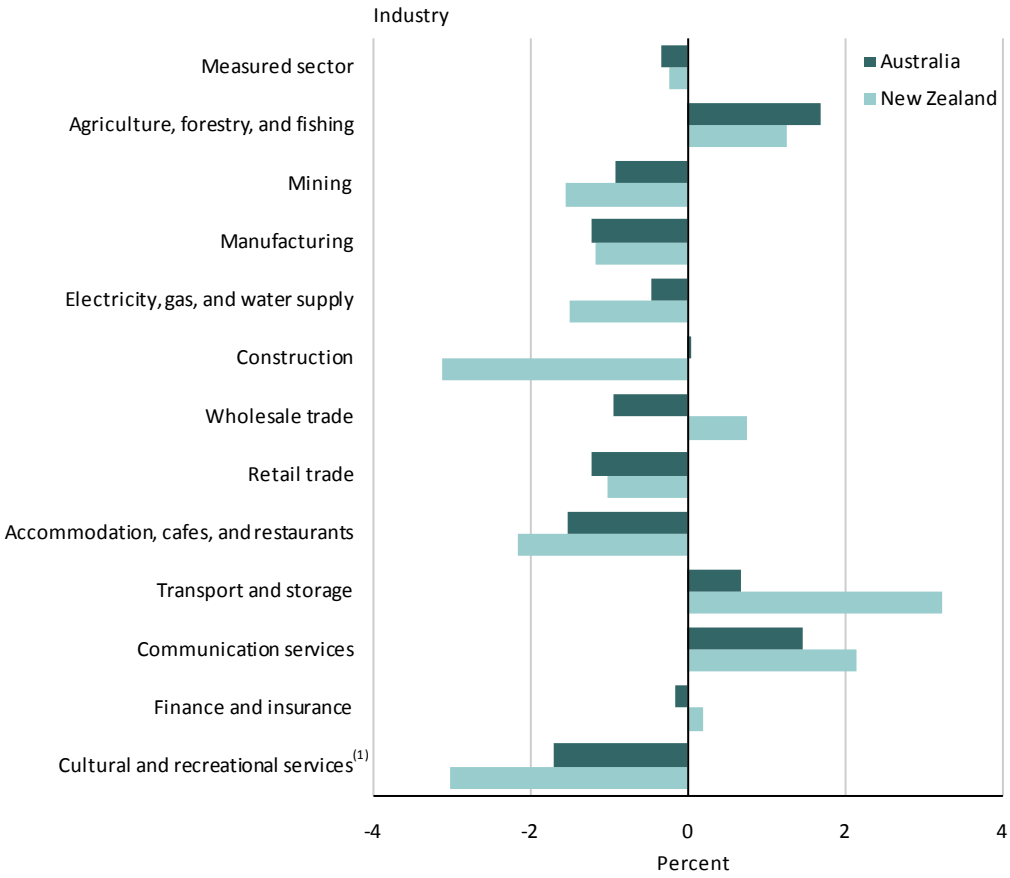
From 1986–2008, measured sector capital productivity declined by 0.2 percent annually in New Zealand, and by 0.4 percent in Australia. In constrast with labour productivity, seven of the 12 industries recorded a drop in capital productivity in New Zealand, and eight in Australia (see figure 20.5). The lowest-performing industries in New Zealand were construction; cultural and recreational services; and accommodation, cafés, and restaurants. The last of these two were also Australia's lowest-performing industries.

New Zealand's fastest growing industries were transport and storage; communication services; and agriculture, forestry, and fishing. These were also Australia's top three industries, although not in that order. In New Zealand, capital input growth within transport and storage; and agriculture, forestry, and fishing has been low compared with most other industries. In wholesale trade, and also finance and insurance, New Zealand's capital productivity increased from 1986–2008, but Australia's decreased.

Figure 20.5

New Zealand and Australia capital productivity

Average annual growth rates 1986–2008



1. Average annual growth rates are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

Multifactor productivity

From 1986–2008, measured sector MFP increased by 1.4 percent annually in New Zealand, and by 1.1 percent in Australia. In terms of growth rates, the top four industries were the same for both countries: communication services; transport and storage; agriculture, forestry, and fishing; and finance and insurance (see figure 20.6). In the first three of those, New Zealand outperformed Australia; however, Australia's finance and insurance growth was stronger. New Zealand had a marginally higher MFP growth rate in the retail trade industry.

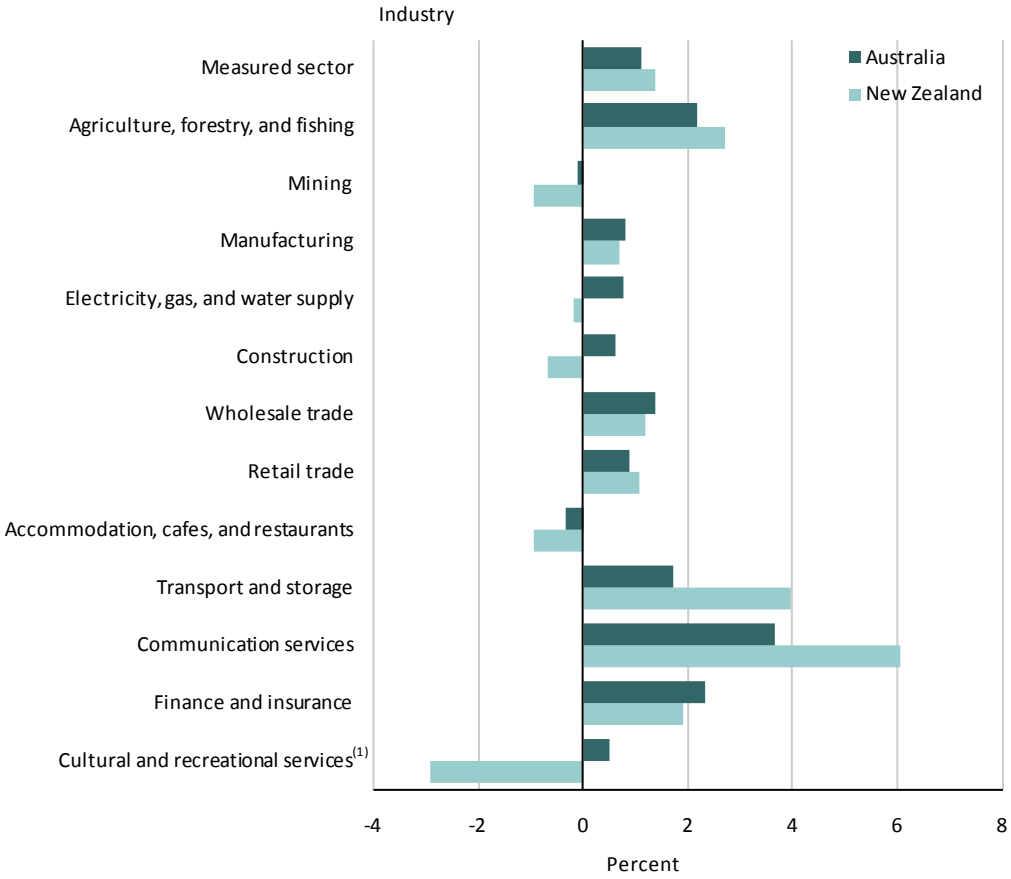
However, in the other seven industries, Australia's growth in MFP was stronger than New Zealand's. There were three industries for which Australia's MFP grew from 1986–2008, while New Zealand's declined: electricity, gas, and water supply; construction; and cultural and recreational services. In fact, New Zealand had a total of five industries in which MFP declined over the period, compared with just two for Australia.

The variation across industries in the total period growth rates is higher in New Zealand than in Australia. This applies not only for MFP, but for labour and capital productivity as well.

Figure 20.6

New Zealand and Australia multifactor productivity

Average annual growth rates 1986–2008



1. Average annual growth rates are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

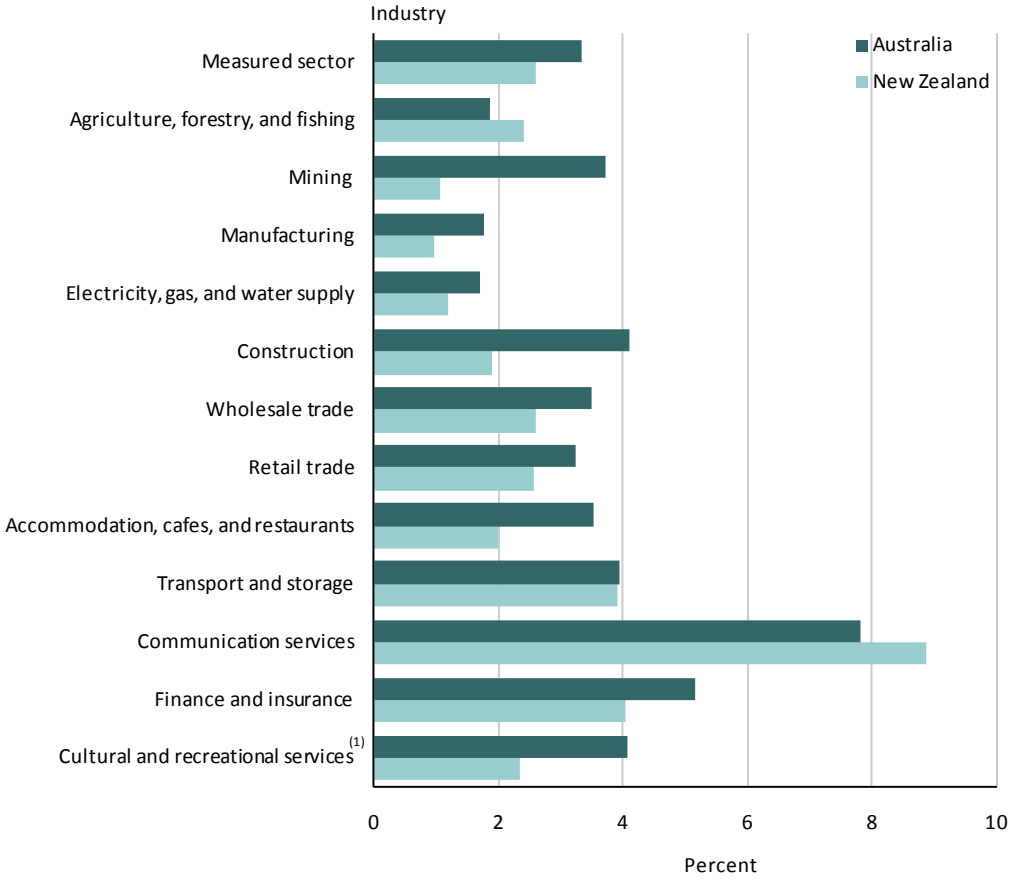
Output

From 1986–2008, measured sector output increased by 2.6 percent annually in New Zealand, and by 3.3 percent in Australia. For both countries, output was higher in all 12 industries in 2008 than it was in 1986 (see figure 20.7). Australia's output growth was higher in 10 industries, with just communications services and agriculture, forestry and fishing growing faster in New Zealand. In the transport and storage industry, both countries had very similar average annual growth rates.

Australia's strongest performing industries relative to New Zealand were mining and construction. The mining industry recorded growth of 3.7 percent annually in Australia, compared with 1.1 percent in New Zealand. Growth in the construction industry was 4.1 percent and 1.9 percent, in Australia and New Zealand, respectively. From 1986–2008, Australia's fastest-growing industries were communication services, finance and insurance, cultural and recreational services, and construction. All grew at more than 4 percent per year over their respective time series.

Figure 20.7

New Zealand and Australia output
Average annual growth rates 1986–2008



1. Average annual growth rates are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

Capital to labour ratio

From 1986–2008, the measured sector capital to labour ratio increased by 2.8 percent annually in New Zealand, and by 2.5 percent in Australia. For both countries the capital to labour ratio increased in all 12 industries from 1986 to 2008, that is, capital deepening was widespread (see figure 20.8).

New Zealand's positive performance was driven by significant capital deepening in communication services; and electricity, gas, and water supply. Australia's capital deepening was more consistent across the industries – while communication services also recorded the largest increase in the capital to labour ratio, eight other industries grew by between 2 percent and 4 percent annually from 1986–2008. The strongest of these were finance and insurance, wholesale trade, and electricity, gas, and water supply.

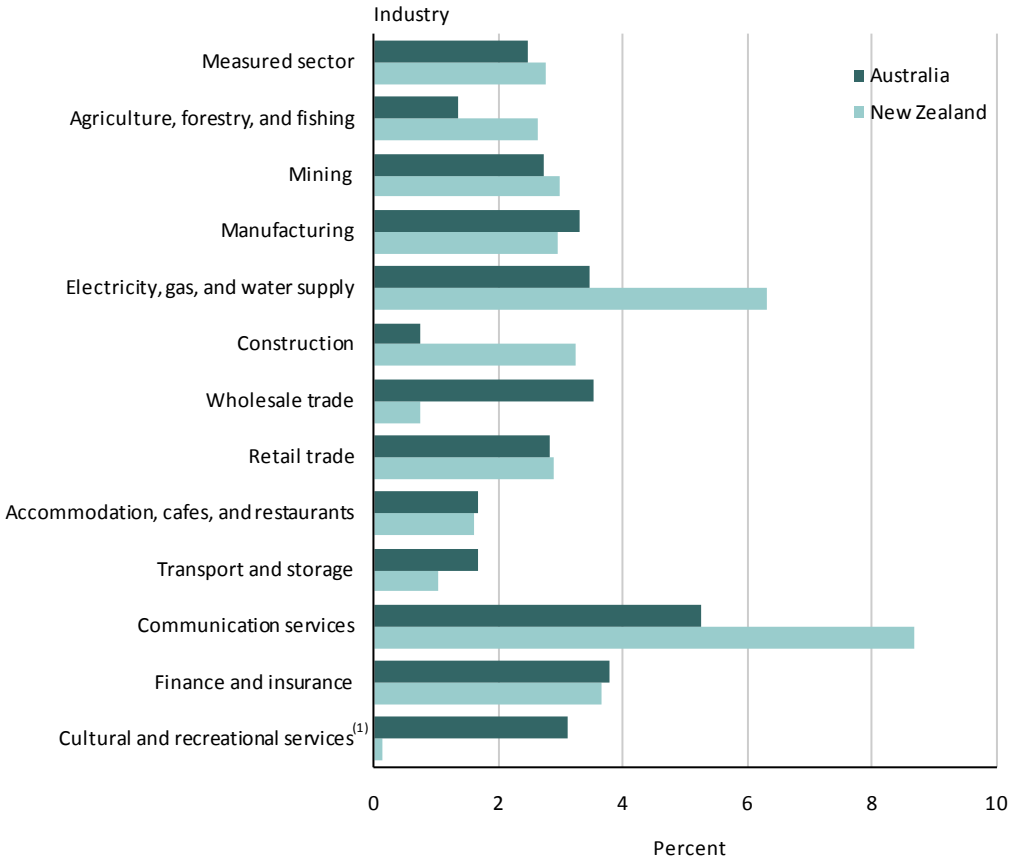
New Zealand's growth in capital deepening was stronger than Australia's in six of the 12 industries. These were communication services; electricity, gas, and water supply; agriculture, forestry and fishing; mining; construction; and retail trade. At the other end of the scale, there

was only a small amount of capital deepening within cultural and recreational services in New Zealand, where growth in capital input was only slightly higher than labour input.

Figure 20.8

New Zealand and Australia capital to labour ratio

Average annual growth rates 1986–2008



1. Average annual growth rates are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

Income shares

From 1986–2008, the average measured sector labour income share was 60 percent in New Zealand and 59 percent in Australia (see figure 20.9). In both countries, labour's share of income fell over time.

In New Zealand, labour income contributed 61 percent to total income in 1986, dropping to 59 percent in 2008. In Australia, the comparable figures were 62 percent and 55 percent. On average, New Zealand's labour income share was higher than Australia's in just four of the 12 industries: agriculture, forestry, and fishing; construction; accommodation, cafés, and restaurants; and transport and storage. The significant difference was in agriculture, forestry, and fishing, with more than 50 percent of industry income attributable to labour in New Zealand.

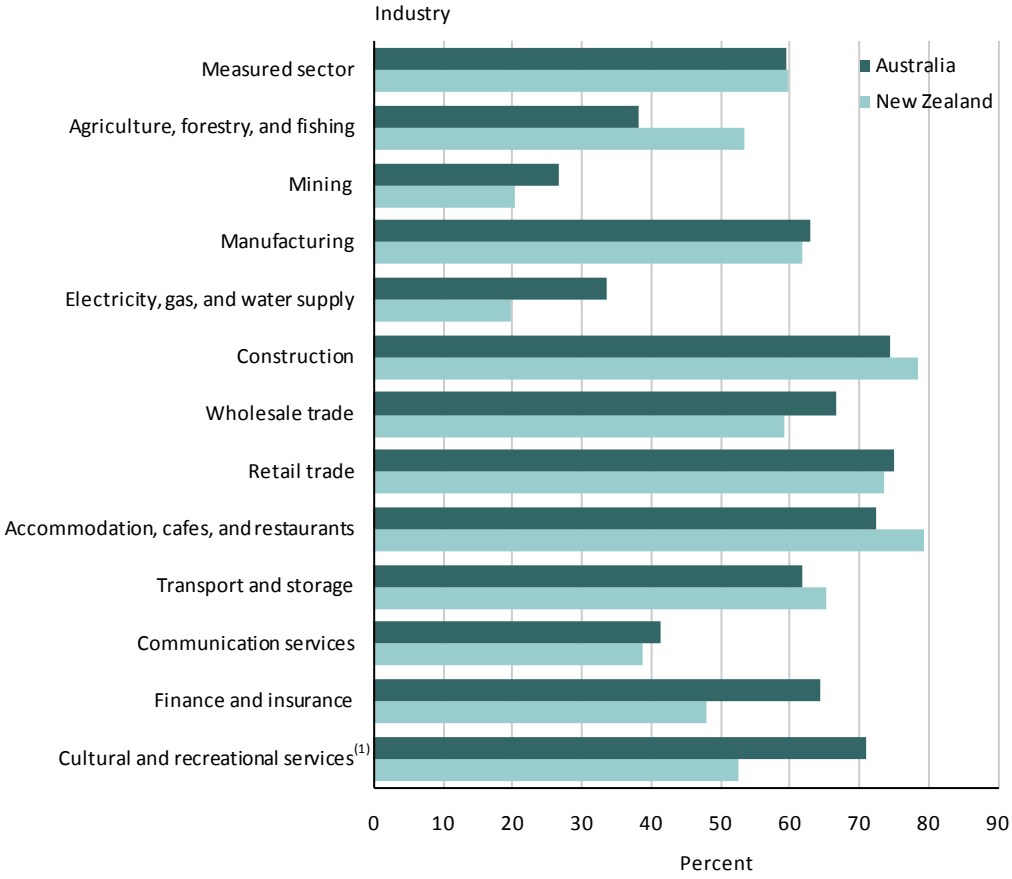
Australia's labour income share is significantly higher in electricity, gas, and water; and mining – the two industries in which labour income share is lowest for both countries. In both New

Zealand and Australia, the three industries with the highest proportion of labour income relative to capital are accommodation, cafés, and restaurants; construction; and retail trade.

Figure 20.9

New Zealand and Australia labour income share

Average from 1986–2008



1. Average income shares are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

Contribution to measured sector labour productivity growth

From 1986–2008, measured sector labour productivity in New Zealand grew by 2.5 percent annually, compared with 2.1 percent in Australia. The contribution of each of the 12 industries towards this aggregate growth is dependent on their growth and weight within the measured sector (see figure 20.10).

The strongest contributors to measured sector growth in New Zealand were manufacturing; agriculture, forestry, and fishing; communication services; and transport and storage. The top four contributors in Australia were manufacturing; finance and insurance; wholesale trade; and communication services.

In both countries, manufacturing had average or slightly below average labour productivity growth from 1986–2008 (see figure 20.4). However, it is easily the highest-weighted industry in the

measured sector, accounting for approximately 26 percent of measured sector GDP in New Zealand across the series, and 22 percent in Australia.

Agriculture, forestry, and fishing makes a far more significant contribution to measured sector growth in New Zealand than in Australia. Not only is it more highly-weighted in New Zealand, but labour productivity growth has been stronger. To a lesser extent, the same can be said of communications services. As figure 20.4 shows, communication services was the strongest performer in terms of labour productivity growth in both countries from 1986–2008. However, it is relatively low-weighted, contributing only 5 percent to measured sector GDP in New Zealand and Australia. Therefore, its contribution is smaller than manufacturing.

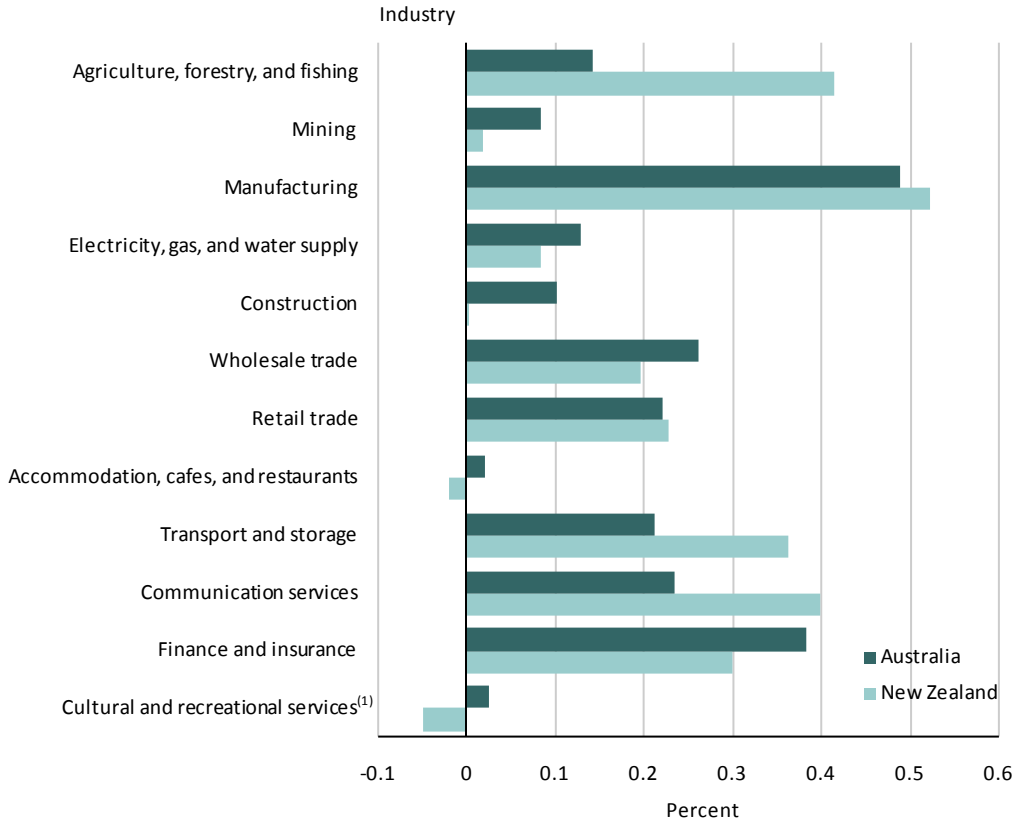
Industries that have contributed more strongly in Australia than New Zealand include construction; mining; electricity, gas, and water; and wholesale trade. However, with the exception of wholesale trade in Australia, none of these industries are among the strongest contributors to measured sector labour productivity growth.

In New Zealand, labour productivity declined in accommodation, cafés, and restaurants; and cultural and recreational services, resulting in a negative contribution to measured sector growth. In Australia, the same two industries had the lowest contributions, but they were slightly positive.

Figure 20.10

Industry contributions to measured sector labour productivity growth

New Zealand and Australia 1986–2008



1. Contributions are for 1996–2008 in both Australia and New Zealand for cultural and recreational services.

Source: Statistics New Zealand and Australian Bureau of Statistics

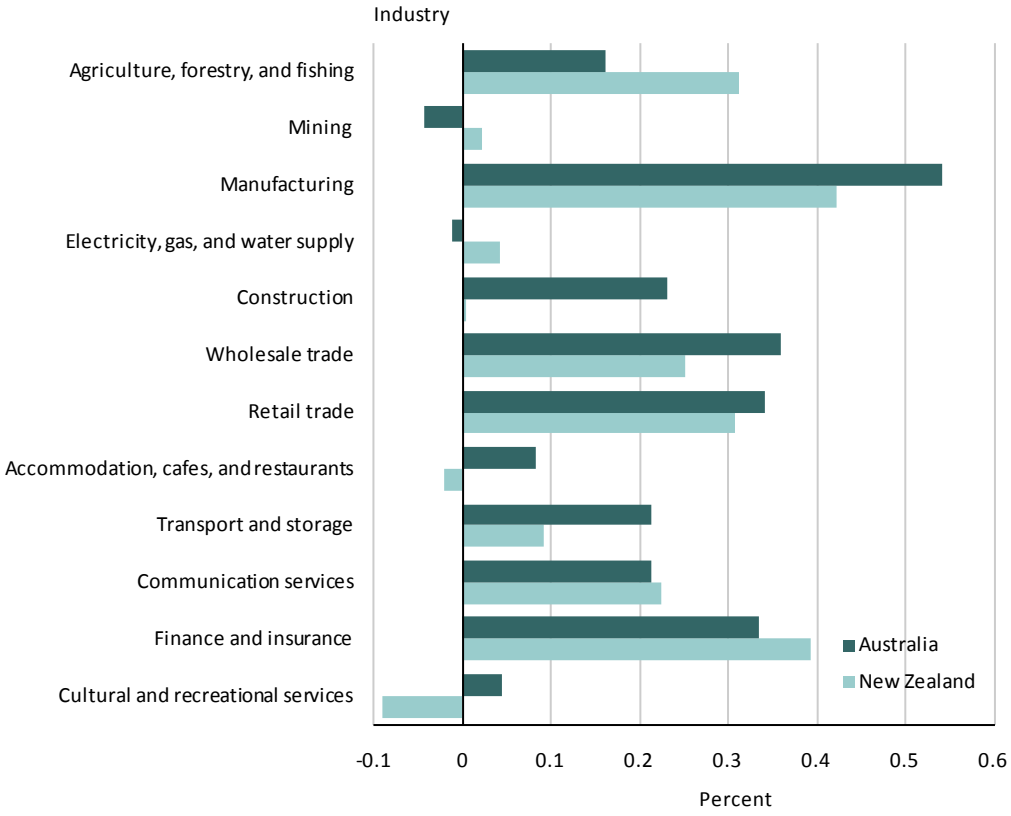
Focusing on the more recent time period from 1996–2008, the picture changes to some extent. Over this period, measured sector labour productivity grew by just 1.9 percent annually in New Zealand, and 2.3 percent in Australia.

Manufacturing was again the most significant contributor to growth in both countries; however, it was stronger in Australia than in New Zealand (see figure 20.11). In New Zealand, finance and insurance was not far behind manufacturing, followed by agriculture, forestry, and fishing; and retail trade. The contributions from communication services and transport and storage were still positive, but less significant.

In Australia, the next most significant contributors were wholesale trade, retail trade, and finance and insurance. Over these 12 years, the contribution to aggregate growth from seven of the 12 industries was higher in Australia than New Zealand. However, labour productivity in the mining industry declined in Australia from 1996–2008, while it rose in New Zealand, meaning New Zealand's contribution was positive and Australia's negative for this industry. This was also the case in electricity, gas, and water.

Figure 20.11

Industry contributions to measured sector labour productivity growth
New Zealand and Australia 1996–2008



Source: Statistics New Zealand and Australian Bureau of Statistics

Shift of industry classification to ANZSIC 2006

The comparisons in this chapter are undertaken using ANZSIC 1996, for the 12 common industries in which Statistics NZ and the ABS are publishing productivity growth estimates. However, in December 2009, the ABS published their National Accounts and productivity statistics under a new industry classification, ANZSIC 2006. The ABS' ANZSIC 1996 national accounts and productivity estimates are discontinued, with 2008 the last year in the time series.

In New Zealand, 2010 will be last year of the ANZSIC 1996 series. Statistics NZ is scheduled to publish its first set of annual current price National Accounts under ANZSIC 2006 in November 2011, followed by quarterly GDP, with productivity statistics scheduled to follow in March 2012. Under ANZSIC 2006, the first set of annual productivity statistics will be published for the March 2011 year. It has not yet been determined how far the series will be backdated. The comparison between level 1 of the two classifications is in table 20.2. None of the industries have exactly the same coverage in ANZSIC 2006 compared with their ANZSIC 1996 equivalent. Even for industries in which the ANZSIC 2006 industry title is identical to the ANZSIC 1996 title, there are differences at lower levels of the classification. The entire table is at level 1 of the classification with one exception – in the ANZSIC 1996 column, property and business services are separated

in New Zealand, while in Australia they are combined. In the full measured sector, business services is included in New Zealand from 1996 onwards, while property and business services was excluded in Australia's ANZSIC 1996 market sector.

Table 20.2

ANZSIC 1996 and ANZSIC 2006 industries

ANZSIC 1996 industry		Comparable ANZSIC 2006 industry	
A	Agriculture, forestry, and fishing	A	Agriculture, forestry, and fishing
B	Mining	B	Mining
C	Manufacturing	C	Manufacturing
D	Electricity, gas, and water	D	Electricity, gas, water, and waste services
E	Construction	E	Construction
F	Wholesale trade	F	Wholesale trade
G	Retail trade	G	Retail trade
H	Accommodation, cafés, and restaurants	H	Accommodation and food services
I	Transport and storage	I	Transport, postal, and warehousing
J	Communication services	J	Information, media, and telecommunications
K	Finance and insurance	K	Financial and insurance services
LA	Property services	L	Rental, hiring, and real estate services
LB	Owner-occupied dwellings		Owner-occupied dwellings
LC	Business services	M	Professional, scientific, and technical services
		N	Administrative and support services
M	Government administration and defence	O	Public administration and safety
N	Education	P	Education and training
O	Health and community services	Q	Health care and social assistance
P	Cultural and recreational services	R	Arts and recreation services
Q	Personal and other community services	S	Other services

Australia's ANZSIC 2006 productivity series is referred to as MFP16, because it now includes 16 industries, those which are non-italicised in table 20.2. In simple terms, the ABS has added the equivalent of property services and business services into their new measured sector. At lower levels of the classification, there are some switches, which are not apparent in table 19.2. The ABS has backdated the MFP16 series to 1995.

Statistics New Zealand has not yet determined which industries will be in the ANZSIC 2006 measured sector, but is aware of the importance of maintaining comparability with Australia where possible.

21 Glossary

ANZSIC 1996 – Australian and New Zealand Standard Industrial Classification 1996 (ANZSIC 96). This is the industrial classification used in this report.

ANZSIC 2006 – Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC 06). From March 2012, Statistics NZ will use this industrial classification for its productivity estimates. The updated set of Australian productivity estimates already use ANZSIC 06.

Average annual growth rate – Average annual growth rates reflect the average increase (or decrease) in a variable across a period of time. These are calculated as geometric means which are better suited to take account of the compounding of growth rates over time. Arithmetic averages give higher growth rates and would lead to a different index figure for the latest year when applied to the base year.

Capacity utilisation – Capacity utilisation refers to the difference between the potential and actual use of an input. Capacity utilisation is high when actual output is close to potential output because the most use is being made of labour and capital. In the productivity measures produced by Statistics NZ, it is assumed that capital and labour are utilised at a constant rate over time.

Capital to labour ratio – Measured as the capital input index divided by the labour input index.

Capital deepening – Positive growth in the capital to labour ratio. See also 'contribution of capital deepening'.

Capital income – That part of the cost of producing gross domestic product which consists of gross payments to capital. It represents the value added by capital in production, and is equivalent to the gross operating surplus less the labour income of working proprietors plus the capital proportion of taxes less subsidies on production.

Capital productivity – Measured as a ratio of output to capital input. This is derived by dividing the index of the chain volume measure of GDP by an index of capital services. Capital productivity reflects not only the contribution of capital to changes in production, but also the contribution by labour and other factors affecting production.

Capital services – Capital services reflect the amount of 'service' each asset provides during a period. For each asset, the services provided in a period are directly proportional to the asset's productive capital value in the period. As an asset ages and its efficiency declines so does the productive capital value and the services the asset provides. Capital services are the appropriate measure of capital input in production analysis.

Capital shallowing – A decline in the capital to labour ratio.

Chain volume measures – Annually-reweighted chain Laspeyres volume indexes referenced to the current price values in a chosen reference year (ie the year when the quarterly chain volume measures sum to the current price annual values). Chain Laspeyres volume measures are compiled by linking together (compounding) movements in volumes, calculated using the average prices of the previous financial year, and applying the compounded movements to the current price estimates of the reference year.

Compensation of employees – The total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the employee during the accounting period. It is further classified into two sub-components: wages and salaries; and employers' social contributions. Compensation of employees is not payable in respect of unpaid work undertaken voluntarily, including the work done by members of a household within an unincorporated enterprise owned by the same household. Compensation of employees excludes any taxes payable by the employer on the wage and salary bill (eg payroll tax, fringe benefits tax).

Contribution of capital deepening – The growth in the capital to labour ratio, weighted by capital's share of total income. Given that capital's share of total income is always less than 100 percent the contribution of capital deepening is always less than the growth in capital deepening. It is used for growth accounting for labour productivity.

Contribution of capital input – The growth in the capital input index, weighted by capital's share of total income. Given that capital's share of total income is always less than 100 percent the contribution of capital input is always less than the growth in capital input. It is used for growth accounting for output.

Contribution of labour input – The growth in the labour input index, weighted by labour's share of total income. Given that labour's share of total income is always less than 100 percent the contribution of labour input is always less than the growth in labour input. It is used for growth accounting for output.

Gross domestic product (GDP) – The total market value of goods and services produced in New Zealand within a given period after deducting the cost of goods and services used up in the process of production but before deducting allowances for the consumption of fixed capital. Thus, GDP, as defined here, is 'at market prices'. It is equivalent to gross national expenditure plus exports of goods and services less imports of goods and services.

Gross mixed income – The surplus due to owners of unincorporated businesses. It is often referred to as profit, although only a subset of total costs are subtracted from the output of unincorporated businesses to calculate it. Gross mixed income is split and allocated to capital and labour as factors of production.

Growth accounting – Growth accounting decomposes the growth rate of an industry's output into that which is due to the increase in factors of production – labour and capital – and that which cannot be accounted for by changes in labour and capital utilisation. This residual growth in output which cannot be accounted for is known as multifactor productivity, that is, the extent to which an industry is getting more output from the same amount of inputs.

Growth cycle – The span of years between the peak of one cycle and the peak of a following cycle. Peaks are determined using statistical techniques, and are chosen to represent high points in capacity utilisation of the economy. Productivity is best analysed over growth cycles, as annual movements can be volatile and don't usually represent true changes to the underlying production function.

Index – An index series is a simple way of expressing, in percentage terms, the change in some variable from a given point in time to another point in time.

Inventories – Inventories are a class produced non-financial assets and consist of: stocks of outputs that are still held by the units that produced them before being further processed, sold, delivered to other units, or used in any other ways; and stocks of products acquired from other

units that are intended to be used for intermediate consumption or for resale without further processing.

Labour income – That part of the cost of producing the GDP which consists of gross payments to labour. It represents the value added by labour in production, and is equivalent to compensation of employees plus the labour income of working proprietors plus the labour proportion of taxes less subsidies on production.

Labour input index – An index of the weighted number of hours paid in the measured sector. This is created by weighting together the industry level labour volume series using labour income weights.

Labour productivity – Labour productivity is measured as a ratio of output to labour input. Labour productivity estimates are indexes of real GDP per hour paid. Labour productivity reflects not only the contribution of labour to changes in product per labour unit, but is also influenced by the contribution of capital and other factors affecting production.

Labour volume series (LVS) – An estimate of the total number of hours paid in paid employment per week for the whole economy or a given industry.

Measured sector – The industry coverage of the productivity statistics is defined as the 'measured sector', consisting of industries for which estimates of inputs and outputs are independently derived in volume terms. Excluded are those industries for which real value added in the national accounts is largely measured using input methods, such as number of employees. These are mainly government non-market industries that provide services, such as administration, health, and education, free or at nominal charges.

Multifactor productivity (MFP) – Multifactor productivity estimates are indexes of real GDP per combined unit of labour and capital. They have been derived by dividing chain volume estimates of market sector GDP by a combined measure of hours paid and capital services. An increase in its value is commonly referred to as technical change or efficiency growth. However, it is more accurately interpreted as some combination of technological progress, efficiency gains, deviations from constant returns to scale, unobserved changes in capacity utilisation, or departures from economy-wide long run equilibrium. Multifactor productivity is essentially a residual, and so will also capture the impact of unobserved inputs on production.

Output – For the productivity measures, output is defined as chain-volume value added. Annual value added for the measured sector is derived following the same procedures 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. The resulting chained volume series are re-expressed as an index with an expression base of 1000 in the March 1978 year.

Productive capital stock – A measure of productive capacity and forms the basis for the measure of capital services. Productive capital stock estimates are derived as the written-down value of each asset in accordance with its decline in efficiency due to age. Productive capital stock is measured in units of 'standardised efficiency'.

Rental prices – Also referred to as the user cost of capital. The rental price is the unit cost for the use of an asset for one period. That is, the price for employing or obtaining one unit of capital services. The rental price for an asset is determined by its price index when new, its rate of economic depreciation, the average tax rate on production within the industry, and an exogenous real rate of return (set at 4 percent).

Total income – That part of the cost of producing GDP which consists of gross payments to factors of production (labour and capital). It represents the value added by these factors in the process of production and is equivalent to current price GDP.

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Appendix 1 Technical notes

Productivity measurement and interpretation

The Statistics NZ method of estimating productivity statistics is based on OECD guidelines, as outlined in the OECD manual, *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth* (2001). The approach adopted is referred to in the manual as "the index number approach in a production theoretic framework". The calculation of productivity statistics begins by postulating a production function of the form:

Equation 1

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

where V = chain-volume value-added
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)

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

Equation 2

$$LP = \frac{V}{L}$$

Where LP = an index of labour productivity. This is an index of chain-volume value added divided by an index of labour inputs.

Similarly, a capital productivity index KP is calculated as:

Equation 3

$$KP = \frac{V}{K}$$

Where KP = an index of capital productivity. This is an index of chain-volume value added 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 multifactor productivity, with no change occurring in the labour input itself.

The final productivity index that can be calculated is for multifactor productivity (MFP). The technological parameter that represents disembodied technological change (or MFP) cannot be observed directly. By rearranging the production function equation, it can be shown that the

technology parameter can be derived residually as the difference between the growth in an index of outputs to an index of inputs:

Equation 4

$$A(t) = \frac{V}{f(L, K)}$$

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.

Industry coverage

The current productivity estimates 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 (see the report *Measuring government sector productivity in New Zealand: A feasibility study* (Statistics NZ, 2009)).

The measured sector is defined in appendix table 1.

Appendix table 1

Productivity industry coverage[1]

Measured sector industries	Omitted industries
A Agriculture, forestry, and fishing	LA Property services
AA Agriculture	LB Ownership of owner occupied dwellings
AB/AC Forestry and fishing	M Government administration and defence
B Mining	N Education
C Manufacturing	O Health and community services
CA Food, beverage, and tobacco	
CB Textile and apparel	
CC Wood and paper products	
CD Printing, publishing, and recorded media	
CE Petroleum, chemical, plastic, and rubber products	
CF Non-metallic mineral products	
CG Metal products	
CH Machinery and equipment	
CI Furniture and other	
D Electricity, gas, and water supply	
E Construction	
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[2]	
Q Personal and community services[2]	

1. Based on the Australian and New Zealand Standard Industrial Classification 1996 (ANZSIC 1996).

2. Included in the measured sector from March 1996 onwards.

Output series methodology

Output is defined as constant-price value-added by industry. Annual movements in the industry output index are identical to annual movements in chain-volume GDP statistics.

Labour series methodology

The labour volume series (LVS) measures the quantity of labour input over a time series. The sources and methods for the industry-level LVS are exactly the same as for the LVS that is used in the measured sector productivity release.

The series is based on hours paid per week for a given quarter. The LVS uses data from the Quarterly Employment Survey (QES), the Business Demography Database (BDD), the Household Labour Force Survey (HLFS), the Census of Population and Dwellings (census), Linked Employer-Employee Data (LEED), the Department of Labour Quarterly Employment Survey (DoL QES), and the Department of Labour Half-Yearly Employment Information Survey (DoL HYEIS) to obtain data on counts and hours for employees and working proprietors across industries.

From the data source perspective, there are three components of the LVS used in the industry-based series.

Component 1 includes employees in industries covered by the QES. For this component, 1978–87 data from the DoL HYEIS and the DoL QES is used to provide data on counts and hours paid (including overtime) of employees. From 1987 to 2000, annual BDD counts of employees are interpolated using quarterly movements in employee count from the DoL QES up to 1989, and then the QES. This series is then multiplied by quarterly estimates of average weekly hours (including overtime) from the QES to achieve a quarterly series for paid hours. From 2000 onwards, the methodology is similar, except that annual LEED counts of employees replace the BDD as the source for counts.

Components 2 and 3 are estimated in the same manner, using a combination of household survey data, establishment survey data, census data and LEED. Component 2 covers working proprietors, and component 3 includes employees out of scope of the QES. For both of these components, the hours data is benchmarked using totals from the census up until 2000. From 2000 on, LEED totals provide the benchmarks.

Up to 1986, movements between benchmarks for counts and hours are interpolated using data from the DoL HYEIS, DoL QES and Agriculture Census. From 1986 onwards, movements between hours benchmarks are interpolated using quarterly estimates of change from the HLFS, applying the same methodology used in the interpolation of component 1. Over this period, movements between job count benchmarks are also interpolated using quarterly HLFS estimates of change

Appendix table 2 outlines the sources.

Appendix table 2

Summary of how the economy-wide labour volume series is constructed[1]

Industry	Data sources			
	Employee count	Employee hours	Working proprietor count	Working proprietor hours
		1978–1987[2]		
DoL QES industries[3]	DoL QES	DoL QES	Census/DoL QES	Census/DoL QES
Agriculture	Census/Agriculture Census	Census	Census/Agriculture Census	Census
Services to agriculture, hunting, and trapping	Census	Census	Census	Census
Commercial fishing	Census	Census	Census	Census
		1987–2000		
QES industries	BDD[4]/QES jobs[5]	QES paid hours[5]	Census/HLFS count	Census/HLFS usual hours
Agriculture	Census/HLFS count	Census/HLFS usual hours	Census/HLFS count	Census/HLFS usual hours
Services to agriculture	Census/HLFS count	Census/HLFS usual hours	Census/HLFS count	Census/HLFS usual hours
Commercial fishing	Census/HLFS count	Census/HLFS usual hours 2000 onwards[6]	Census/HLFS count	Census/HLFS usual hours
QES industries	LEED	QES paid hours	LEED[6]	Census/HLFS usual hours
Agriculture	LEED	Census/HLFS usual hours	LEED[6]	Census/HLFS usual hours
Services to agriculture	LEED	Census/HLFS usual hours	LEED[6]	Census/HLFS usual hours

1. Exclusions from the series include international sea transport (as people working in this industry are working abroad) and foreign government representation (as embassies, etc, are deemed to be island states and economies of their particular home country).
2. Data sourced from the census and Agriculture Census is linked to the census/HLFS data in 1986. All other DoL QES-based employee data are linked to the BDD/QES in 1989.
3. The DoL QES did not commence until 1980. Before this, DoL's Half-yearly Employment Information Survey data was used.
4. Annual BDD employee count benchmarks are incorporated into the series from 1987 for most industries, and from 1988 for the remainder.
5. BDD data is interpolated using DoL QES data until 1989
6. LEED counts for working proprietors are based on annual data, supplemented by data from the HLFS and QES.

Note: DoL – Department of Labour; QES – Quarterly Employment Survey; BDD – business demography database; HLFS – Household Labour Force Survey

Component 1 - Employee jobs in industries covered by the QES (sourced from establishment or firm–based data, and administrative taxation data). This component of the quarterly hours paid series is constructed by first estimating an employee job count series.

From 1978 to 1980, job counts are obtained from full coverage semi-annual data from the DoL HYEIS. Linear interpolation is used to convert the biannual data to quarterly. For the years 1980 to 1988, the full-coverage February quarter acts as a benchmark, with the May, August and November quarters being interpolated using growth rates at the ANZSIC working industry by sector level.

From 1989 to 2000, quarterly movements in the QES job count are used to interpolate between annual employee job count totals from the BDD at the ANZSIC working industry by sector level. ANZSIC working industries (or ANZIND) are defined by six-digit ANZSIC.

From 2000 onwards, LEED provides the annual employee job count totals, at the ANZSIC working industry level. LEED monthly point-in-time data on the counts of jobs, and people in jobs, on the 15th of each month are used. Job counts are combined with quarterly job-level hours paid data from the QES to calculate the total hours paid in each industry.

There are a number of exceptions to this standard methodology, in instances where other data sources are judged to produce more suitable labour volume estimates.

The quarterly hours paid series is then compiled as the product of the interpolated job-count series and the average weekly hours paid per job calculated from the QES. (The average weekly hours paid per job from the QES is calculated by dividing total hours paid per week as recorded in the survey by the survey employee job count.) Quarterly totals of hours paid are not further benchmarked, as hours data is not collected for the BDD or LEED.

Component 2 - Working proprietors (sourced from household survey data, and administrative taxation data) Refer to component 3.

Component 3 - Employees in industries excluded from QES (sourced from household survey data, and administrative taxation data). Throughout the series, usual hours worked (from the census) are used as a benchmark to estimate hours paid for components 2 and 3. It is the number of hours the respondent usually works in employment during a particular reference period, even if they did not in fact do so during the survey reference period because of temporary absences (due to sickness or holidays, etc). The QES measure of hours paid is different in concept to usual hours of work measured by the HLFS and census. It is assumed, at least for the relevant industries, that these are close enough to allow them to be treated as measuring the same thing.

For industries within the scope of the DoL employment surveys, census benchmarks for working proprietor counts are interpolated using movements in the DoL employment survey data from 1978 to 1986. This data is limited to working proprietors who employ two or more staff, implicitly assuming that this group is representative of all working proprietors. Working proprietor hours are interpolated using movements in employee hours from the DoL surveys.

For agricultural sub-industries outside the scope of the DoL survey, census data for 1976, 1981 and 1986 are used to create an annual working proprietor average hours series. This average hours series is created by using linear interpolation between census benchmarks. This series is then combined with the Agriculture Census employment data to get an annual series of hours worked in agriculture. For other industries where robust data is not available from the DoL

surveys or Agriculture Census, linear interpolation between census benchmarks is used to create a quarterly series of labour input.

From 1986 to 2000, the quarterly series for employment, and hours paid for the above two components, are derived by interpolating between five-digit ANZSIC totals from the census using quarterly estimates of change from the HLFS at the published one-digit ANZSIC level. The resulting five-digit ANZSIC level series are then aligned to an ANZSIC-based classification that groups industries for publication (ANZIND) for the relevant industries. Usual hours worked (from the HLFS) is used as a proxy for hours paid.

From 2000 onwards, the series for employment is sourced from LEED, for both components 2 and 3. Consistent 1986–2000 period, hours paid are derived by interpolating between five-digit ANZSIC totals from the census using quarterly estimates of change from the HLFS at the published one-digit ANZSIC level. Additionally, monthly point-in-time LEED data on secondary jobs is used, combined with HLFS data on hours worked in secondary jobs. This data is not disaggregated by worker type or industry. Furthermore, a small proportion is added to the employment counts to account for unpaid family work. This data is sourced from the HLFS.

For working proprietors, quarterly proportions from the HLFS and QES are used to add seasonality to the LEED counts, while keeping the annual average counts unchanged.

Capital input series methodology

Constructing estimates of capital productivity and MFP using an index number technique requires an index representing the flow of capital services. Capital services are generated by the use of capital assets over a specified period of time (annual March years in this case).

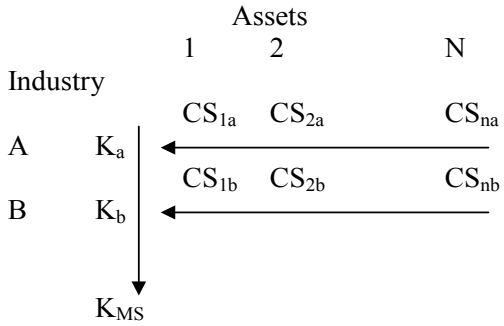
The range of capital assets includes 24 of the 26 produced assets, which are estimated in the national accounts using a perpetual inventory method (PIM). The PIM accumulates these assets' investment flows and applies retirement, efficiency and discount parameters to derive estimates of productive capital stock (PKS), net capital stock (NKS) and consumption of fixed capital (CFK).

In addition to these assets, capital services estimates used in this study encompass land (for all industries except fishing), and inventories in a selection of industries. Included within the inventories estimates are livestock (in agriculture) and timber (in forestry).

The construction of the capital services index for the measured sector proceeds in two distinct steps. A capital services index is calculated by aggregating the services provided by the capital assets. With reference to appendix figure 1, this is the process of 'horizontal' aggregation.

Appendix figure 1

The two stages of deriving measured sector capital services



Estimates of capital services cover the private and government sectors. This coverage is consistent with the labour and output series.

Capital asset types within the scope of the PIM

Productivity studies require a measure of the PKS. An asset's productive capital stock is its gross capital stock adjusted for the decline in its efficiency. Volume measures of PKS represent 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 Statistics NZ PIM specifies for each asset type a mean expected useful life, a retirement function based on a distribution about this life and a pattern of (hyperbolic) efficiency decline. These parameters and gross fixed capital formation in volume terms are used to estimate an asset type's PKS in volume terms.

Considering one asset type of a single vintage, a hyperbolic age efficiency function is specified as:

Equation 5

$$E_t = \frac{M - A_t}{M - bA_t} \qquad (0 \leq \text{At} < \text{M})$$

Where E_t = the efficiency of the asset at time t, relative to its efficiency when new

M = the asset life, as per an assumed retirement distribution

A_t = the age of the asset of the given vintage, at time t

b = the efficiency reduction parameter.

To aggregate the efficiency units of assets with different lives (M), it is necessary to construct the weighted average of the age efficiency terms. The weights are the relative frequencies of asset lives, as determined by the Winfrey probability function.

Equation 6

$$R(A_t) = \sum_{M=A}^{M\max} P(M)\frac{M - A_t}{M - bA_t} \quad (0 \le \text{At} < \text{M})$$

Where $R(A_t)$ = relative efficiency of assets of age A

$P(M)$ = relative frequency of assets with life M

M_{max} = maximum useful life of the asset, as determined by the Winfrey function.

The real productive capital stock of an asset type within a given industry is then calculated as the sum of the relative efficiency of each vintage weighted by its gross fixed capital formation:

Equation 7

$$PKS_t = \sum_{A=0}^{M\max} R(A).GFKF_{(t-A)}$$

Where PKS_t = productive capital stock of the asset type in period t, in volume terms

$GFKF$ = gross fixed capital formation in volume terms.

The critical input to the PIM is current price gross fixed capital formation (GFKF). GFKF data at a detailed asset level is estimated by working industry, sector of ownership (private, local and central government) and market group (market or non-market enterprise) as part of the annual national accounts supply-use balancing process. The supply side estimates are sourced from data on imports and domestic production - AES sales figures and quarterly surveys. Demand side estimates are obtained from AES GFKF data, direct enquiry, the financial accounts of large corporates and government sector financial accounts.

For the years in which the demand and supply estimates have yet to be reconciled through supply-use balancing, economy-wide GFKF data by asset type and sector are obtained from quarterly GDP estimates. Where specific information is not yet available, industry and market group allocations are made according to the proportions from the latest balanced year.

Data for all years is summed and enter the PIM by 26 asset types, by sector, by market group and by working industry. From this point, volume estimates of GFKF are derived using price index deflation. Age-price and age-efficiency functions are then used to form estimates of PKS, NKS and CFK.

The AES covers approximately 90 percent of New Zealand's 'economically significant' enterprises. An enterprise is deemed to be economically significant if it meets at least one of the following criteria:

- has annual GST expenses or sales of more than $30,000
- has a rolling mean employment count over any given 12-month period of more than two
- is in a GST-exempt industry (except residential property leasing and rental)
- is part of a group of enterprises
- is a new GST registration that is compulsory, special or forced
- is GST registered and involved in agriculture or forestry.

Industries excluded from the AES include residential property operators not elsewhere classified, and foreign government representation. Also excluded from the AES are religious organisations and private households employing staff.

The elemental level at which PIM outputs are produced is the working industry by asset type. For a single asset type, estimates of these outputs at the published industry level are the sum of the corresponding working industry level values. This is the case in both current prices and volume terms.

The asset price indexes employed in the PIM for deflation (and reflation) are specified by asset type and by sector (private and government) but are invariant to the industry of use.[4] However, the implicit price deflators which the PIM produces (at the asset type by working industry level) are industry as well as asset specific. The industry deflator is influenced by the relative contributions of the sector's capital stocks to the industry's overall capital stock. To be consistent with the elemental level of analysis, the Statistics NZ calculation of capital services employs these implicit price deflators as the asset price indexes.

A comprehensive description of Statistics NZ's PIM is provided in the draft manual *Measuring Capital Stock in the New Zealand Economy* (Statistics NZ, unpublished).

Capital asset types outside the scope of the PIM

Land

Estimates of the productive land stock are produced for each industry. Estimates of agricultural land use, by hectares, are obtained from Statistics NZ agricultural production censuses and surveys. For years where agricultural production censuses and surveys are unavailable, land volume data from Quotable Value Limited is used to interpolate. The volume estimate for forestry land use, by hectares, is obtained from the Ministry of Agriculture and Forestry' National Exotic Forestry Description reports. Estimates of commercial, industrial, mining and other non-agricultural land volumes are obtained annually from Quotable Value Ltd. Commercial, industrial, mining and other non-agricultural land are included in the capital input series from 1996 onwards.

Current price estimates of the stock of land are calculated for all industries by multiplying their respective volumes (hectares) by a price per hectare. Average per hectare prices are estimated using valuation and volume data from Quotable Value Ltd. The resulting current price series include the value of land improvement expenditures, thereby creating a double count with the PIM asset type 'land improvements'. To address this, current price productive capital stock estimates of land improvements, sourced from the PIM, are deducted from the current price land values. These current price values, net of land improvements, are then divided by land volumes to establish implicit price deflators.

Volume estimates of land for productivity analysis are derived by quantity revaluation using 1995/96 prices. These volumes are considered to be both the land's productive capital stock and net capital stock, as land is regarded as a non-depreciable asset.

Inventories

Inventories are now included within the scope of the capital assets. Price and volume estimates of inventories have been obtained from the National Accounts for selected industries. They have

4. The majority of these price indexes are provided by Statistics New Zealand quarterly capital goods price index.

been included from 1978 for the agriculture and forestry industries, and from 1987 for the manufacturing industries; wholesale trade; retail trade; and accommodation, cafés, and restaurants; reflecting the availability of source data. With the inclusion of inventories in the capital asset scope, the treatment of livestock and timber stocks has changed. Livestock and timber stocks are now sourced from the National Accounts as part of the inventories series from 1980 onwards. Before to 1980, movements are calculated using the previous methodology, and are linked on to the National Accounts-sourced series at this point.

The capital services index for an industry is a chain-linked Tōrnqvist index of the capital services provided by the asset types employed in that industry. A Tōrnqvist index is used to maintain consistency with the construction of the input index for M estimates, as well as the labour volume index.

Because the movements in the volume of the capital services provided by an asset are unobservable, they are proxied by movements in the asset's productive capital stock (ie the potential volume of capital service flows based on the asset's physical stock and age-efficiency function). This is effectively an assumption of inter-temporal constant capacity utilisation. Assuming constant capacity utilisation suggests pro-cyclical biases in capital and multifactor productivity statistics.

The Tōrnqvist index is constructed as the geometric mean of assets' two-period productive capital stock ratios (representing capital services ratios) weighted exponentially by each asset's mean two-period share of the industry's value of capital costs. An asset's cost of capital is its user cost (rental price) multiplied by its flow of capital services.[5]

Equation 8

$$KC_{ijt} = u_{ijt} PKS_{ijt}$$

Where KC_{ijt} = cost of capital services for asset j in industry i, period t

u_{ijt} = user cost of asset j in industry i, period t

PKS_{ijt} = productive capital stock of asset type j in industry i, period t.

Industry capital cost is the sum of each asset's cost of capital services:

Equation 9

$$KC_{it} = \sum_{j} u_{ijt} PKS_{ijt}$$

Where KC_{it} = cost of capital services in industry i, period t.

So that the capital services index is represented by equation 10 and its associated weights by equation 11:

Equation 10

$$k_{it} = \frac{C_{it}}{C_{i(t-1)}} = \prod_{j} \left(\frac{PKS_{ijt}}{PKS_{ij(t-1)}} \right)^{Wijt}$$

5. Capital service flows are assumed to be proportional to the level of the productive capital stock.

Equation 11

$$Wijt = \frac{1}{2}\left(\frac{KC_{ijt}}{KC_{it}} + \frac{KC_{ij(t-1)}}{KC_{i(t-1)}}\right)$$

Where k_{it} = capital services index for industry i in period t

C_{it} = volume of capital services produced by industry i in period t.

The user cost is the cost of using a capital good for a specified period (in this case, one year). It is analogous to the wage rate in the LVS. In the context of 'thin' or non-existent rental markets, the user cost is approximated by the implicit rental that owners of capital pay to themselves.

Statistics NZ adopts a user cost which is determined by four factors: the asset price, as new, relative to its base period price; a real rate of return; the asset's rate of economic depreciation; and the effective rate of non-income tax on production. This user cost is given by Equation 12.

Equation 12

$$u_{ijt} = p_{ijt}(i + d_{ijt}) + p_{ijt}x_{it}$$

Where p_{ijt} = the price index of new capital asset j in industry i, period t

i = the real rate of return (set at 4 percent)

d_{ijt} = the rate of economic depreciation of asset j in industry i, period t

x_{it} = the average non-income tax rate on production for industry i, period t.

The asset price term, p_{ijt}, is the implicit price index which results from dividing an asset's productive capital stock in current prices by its chain-volume equivalent. From Equation 8 it was seen that the cost of capital services for a single asset is equal to its user cost multiplied by the volume of capital services, represented by PKS. In practice, PKS (the capital services volume) is measured in constant dollars, hence the user cost (the capital services price) is calculated as a price relative in order for the resulting product to be measured in dollar units. The user cost in the above formulation is effectively 'unit free'. Using the asset price term p_{ijt}, results in the cost of capital services being expressed in the prices of period t.

The rate of economic depreciation, which combines the devaluing effects on an asset of efficiency loss and ageing, is the ratio of the consumption of fixed capital to its productive capital stock:

Equation 13

$$d_{ijt} = \frac{CFK_{ijt}}{PKS_{ijt}}$$

Where CFK_{ijt} = consumption of fixed capital of asset j in industry i, period t

PKS_{ijt} = productive capital stock of asset j in industry i, at end of period t.

Both CFK_{ijt} and PKS_{ijt} values are in volume terms. The rate of economic depreciation (equation 13) is expressed with PKS_{ijt} as the denominator in order to derive the correct cost of capital services (refer equation 8 in which PKS_{ijt} appears as the volume measure).

Non-income business taxes are those taxes on production that are assignable to capital inputs. The parameter x_{it} is the ratio of these taxes at the industry level to the industry's chain-volume productive capital stock.

Equation 14

$$x_{it} = \frac{NTk_{it}}{PKS_{it}}$$

Where NTk_{it} = net taxes on production attributed to capital in industry i, period t

PKS_{it} = productive capital stock in industry i, at end of period t

Both NTk_{it} and PKS_{ijt} values are in current prices.

The remaining term in the user cost equation 12 is the real rate of return required by firms to effectively cover their financing costs. International work done at the OECD where exogenous real rates of return have been used for capital services measurement at the total economy level showed that in the 18 countries examined, long-run averages of real interest rates oscillated around values between 3 and 5 percent per year, depending on the country (OECD, 2009). Work done during the development of the perpetual inventory model (PIM) of capital stock within Statistics NZ found that in the 20-year period 1980–2000, the mean long–run real interest rate (as represented by long-term interest rates on NZ Government Stock, deflated by the CPI) was 4 percent. This rate is used in the PIM to discount the composite age-price function to derive the composite age-efficiency function. To ensure internal consistency, the same 4 percent real rate is used in the calculation of the user cost of capital.

There are a number of different ways in which the user cost of capital, and in particular the interest rate, could be derived. A good summary of these different approaches is provided in *Measuring Capital: OECD Manual 2009, second edition* (2009). One alternative approach that is adopted by many statistical agencies is to derive the rate of return endogenously. Under this approach, capital income is equated with the value of capital services (see equation 9) to give:

Equation 15

$$Yk_{it} = \sum_{j} u_{ijt} PKS_{ijt}$$

Where Yk_{it} = current price capital income in industry i, period t.

Using the user cost equation 12 and solving for the real rate of return gives:

Equation 16

$$i_{it} = \frac{Yk_{it} - \sum_{j} PKS_{ijt}\left(p_{ijt} d_{ijt} + p_{ijt} . x_{it}\right)}{\sum_{j} p_{ijt} PKS_{ijt}}$$

While the endogenous approach has some theoretical appeal, and is by definition self-balancing, there are a number of drawbacks to this approach:

- where asset coverage is incomplete, the rate of return will be biased upwards
- an endogenous approach assumes perfect foresight on the part of economic agents (as it is an ex-post rate)
- it assumes the absence of economic rents

- there is increased likelihood of negative user costs in the presence of either low capital income or significant capital gains.

Following an assessment of a range of alternative methods for calculating the user costs to be used in weighting the movements in volumes of assets within the industry capital services indexes, the exogenous real rate (4 percent) was selected as being the most appropriate in the New Zealand circumstances.

In a small number of cases it is possible for the user cost to be negative or zero, which leads to computational problems. In both of these cases a user cost of 0.00001 is used in order to ensure a non-zero and non-negative user cost of capital. In practice, this is a rare event and the impact of removing this treatment, which is based on pragmatism, has been quantified and found to be negligible.

Exclusion of roading assets from industry capital services indexes

Of the 26 assets included in the PIM, only 24 are used within the capital services measure. The two excluded assets are central government roading and local government roading. These are owned by ANZSIC division M, government administration and defence, which fall outside the measured sector.

None of the industries bears the cost of using these assets, which are essentially public goods in the sense that they are non-excludable and non-rival in consumption. The roading network, like other public goods, does not represent a capital asset with an allocable user cost. Rather, its existence enhances the facility of other transport equipment assets and is absorbed into the calculated multifactor productivity residual.

The industry capital services index

The capital services index for the measured sector is formed by a Tōrnqvist aggregation of the constituent industries' capital services indexes. The aggregation weights are the mean two-period industry shares of measured sector current-price capital income. Equation 17 summarises this aggregation:

Equation 17

$$K_t = \prod_i \left(k_{it}\right)^{Wk_{it}}$$

Where K_t = the measured sector capital services index, period t.

This is equivalent to:

Equation 18

$$\frac{C_t}{C_{(t-1)}} = \prod_i \left(\frac{C_{it}}{C_{i(t-1)}} \right)^{Wk_{it}}$$

Where C_t = the volume of capital services in the measured sector, period t.

And:

Equation 19

$$Wk_{it} = \frac{1}{2}\left(\frac{Yk_{it}}{\sum_i Yk_{it}} + \frac{Yk_{i(t-1)}}{\sum_i Yk_{i(t-1)}} \right)$$

Equations 17 and 18 provide an index representing proportionate movements in industries capital services. Assigning a value of 1000 to the 1978 year volume of capital services, and using these movements, produces the capital services index (1978 = 1000) for the full 1978–2009 time period.

Capital and labour income shares

The industries' 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.

This net mixed income must be separated into its two components, namely the income flows which result from the use of labour and capital.

Estimating industry labour income

The previously calculated employee and working proprietor hours paid series, along with the National Accounts compensation of employees data, are used to allocate the industry net mixed income to the primary factors. The labour income of working proprietors is imputed as:

Equation 20

$$Ylwp_{it} = COE_{it}\left(\frac{WPhp_{it}}{TEhp_{it}}\right)$$

Where $Ylwp_{it}$ = labour income of working proprietors in industry i, period t

COE_{it} = compensation of paid employees in industry i, period t

$WPhp_{it}$ = working proprietor hours paid in industry i, period t

$TEhp_{it}$ = total hours for paid employees in industry i, period t.

The labour income of working proprietors for industry i, as defined in equation 20, has a ceiling; it cannot be greater than the net mixed income of that industry. In such cases, the net mixed income apportioned to capital will be equal to zero.

A share of net taxes on production is apportioned to labour income as well. This is based on the relative share of labour income to the sum of labour and capital income.

Equation 21

$$NTl_{it} = \left(\frac{COE_{it} + Ylwp_{it}}{COE_{it} + GOS_{it}}\right)NT_{it}$$

Where NTl_{it} = net neutral taxes on production attributed to labour income in industry i, period t

NT_{it} = net taxes on production in industry i, period t.

GOS_{it} = gross operating surplus in industry *i*, period *t*.

Total net taxes on production attributable to labour are given by:

So that current price industry labour income is given by:

Equation 22

$$Yl_{it} = COE_{it} + Ylwp_{it} + NTl_{it}$$

Where Yl_{it} = labour income in industry *i*, period *t*.

Estimating industry capital income

Capital income is assumed to be the sum of gross operating surplus (after the deduction of the labour income of working proprietors - as defined in equation 20) and net taxes on production which are attributable to capital.

Gross operating surplus and net taxes on production are sourced from the current-price industry production accounts published in the National Accounts. These production accounts are available for years in which the industries have been balanced through an input-output analysis[6].

Adjusted gross operating surplus (ie gross operating surplus less the labour income of working proprietors) is given by:

Equation 23

$$AGOS_{it} = GOS_{it} - Ylwp_{it}$$

Where $AGOS_{it}$ = adjusted gross operating surplus in industry *i*, period *t*

GOS_{it} = gross operating surplus in industry i, period t

$Ylwp_{it}$ = labour income of working proprietors in industry *i*, period *t*.

Industry capital income is therefore calculated as the sum of adjusted gross operating surplus plus a share of net taxes on production, which is added in order that the capital and labour incomes sum to industry gross value added. This is based on the relative share of capital income to the sum of labour and capital income. Industry capital income is estimated as:

Equation 24

$$Yk_{it} = AGOS_{it} + NTk_{it}$$

Where NTk_{it} = net taxes on production attributed to capital income in industry *i*, period *t*.

And:

Equation 25

$$NTk_{it} = \left(\frac{AGOS_{it}}{COE_{it} + GOS_{it}} \right) NT_{it}$$

Where NT_{it} = net taxes on production in industry *i*, period *t*

6. As at March 2010, the latest balanced year is 2007. Observed industry capital income, industry capital service weights and factor income shares for 2008 and 2009 are fixed.

COE_{it} = compensation of paid employees in industry i, period t.

Note that the term NTk_{it} is used as the numerator in the calculation of the average rate of non-income tax on production.

Growth accounting

The growth accounting technique examines how much of an industry's output growth can be explained by the growth rate in different inputs (namely, labour and capital). The additional output growth - known as MFP - is determined residually.

The growth accounting technique also examines how much of an industry's labour productivity growth can be determined by growth in the amount of capital available per worker. Again, the additional labour productivity growth is determined residually, and is termed MFP.

A growth accounting approach must rely on a number of simplifying assumptions:

- production processes can be represented by a production function at the industry level of the economy. A production function will relate a maximum output level to a set of available inputs
- producers behave efficiently, that is they maximise revenue and / or minimise costs
- markets are competitive. Market participants are price takers, which means they can only adjust quantities and can not individually influence market prices.

These assumptions are not necessarily met in practice, but provide a reasonable approximation to many markets.

Presentation across growth cycles

This report contains productivity data presented as annual averages within specific measured sector growth cycles. While the productivity model assumes no differences (across industry and time) in the asset capacity utilisation rates, in reality capacity utilisation of capital will vary across a cycle. The cycles are identified as 'peak to peak', determined where output growth and MFP growth are at their highest deviation from trend. The final growth cycles selected also take into account economic events throughout the time period. It is important to note that individual industries will not necessarily have the same growth cycles. For comparability across industries, and with the measured sector, industry specific growth cycles have not been used.

Published series

The productivity indexes for the majority of the published industries have an expression base year ended March 1978=1000, consistent with the first year of the series. The three industries which commence in 1996 have an expression base year ended March 1996 = 1000. Industry gross domestic product data used to calculate productivity indexes from 1978 to 1988 is currently provisional.