UNCOVERING INDUSTRY DRIVERS OF NEW ZEALAND'S LABOUR PRODUCTIVITY GROWTH

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Abstract

This paper highlights the industry level drivers of aggregate labour productivity growth in New Zealand. We show how the various trends in labour productivity growth have been influenced by capital deepening and multifactor productivity across industries, and how each industry has contributed to the measured sector's labour productivity growth.

JEL Codes: J24, O47

Keyword(s): Productivity measurement; industry; labour

Introduction

Productivity growth is critical to long-term growth in material living standards; it means that more value is added in production, and therefore more income is available to be distributed. For this reason, there has been growing interest in gaining a better understanding of New Zealand's productivity performance, both within industries and relative to other countries.

Successive governments have prioritised productivity growth as the way to lift New Zealand's income per capita relative to the average of Organisation for Economic Development and Co-operation (OECD) member countries. New Zealand's income per capita in 2008 was US $27,036, while the average for OECD countries was US $33,733. This gap is largely due to differences in labour productivity which is strongly correlated with gross domestic product (GDP) per capita. Between 1995 and 2008, labour productivity growth averaged 1.3 percent and 1.9 percent per annum in New Zealand and across OECD countries respectively (OECD, 2010).

Productivity measures are vital to a better understanding of long-term improvements in New Zealand's living standards, economic performance, and international competitiveness. Productivity statistics provide information to government, researchers, and media on how the economy is performing. The aggregate productivity growth rate can mask substantial variation in growth within individual industries. To ensure the relevance of productivity statistics, it is important to unpick the data at a lower level. This provides a better understanding of what is driving aggregate productivity growth.

Presenting productivity at the industry level unmasks the relatively smooth aggregate trends. Industry-level estimates allow researchers and policy makers to address questions like 'why have certain industries performed so well?' or 'where should policies for productivity growth be targeted?' In this paper, we ask 'which industries have driven labour productivity growth in over the past three decades?' and 'what has driven the growth within industries?'

This paper draws on the key findings from *Industry Productivity Statistics: 1978–2008,* the first set of official productivity statistics at industry level, to show which industries have been driving labour productivity growth over time. Labour, capital, and multifactor productivity (MFP) estimates have been published by Statistics New Zealand since 2006. These estimates are for New Zealand's measured sector which largely consists of market-based industries.[1] In 2007, the latest year for which value added current price data are available from the national accounts, the measured sector covered 74 percent of the economy. In *Industry Productivity Statistics: 1978-2008*[2], estimates for labour, capital, and multifactor productivity for 23 of New Zealand's industries (as defined under the Australia New Zealand Standard Industrial Classification (ANZSIC) 1996) are available. For all but three of the industries, the estimates extend back 30 years. The level of industry detail is consistent with the lowest level currently published within official gross domestic product (GDP) statistics.[3] Two of these 23 industries are aggregated into the agriculture, forestry and fishing industry, and a further nine are aggregated

[1] Industries included and excluded from the measured sector are defined in the *'Industry coverage'* section of this paper.
[2] The full report and tables are available from www.stats.govt.nz/productivity
[3] The exception to this is forestry and fishing, which 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.

into the manufacturing industry, meaning that estimates are published for 25 industries in total.

The industry publication represents the most comprehensive suite of industry productivity estimates for New Zealand. It is a major step forward in understanding New Zealand's productivity performance over the last three decades and allows for the first time detailed exploration of the industry drivers of productivity gains.

This paper outlines the methodology of productivity measurement at the industry level followed by empirical analysis. This begins with the productivity performance of the three broad industry sectors and their contributions to measured sector labour productivity growth. Next, broad industry types are broken down to show individual industry performance in labour productivity. Changes and trends in industry contributions to measured sector labour productivity are highlighted, along with the influence of capital deepening and MFP. The analysis finishes with a brief discussion on the role of information and communication technology on labour productivity growth and suggests directions for future research.

Methodology

Productivity measurement and interpretation

The methodology for estimating industry level productivity growth is consistent with Statistics New Zealand's annual measured sector release.[4] 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 involves the estimation of a Cobb-Douglas production function in index form. The labour, capital, and total input series for each industry were constructed in the same manner as for the measured sector: the labour input index is a composite index of hours paid; the capital input index reflects the flow of capital services from assets; and the composite total inputs index reflects both labour and capital inputs. Productivity growth is defined as the ratio of output growth to input growth.

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

$$V_i = A_i(t) \times f(L_i , K_i) \quad (1)$$

where V_i = chain-linked industry value added index

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 (known as MFP).

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

$$LP_i = V_i / L_i \quad (2)$$

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

Caution in interpreting the partial measures of productivity is recommended. 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. As shown in the '*Growth accounting'* section, for example, labour productivity also reflects the change in capital available per worker and how efficiently labour is combined with the other factors of production.

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 and the growth in an index of inputs:

$$A_i(t) = V_i / f(L_i,K_i) \quad (3)$$

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.

[4] Further detail on the methodology underlying the industry level productivity estimates can be found in *Appendix 1: Technical notes* of the full report.

Growth accounting

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

The growth accounting formula for labour productivity for an industry is derived as follows. Using equation 2, labour productivity is defined as:

$LP_i = V_i / L_i$

Substituting in equation 1:

$LP_i = (A_i(t)L_i^{wli}K_i^{wki}) / L_i$

Taking natural logarithms of both sides and simplifying:

$ln\ LP_i = ln\ A_i(t) + wk_i\ ln\ (K/L)$

Taking the total differential (to derive the growth rate) yields:

$$d ln\ LP_i = d ln\ A_i(t) + wk_i\ d ln\ (K/L) \quad (4)$$

This last equation shows that the growth rate in labour productivity for an industry is equal to the growth in its MFP plus the growth in the weighted capital-to-labour ratio (capital deepening or capital shallowing).

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 cannot 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

To understand the full impact of an industry's productivity growth on aggregate growth, we used the contributions to growth approach. In accounting for the industry's weight, this method enables insight to be gleaned into which industries have been driving growth, and also those industries which have been dampening 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 r that reflects the effect of the reallocation of hours worked on aggregate labour productivity growth (Stiroh, 2001). The weights for aggregating industry labour productivity growth are given by a two-period average share of industry labour income in aggregate labour income. This formulation is represented by equation 5:

$$dLP = \sum wl.\ dLP_i + r \quad (5)$$

Presentation across growth cycles

This paper contains productivity data presented as annual averages within growth cycles. The methodology used 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.

In this paper, we focus on longer cycles than those in *Industry Productivity Statistics: 1978–2008* as the focus is on exploring various characteristics of industries over longer time periods. The cycles adopted in this paper are 1982–90, 1990–97, and 1997–06. The peak years of these cycles are also peak years of the cycles discussed in the full report. Comparisons between the 1978–96 and 1996–2008 periods are also made, where appropriate or insightful, as the latter period includes additional industries.

It is important to note that the end-points of the series (ie 1978–82 and 2006–08) are not complete peak to peak cycles. They have therefore not been presented alongside the other complete cycles as they do not present a full picture and could be misleading.

Output series methodology

Output is defined as chain-linked value added. Annual movements in the industry output index are identical to annual movements in published GDP statistics, namely a chain-volume Laspeyres index of constituent sub-industries, aggregated to the industry level.

Industry value-added data used to calculate 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.[5]

Capital input series methodology

Although labour productivity is the focus of this paper, an overview of the calculation of the capital input series is important for understanding the construction of the indexes used for deriving the contributions to labour productivity. 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 Törnqvist index, with weights based on asset-specific implicit rental prices (user costs).

Capital and labour income shares

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's capital and labour input indexes. The capital income share is used to weight the contribution of capital deepening within the growth accounting for labour productivity equation.

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.

Industry coverage

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 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. The industries that comprise the current measured sector, and their contributions to GDP (for the year ended March 2007), are defined in table 1.

Table 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

Empirical analysis

We begin the empirical analysis by comparing the labour productivity performance of primary industries, goods-producing industries, and service industries. This is set in the context of the changing structure of New Zealand's economy over the last three decades.

[5] See Appendix 1 for a summary of the data used to construct the labour volume series.

Industries are grouped by broad type as per the national accounts groupings:

- Primary industries: agriculture; forestry; fishing; and mining.
- Goods-producing industries: manufacturing; electricity, gas, and water; and construction.
- Service industries: wholesale trade; retail; accommodation cafes, and restaurants; transport and storage; communications; finance and insurance; business services; cultural and recreational services; and personal and other community services.

Then, we proceed to answer the question 'which industries have driven labour productivity growth in over the past three decades?' by showing how labour productivity has performed at the industry level. Changes and trends in industry contributions to measured sector labour productivity are highlighted.

The second key question posed in the introduction, 'what has driven the growth within industries?', is then explored using the growth accounting technique described above. This is complemented with a brief discussion on the role of information and communication technology on labour productivity growth.

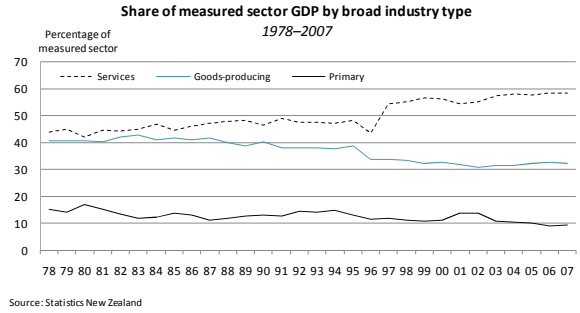
Broad industry analysis

Context

Productivity can *a priori* be expected to differ between broad industry types. Historically, service industries are likely to have lower labour productivity growth rates as they are likely to be subject to "Baumol's cost disease" (Baumol, 1967). This theory argues that, over time, it is impossible to reduce the amount of inputs for a given set of outputs. 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 needs to increase in line with general wages (to attract new labour to the industry), additional costs unrelated to productivity increases are incurred. Over the long-term, differences in productivity growth between sectors shifts the structure of the economy towards service industries (Baumol, 1967).

Paralleling the experience of other developed economies, New Zealand's economy has become more service orientated. This is reflected in the changing share of measured sector GDP due to each industry type, as shown in figure 1. The contribution of primary industries to measured sector GDP was 15.2 percent in 1978, but declined to 9.5 percent by 2007. This is still a much greater share than the primary sector has in the US and the UK (Sasaki, 2007). Goods-producing industries contribution to measured sector GDP also declined over this series, from 40.7 percent to 32.2 percent. Service industries were the dominant broad industry type throughout the period, with measured sector GDP from service industries accounting for 44.1 percent in 1978 and 58.4 percent in 2007. The increased share of services is partly due to the inclusion of business services and personal and other community services from 1996 into the measured sector.

Figure 1



Source: Statistics New Zealand

Labour productivity by broad type: General findings

Although labour productivity indexes have not been constructed by broad industry type, some general findings can be gleaned by comparing the performance of all industries within the broad type with the measured sector.

Labour productivity growth in primary industries has generally been greater than that of the measured sector as a whole. All primary industries labour productivity indexes were, on the whole, greater than that for the measured sector between 1986 and 2004. However, it is by far the most volatile broad industry type with highly variable year on year changes occurring throughout the series.

The labour productivity performance of goods producing industries tends to track that of the measured sector as a whole. However, the electricity, gas, and water industry stands out from construction and manufacturing especially after 1987.

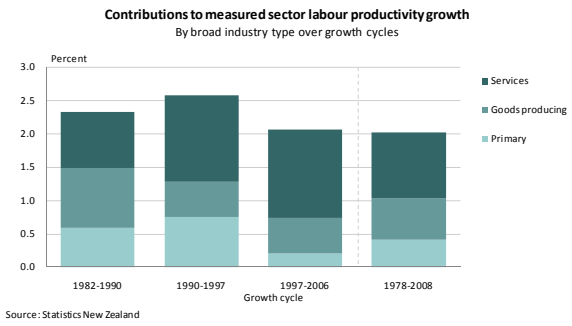
Labour productivity in the service sector exhibits two distinct patterns. While some service industries have been among the top performers, most (six out of the nine) service industries have recorded lower growth than the measured sector average. This heterogeneity reflects the diverse nature of service industries. The only industries to show negative labour productivity growth across the series were service industries. While negative productivity in services growth can be puzzling to explain, as it is inconsistent with profit maximising behaviour, such findings have also been found in the US and Canada (Sharpe et al, 2002).

Sector contributions to labour productivity growth

The contribution of each broad industry type to measured sector labour productivity was calculated by adding the contributions of each industry to the measured sector (ie equation 5 reflects an additive decomposition of measured sector labour productivity).

Across the series, (even after accounting for industries with declining labour productivity) service industries provided the greatest contribution to measured sector, followed by goods-producing industries (see figure 2). The contribution of service industries increased over growth cycles, and accounted for nearly two thirds of measured sector labour productivity by the 1997–2006 cycle. As service sector contributions grew, the relative contributions of primary and goods-producing industries declined. The pattern of decline in contributions from these two groups though was quite different. Primary industry contributions increased marginally between the 1982–90 and 1990–1997 cycles. However, the contribution to measured sector labour productivity dropped from 29 percent during 1990–97 to 10 percent during the 1997–2006 cycle. Labour productivity contributions from goods producing industries, on the other hand, declined noticeably between the first two cycles but rose slightly thereafter.

Figure 2



Source: Statistics New Zealand

To some extent, the increased contribution of service industries reflects the weight as well as the strong performance of industries such as communications services and finance and insurance. To illustrate this, table 2 compares the proportions of labour productivity growth by industry type with the proportion of GDP by industry type and cycle. In cases where a sector's share of labour productivity was greater than its share of GDP, labour productivity growth was above average.

Table 2
Average annual proportion of labour productivity contribution to measured sector growth and average share of measured sector GDP
By broad type and growth cycle

		Primary	Goods producing	Service	Total
1982-1990	Share of labour productivity growth	25.5	38.6	35.9	100
	Share of GDP	11.9	44.3	43.7	100
1990-1997	Share of labour productivity growth	29.4	20.3	50.4	100
	Share of GDP	13.1	37.7	49.2	100
1997-2006	Share of labour productivity growth	10.0	27.1	62.9	100
	Share of GDP	10.7	31.1	58.3	100
1978-2008	Share of labour productivity growth	**20.4**	**30.5**	**49.1**	**100**
	Share of GDP	**11.3**	**36.3**	**52.4**	**100**

Source: Statistics New Zealand

Across the series, and particularly in the first two cycles, the primary sector contributed proportionally more to labour productivity than the other two industry types (ie the difference between the contribution to labour productivity growth and share of GDP is greatest for the primary sector during these periods). As its weight remained relatively constant over time, the dramatic drop in the contribution of primary industries between the last two cycles was due to declining labour productivity. Goods-producing industries contributed proportionately the least of all three types (ie the difference between the contribution and its weight is the largest negative value for this sector, and this is most noticeable during the 1990–97 cycle.) The contribution of service industries was proportionately less than expected across the series. Over the cycles, however, service sector contributions increased substantially compared to its weight. By the 1997–2006 cycle, its contribution had reached 63 percent, a marked turnaround from the contribution of 36 percent during the 1982–90 cycle. Its weight only increased by 14.6 percent across these cycles. This highlights both the strong performance of labour productivity growth of service industries as a whole, and its growing importance to GDP, even though this last period includes industries which have shown declining labour productivity.

The contributions of service industries on the wider economy, however, may be understated. This is because the output of service industries can be difficult to measure, leading to underestimates of actual output growth (Stiglitz et al., 2009). Many services, especially arts and culture, provide social benefits that may not be captured in the output measure such as social connectedness, cultural, identity, health, and wellbeing (Ministry of Social Development, 2009). In addition, services may play a key role in intermediate demand rather than final demand which leads to positive spillovers for productivity throughout the wider economy (Pugno, 2005). If services do produce intermediate demand, then the implication from Baumol's model that unbalanced growth between sectors leads to declining macroeconomic growth may be reversed (Oulton, 2001). Outsourcing to firms in the business services industry, for example, has been observed internationally and has also likely had an impact in New Zealand. According to Ng (2007), the growth in outsourcing by the finance and insurance industry has benefited New Zealand's business services industry through the demand for the development of banking application software; processing and settlement of payments services; and finance and accounting services. The consumption of cultural services may benefit human capital formation which in turn increases economic growth (Pugno, 2007).

Industry labour 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 3). The communication services industry had the highest labour productivity growth rate over this time, increasing by 9.3 percent per year. Labour productivity in this industry showed year-on-year increases except for 1997, where a huge increase in labour volume (up

15.0 percent) outstripped output growth (up 10.5 percent). 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. Personal and other community services showed stronger growth than the measured sector from 1997–2006.

Table 3
Labour productivity by industry
Average annual percentage change by cycle
Year ended March

Industry	Cycle			Average for 1978–2008 (%)
	1982–1990	1990–1997	1997–2006	
	Average annual % change			
Agriculture, forestry, and fishing	5.6	6.3	2.6	**4.0**
Mining	7.6	8.1	-3.1	**1.9**
Manufacturing	2.1	1.3	2.3	**1.7**
Electricity, gas, and water supply	3.8	7.0	4.5	**4.4**
Construction	1.5	0.3	-0.5	**0.5**
Wholesale trade	0.1	-1.0	2.5	**0.7**
Retail trade	-0.5	1.5	2.5	**1.0**
Accommodation, cafés, and restaurants	-1.7	-0.7	0.0	**-1.3**
Transport and storage	5.5	5.9	1.3	**3.6**
Communication services	10.0	13.6	8.9	**9.3**
Finance and insurance	0.8	3.2	6.2	**3.4**
Business services[1]	..	..	-0.1	**..**
Cultural and recreational services[1]	..	..	-1.9	**..**
Personal and other community services[1]	..	..	3.8	**..**
Measured sector	**2.4**	**2.6**	**1.9**	**2.1**

1. Data available only from 1996.

Symbol:
.. figure not available

Source: Statistics New Zealand

At the other end of the spectrum, the only industry in which labour productivity declined from 1978– 2008 was the accommodation, cafes and restaurants industry. Cultural and recreational services, and business services also recorded negative labour productivity growth but their series only runs from 1996.

The decline in labour productivity for business services is consistent with international findings (Kox et al., 2007). Similarly, the poor productivity growth of the accommodation, cafes, and restaurants industry is not a phenomenon limited to New Zealand. Low productivity growth is consistent with international results, which show poor growth in the accommodation, cafes and restaurants industry across many developed economies (Wölfl, 2003). Average hourly wages in the accommodation, cafes and restaurants industry are the lowest among all industries, despite the importance of labour for this industry. This is also an industry that is characterised by many small firms, and a high proportion of part-time employees. For the 2008 March year, over 60 percent of the people employed in this industry were part-time employees (Statistics New Zealand, nd). Low skills may also have a bearing on labour productivity in this industry (Statistics New Zealand, 2006).

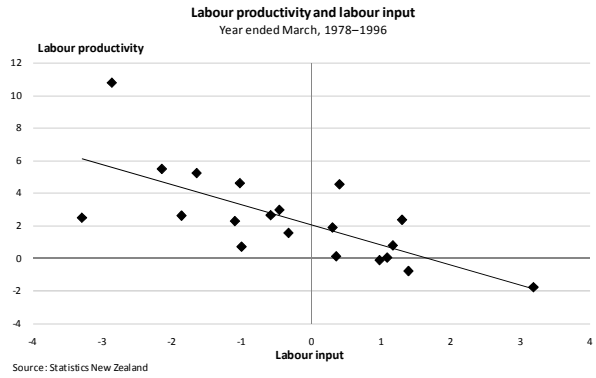
Six industries recorded labour productivity growth above the average over the 1978–2008 period while eight recorded lower than average growth.[6]

Looking at industry labour productivity growth over the growth cycles, the industries that have shown the greatest gains in labour productivity include wholesale trade and retail trade, which grew stronger than average between 1997 and 2006 but less than average across the longer time series. Finance and insurance has shown the strongest and most consistent change in growth rates across cycles, from 0.8 percent per year from 1982–1990 to 6.2 percent per year from 1997–2006. This highlights the strong performance of these industries towards the end of the series. Conversely, mining and transport and storage recorded above average growth across the 1978–2008 series while recording less than average growth between 1997 and 2006. This shift reflects the decline in labour productivity growth in these industries towards the end of the series.

Drivers of industry level labour productivity

Labour productivity growth can be due to a number of factors. At the fundamental level, labour productivity growth is the ratio of output growth to labour input growth. Therefore, it is worth examining how labour input is related to labour productivity. From 1978–1996, there was a strong negative relationship between average growth in labour productivity and labour input (with a correlation coefficient of -0.71).

Figure 3

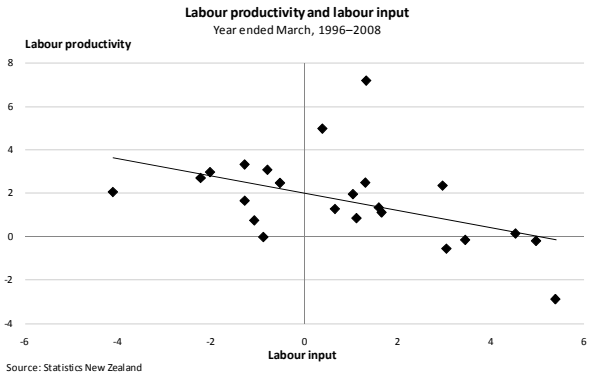


In other words, industries which recorded higher average growth in labour input tended to have lower average labour productivity. Communication services, for example, recorded the second greatest decline in labour input but the strongest growth in labour productivity during this period. Accommodation, cafes, and restaurants, on the other hand had the highest average labour input growth but lowest labour productivity growth. During the 1996–2008 period, however, the relationship between labour productivity growth and labour input growth weakened (although

[6] Business services, cultural and recreational services and personal and other community services are not included in this comparison as their series are only available for the 1996–2008 period.

the relationship was still fairly strong with a correlation coefficient of 0.48).

Figure 4



Looking beyond output and labour input, labour productivity growth can be decomposed into contributing factors. As shown in the *'Growth accounting'* section of the methodology, accumulation of physical capital is a direct driver of productivity growth. Investment directly adds to the stock of capital that workers have available to them so they can produce more for a given level of labour input. Growth in labour productivity is affected by both the growth in capital stock per worker and the growth in MFP — which measures the efficiency with which this labour and capital is combined to produce goods and services. Therefore, 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.

Aside from cultural and recreational services, every industry in the measured sector showed some degree of capital deepening over time (see table 4). This is reflected through higher labour productivity growth than MFP growth.

Table 4
Contributions to labour productivity growth by industry
Year ended March 1978–2008

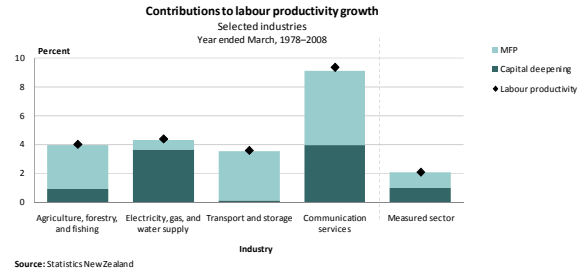
Industry	Labour productivity	Multifactor productivity	Capital deepening
	%		
Agriculture, forestry, and fishing	4.0	3.1	0.9
Mining	1.9	-0.3	2.3
Manufacturing	1.7	0.6	1.1
Electricity, gas, and water supply	4.4	0.7	3.6
Construction	0.5	0.0	0.5
Wholesale trade	0.7	0.2	0.5
Retail trade	1.0	0.3	0.7
Accommodation, 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

The growth accounting decomposition of labour productivity growth effectively highlights the different drivers of industry labour productivity growth. For example, agriculture, forestry, and fishing; electricity, gas and water supply; and transport and storage have all displayed strong labour productivity growth. In agriculture, forestry, and fishing, 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. Measured sector growth is relatively equally driven by both capital deepening and MFP (see figure 5).

Figure 5



The highest performing industry – communication services – had labour productivity growth driven by both capital deepening and MFP over the total series. The contribution from capital deepening and MFP was 4.0 percent and 5.2 percent per year, respectively. The largest contributions to labour productivity growth in the communication services industry came from MFP growth for most cycles. Capital deepening did however contribute strongly in the 1980s and 1990s, indicating high levels of capital investment relative to labour input during these periods. The strongest period of labour productivity growth was from 1990–97, at 13.6 percent per year. This was driven primarily by MFP and to a lesser extent capital deepening, rising at 7.1 percent and 6.1 percent per year, respectively.

At the other end of the scale, labour productivity in the accommodation, cafes, and restaurants industry from 1978–2008 recorded an annual average decrease of 1.3 percent per year and was the only industry that recorded a negative growth. The output growth for the same period was 1.8 percent. The decrease in labour productivity 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. MFP contributed negatively to labour productivity growth in every cycle.

Looking at labour productivity growth over the business cycles, three distinct trends can be seen. Measured sector labour productivity growth in the 1982–1990 cycle was primarily driven by capital deepening, the 1990–97 cycle by MFP, and the 1997–2006 cycle by both capital deepening, and MFP. This is reflected well in industry results, with stronger contributions from capital deepening during the 1982–1990 cycle in 8 of the 11 industries, stronger

contributions from MFP in 7 industries in the 1990–97 cycle, and a fairly even split in the last cycle.

Industry contributions to measured sector growth

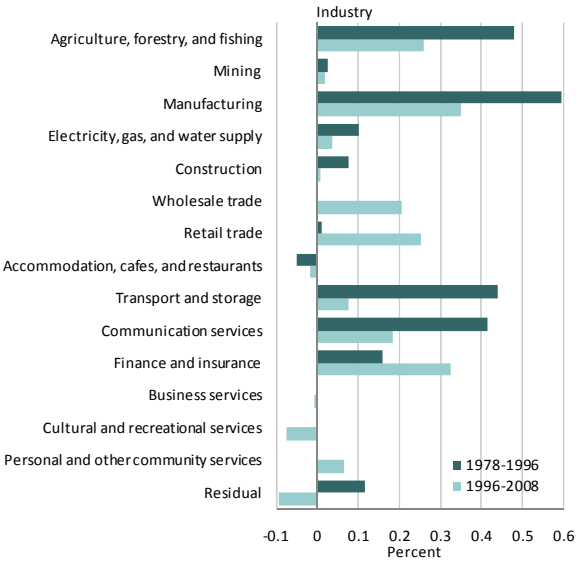
As shown in equation 5, aggregate productivity growth in the measured sector can be broken down to examine the industry drivers of growth. Industry contributions to aggregate labour productivity growth can be expressed as a weighted sum of industry labour productivity growth plus a residual that reflects the effect of the reallocation of hours worked on aggregate labour productivity growth.

The industry contribution to the change in aggregate measured sector labour productivity growth from 1978–96 and 1996–2008 is shown in figure 6. 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, such as manufacturing, can still contribute significantly to measured sector labour productivity growth if it had a high weight.

Figure 6

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

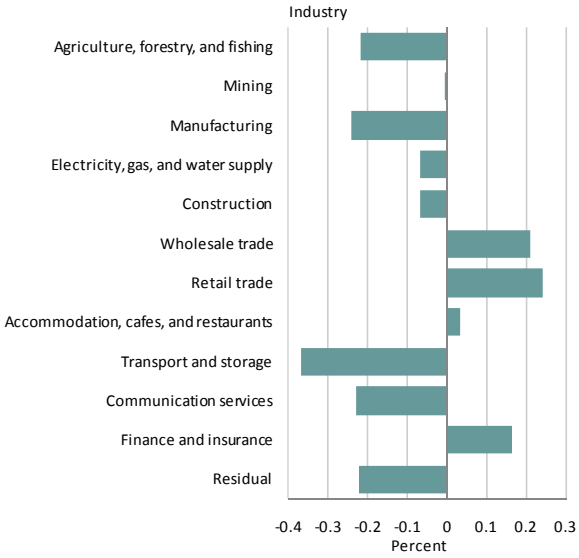
From 1978–96, four industries stand out in terms of contributions to measured sector labour productivity: agriculture, forestry and fishing; manufacturing; transport and storage; and communication services. In the latter period, finance and insurance, along with wholesale and retail trade have come into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

Differences in the industry contributions to measured sector labour productivity growth from 1996–2008 and 1978–96 highlight the changing drivers over time. Essentially, industries that show a negative value in figure 7 have decreased their contribution to measured sector productivity growth, and those that show a positive value have increased their contribution.

Figure 7

Industry contributions to measured sector labour productivity growth

Difference in average annual contribution from 1978–1996 to 1996–2008 [1]



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

Interestingly, figure 7 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.

The role of information and communication technology

The impact of information and communication technology (ICT) use on productivity growth is reflected in the growth accounting for labour productivity framework. Firstly, investment in ICT capital goods contributes to capital deepening and therefore can increase growth in labour productivity.

Secondly, effective use of ICT may help firms increase their overall efficiency, and raise MFP. In addition, greater use of ICT may contribute to network effects (spillover effects), such as lower transaction costs and more rapid innovation, which improve the overall efficiency of the economy, and result in greater MFP. Studies at the firm level indeed point to spillovers from ICT capital (OECD, 2004).

If the use of ICT is having effects on labour productivity growth, it is likely that heavy users would be the first sectors to experience such effects. Although computers may appear everywhere, the use of ICT is actually highly concentrated in the services sector (McGuckin and Stiroh, 2001; Chapter 2).

Service industries such as wholesale trade and financial services are typically the most intensive users of ICT. The principal contribution of ICT to productivity growth in services largely comes in the automation of many previously labour intensive tasks, increasing efficiency, and reducing operating costs. This may suggest that any impacts on economic performance might be more visible in the services sector than in other parts of the economy. Examining the performance of these industries over time and comparing it with industries that do not make intensive use of ICT, can help point to the role of ICT use in strengthening productivity growth (OECD, 2004).

For the purpose of this paper, ICT investment comprises investment in computer equipment (personal computers, networking systems, scanners, printers, receivers and word processors), software, and electronic equipment, (broadcasters, transmitters, receivers, and telecommunication equipment). Similar to international findings, the industries with the greatest investment in ICT assets include business services, communication services, finance and insurance, retail, and wholesale trade.

The productivity performance of these industries towards the latter part of the time series compared with industries with lower levels of ICT investment, largely indicate that those industries who invest more heavily in ICT, tend to show stronger growth in labour productivity. This is particularly evident in the wholesale and retail trade industries, along with finance and insurance, whose productivity performance showed a marked improvement from 1997–2006 compared to earlier growth cycles.

The business services industry seems to be the exception to the trend, with falling labour productivity despite very high levels of ICT investment. The labour productivity performance of 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 (OECD, 2003, p.57). Using the growth accounting for labour productivity technique, it can be seen that increased amounts of capital per worker, such as software and computers, has made positive contributions to labour productivity, but this effect has been offset by declining MFP.

Summary

This paper, using key findings from *Industry Productivity Statistics: 1978–2008*, has highlighted those industries which have driven (or dampened) aggregate labour productivity growth over the last three decades. Productivity in the communications services has been exceptional. Agriculture, forestry, and fishing; electricity, gas, and water supply; transport and storage; and finance and insurance also recorded stronger than average growth. While service industries have, on average, made the greatest contribution to measured sector labour productivity growth, there is marked diversity within this grouping: labour productivity in accommodation, cafes, and restaurants, cultural and recreational services, and business services were the only industries to show a decline across their respective time series.

While international evidence also shows that labour productivity in such industries has declined, further (microeconomic or macroeconomic) research into the economic factors that are contributing to these trends in New Zealand would be worthwhile. For example, at the microeconomic level, useful insights into understanding service industry productivity could be obtained by assessing the effect of firms being unable to exploit economies of scale (akin to Kox et al., 2007) or the benefits of outsourcing. At the macroeconomic level, further research could assess whether the implications of Baumol's (1967) model of unbalanced growth or its counter-arguments (eg Oulton, 2001) are applicable in the New Zealand context. An exploration of the relationship between productivity and terms of trade would provide valuable understanding as to how important the open economy is for productivity. Further research could take account of ICT more explicitly, by modelling it as a separate capital asset and exploring its contribution to productivity (along the lines of OECD (2003) or Triplett and Bosworth (2003)).

Disaggregating the productivity trends in the measured sector into its industry components leads to a much richer data source and therefore allows for a wide range of analyses (and policy questions) to be explored. This is because it is more comprehensive in both its industry coverage and time dimension than any other study on productivity in New Zealand.

References

Baumol, W. (1967) Macroeconomics of unbalanced growth: The anatomy of urban crisis. The American Economic Review 57(3), pp. 415-426.

Kox, H., van Leeuwen, G. and van der Weil, H. (2007) Market structure, productivity and scale in European business services. Statistics Netherlands Discussion Paper – No. 7013.

McGuckin, R.H. and Stiroh, K.J. (2001) Do computers make output harder to measure? Journal of Technology Transfer 26, pp.295-321.

Ministry of Social Development. (2009) The social report. Wellington: Ministry of Social Development.

Ng, T. (2007) The Reserve Bank's policy on outsourcing by banks. Reserve Bank of New Zealand Bulletin 70(2), pp.32-36.

OECD. (2001) Measuring productivity: Measurement of aggregate and industry-level productivity growth. Paris: OECD.

OECD. (2003) ICT and economic growth: Evidence from OECD countries, industries and firms. Paris: OECD.

OECD. (2004) The economic impact of ICT: measurement, evidence and implications. Paris: OECD.

Oulton, N. (2001) Must the growth rate decline? Baumol's unbalanced growth revisited. Oxford Economic Papers 53(4), pp. 605-627.

Pugno, M. (2006) The service paradox and endogenous economic growth. Structural Change and Economic Dynamics 17, pp.99-115.

Sasaki, H. (2007) The rise of service employment and its impact on aggregate productivity growth. Structural Change and Economic Dynamics 18, pp. 438-459.

Sharpe, A., Rao, S. and Tang, J. (2002) Perspectives on negative productivity growth in service sector industries in Canada and the United States. Paper presented at workshop on service sector productivity, May 17 2002, Brookings Institution Washington DC.

Statistics New Zealand. (nd) Quarterly Employment Survey. [Data file]. Series no longer available online.

Statistics New Zealand (2006) QuickStats about Education and Training. Wellington: Statistics New Zealand.

Stiglitz, J., Sen, A. and Fitoussi, J.P. (2009) Report by the Commission on the Measurement of Economic Performance and Social Progress.

Stiroh, K. (2001) Information technology and the U.S. productivity revival: what do the industry data say? Federal Reserve Bank of New York.

Tripplet, J. and Bosworth, B. (2003) Productivity measurement issues in service industries: "Baumol's disease" has been cured. Federal Reserve Bank of New York Economic policy Review September 2003, pp.23-33.

Wölfl, A. (2003) Productivity growth in service industries: An assessment of recent patterns and the role of measurement. OECD Science, Technology and Industry Working Papers – No. 2003/7. Paris: OECD.

Appendix 1

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	Census/HLFS count	Census/HLFS usual hours
		2000 onwards[6]		
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