Output and productivity in the education and health industries

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Adam Tipper

Statistical Analyst, Development, Environment, Satellites, and Strategy Unit

Statistics New Zealand
P O Box 2922
Wellington, New Zealand
info@stats.govt.nz

www.stats.govt.nz

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Abstract

This paper presents the methodologies and estimates for Statistics New Zealand's re-developed output and new productivity measures for the education and health industries. Labour, capital, and multifactor productivity growth rates from 1996–2011 are presented, and contributions to output and labour productivity growth are discussed in a growth accounting framework. Challenges in compiling multifactor productivity are outlined, and the sensitivity to certain measurement choices is shown. The interpretation of productivity as a measure of output to input, and independent of outcomes, is emphasised.

Introduction

Measuring the output and productivity of non-market providers has been of increasing interest among national statistical officers. Traditionally, the lack of market prices has meant that estimating the amount of service provided by non-market providers has been problematic, often resulting in output being measured by inputs. Developments in defining output for non-market providers, such as Eurostat (2001), the Atkinson report (2005), and the OECD (Schreyer, 2010b) has enabled meaningful measures of activity and productivity to be compiled. Growing expenditure on public services, and projected demographic change which drives those expenditures, means that productivity measures enable insight into whether more services can be delivered for a given budget constraint.

Measuring government sector productivity in New Zealand: A feasibility study (Statistics NZ, 2010), showed that productivity measures for these industries could be derived following the implementation of improved output measures (chain-volume value added, GDP production approach). Statistics NZ has updated the methodology for non-market components of chain-volume value added for the education and training (hereon education), and health care and social assistance industries (hereon health care) in line with recommendations from this study.

The feasibility study focused on education and health, as there is international consensus on the definition of output measures for these services. Defining output in collective services, such as police or fire services, is still a difficult task. The study also highlighted that Statistics NZ's measures of value added for the two industries were already well developed: the required changes were refinements rather than complete redevelopment of the methodology.

The new methods for annual chain-volume value added for education and health, incorporated into the national accounts in the Gross Domestic Product: September 2012 quarter release, improve the existing value-added measures for these industries.[1] As refinements, the revisions to the previous published estimates are minimal and the long-term trends in value added are similar. Using detailed data from the Ministry of Education and the Ministry of Health, the value-added measures for both education and health now better reflect the relative values for each activity in the industry. Coverage is widened by including additional activities.

In the production approach of GDP, value added for an industry is measured as the value of goods and services produced, less the cost of goods and services used in the production

[1] Current-price GDP methodology (the sum of input costs) is unchanged. Statistics NZ already compiles current-price GDP according to guidance in the System of National Accounts.

Quarterly methodologies are also unchanged. The recommendations from the feasibility study relate to annual benchmarks, to help produce annual productivity statistics. In addition, volume indicators are not available on a quarterly basis, meaning input indicators are still the most appropriate quarterly measures available.

The new annual volume methodology flows through to annual government final consumption expenditure. In addition, as quarterly value-added measures are reconciled to the annual benchmarks, quarterly value-added estimates have been revised.

process. In other words, value added equals output less intermediate consumption. This is a measure of activities undertaken, and does not account for the outcomes of consuming these services. Explicit quality adjustments – for example, to account for a better service being provided – were not made to the output measures. The appropriate measure for how to adjust using available data has yet to be determined, both within New Zealand and internationally. Finer disaggregation of the indicators allows for some implicit quality adjustment.

Following the updates to the value-added methodology, industry-level productivity measures for the education and health industries covering the 1996–2011 period were added to the existing suite of industry-level productivity statistics in April 2013.[2]

This paper highlights the interpretability of productivity measures for the education and health industries. Productivity measures reflect output growth relative to input growth. They do not necessarily reflect other performance indicators such as effectiveness or quality, for example. Industry-level productivity statistics reflect the productivity of the industry as a whole and are broader than other productivity measures that focus on activities provided in one type of setting (such as public hospitals, for example). As the output series may not completely account for quality change, these statistics should be considered alongside complementary indicators. The assumptions and coverage of productivity statistics also need to be considered.

This paper proceeds as follows. The first part of this paper covers the conceptual approaches to measuring output and productivity for at the industry level: the approach to measuring productivity is outlined, highlighting the challenges that are often present given the lack of market prices, and the concept of output that is produced in a non-market setting is defined within a national accounting framework. The paper then proceeds to the empirical application of the new output and productivity methodologies, first for education and then for health care. For each industry, the industry composition is first outlined, followed by the definition of output and the effect of the new methodology on existing estimates, and then productivity estimates. The productivity statistics include estimates of labour, capital, and multifactor productivity (MFP) growth. Contributions to output growth and to labour productivity growth are presented within a growth accounting framework. The sensitivity of productivity estimates to measurement choices are presented, along with contextual information provided by complementary performance indicators.

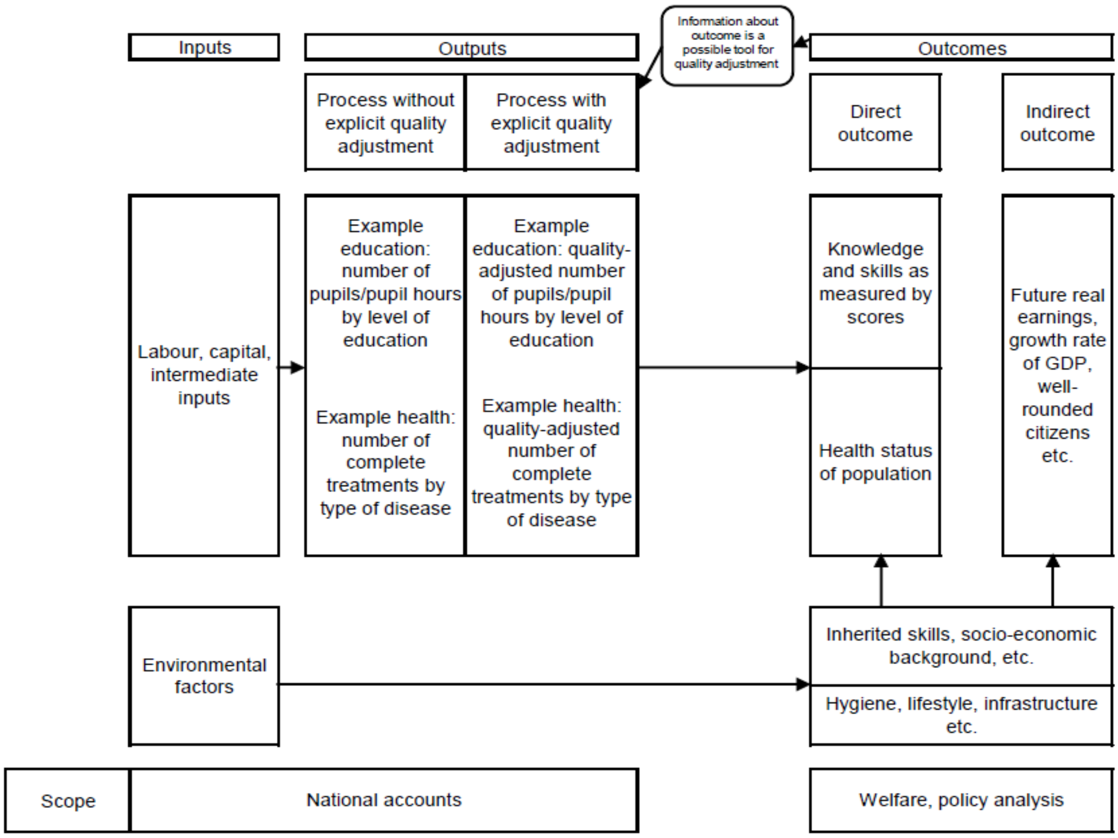
Measuring productivity

Productivity is a measure of output growth relative to input growth. An increase in productivity means that more educational service, or health care, is produced (and therefore available for consumption) for a given amount of resources.

The relationship between inputs, outputs, and outcomes, and the scope boundary for national accounts is presented below. As a measure of outputs relative to inputs, productivity analysis is related to outcomes. However, the outcomes from activity of educational and health care institutions need to be distinguished from environmental factors, such as socio-economic status, lifestyle, and infrastructure.

[2] The education and health industries are not included in the measured sector. The 'measured sector' covers industries that mainly contain enterprises that are market producers. This means they sell their products for economically significant prices that affect the quantity that consumers are willing to purchase. To retain focus on market sector activity and to retain comparability with the Australian Bureau of Statistic’s productivity series, the education and health industries were not included into the measured sector. Ownership of owner-occupied dwelling and public administration and safety are also excluded from the measured sector. The measured sector productivity series is available from 1996 to 2012, and covers 77.2 percent of the economy

Figure 1



Source: Schreyer 2010b

Outputs and inputs relate only to the scope of those within the production boundary, which is defined by the Australia New Zealand Standard Industrial Classification 2006 (ANZSIC06). The outputs of the education and health industries cover market and non-market activity and are based on the producer perspective, which does not account for the contribution individuals make to their health or educational outcomes, nor the role of funding such health care or education provision. The productivity statistics presented here reflect the productivity of the industry as a whole, and are therefore broader than other productivity measures that focus on activities provided in one type of setting (public hospitals, for example).

The statistics in this paper cannot be used to attribute productivity change to a particular institutional sector or working industry. This is because they have been compiled at a total industry level. There could be considerable differences in productivity performance across the producers in a given industry. However these differences are not readily identifiable.

The productivity measurement framework is built on the approach used for official Statistics NZ industry level productivity measures. This is referred to in the OECD manual of 2001 as “the index number approach in a production theoretic framework". In compiling these new measures, Statistics NZ followed the methods outlined by the OECD (2001) as well as guidance for measuring productivity when there are non-market producers (Statistics NZ, 2010; Schreyer 2010a, 2010b; Jorgenson & Schreyer, 2012).

Productivity indexes

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

$$V_i = A_i(t) L_i^{wl_i} K_i^{wk_i} \quad (1)$$

where V_i = chain-linked industry value added index

$A_i(t)$ = 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 multifactor productivity (MFP))

L_i = industry labour inputs

K_i = industry capital inputs

wl_i= industry labour weight

wk_i= industry capital weight

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_i = 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. 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 total inputs:

$$A_i(t) = V_i / L_i^{wl_i} K_i^{wk_i} \quad (3)$$

Using the growth accounting technique, the growth in industry output was decomposed into the contributions from the factors of production (labour and capital) and MFP:

$$d \ln V_i = d \ln A_i(t) + w_k d \ln K_i + w_l d \ln L_i$$

This technique was also used to examine how much of the industry's labour productivity growth could be determined by growth in the amount of capital available per worker or MFP.

$$d \ln LP_i = d \ln A_i(t) + w_k d \ln(\frac{K_i}{L_i})$$

This 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 relies on the simplifying assumptions that:

- production processes can be represented by a production function exhibiting constant returns to scale 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

Statistics NZ's suite of official industry productivity statistics are based on indexes rather than levels. For market-based industries (see Industry Productivity Statistics: 1978–2011 (Statistics NZ, 2013a) productivity is presented across growth cycles. The peak years of a growth cycle reflect the years at which capacity utilisation is at its highest. Cycle peaks are determined by applying a statistical filter to measured sector output data. Output, and capacity utilisation, for the education and health industries is less likely to move in line with measured sector output. For this reason, the productivity data for these industries are presented across the whole 1996–2011 period or during periods of stable growth.[3]

Labour productivity levels can be computed based on the labour hours paid data. However, when comparing the level of labour productivity with other market based industries the differences in output methodology need to be noted. The level of value added for non-market enterprises in the base year, in current prices, is based on the sum of input costs approach. This level is used for compiling chain volume value added using volume extrapolation. For market enterprises, value added is often based on total sales less intermediate consumption (deflated).

Outputs

The output measures used in this paper are based on chain-volume value added, and are independent from inputs. The overarching framework for constructing output measures for education and health is the System of National Accounts 1993 and 2008, an international standard that recommends using direct-volume measures for non-market services where possible.

This section provides an overview of the general approach to measuring output for market and non-market providers. The adopted approach for each industry is discussed later in the respective *Education and training* and *Health care and social assistance* sections.

Value-added approach

The production approach to GDP measures the total value of goods and services produced in New Zealand, after deducting the cost of goods and services used in the production process. This is the value-added approach. Chain-volume estimates have the effect of price change removed from them. The chain-linking method is used to aggregate components of value added for a given industry, and to aggregate industries to derive total GDP. The weights for the components are updated annually when using this method. This accounts for the changing composition of industries, and allows new activities to be incorporated over time.

When a volume measure for value added is derived from output and intermediate consumption, both expressed in volume terms, this is called a double indicator method. Conceptually, this is the ideal approach because it accounts for changes in the volumes of both inputs and outputs during the production period. However, a double indicator method cannot be used in all situations. If the available data is not robust enough, a single indicator method can be used to derive a volume measure of value added directly.

Two basic methods to derive volume measures are price deflation and volume extrapolation (Statistics NZ, 2008).

Price deflation

When goods and services are sold in the market, expenditure on these items can be deflated by a price index for those goods and services. Measuring value added of non-market enterprises, however, is problematic due to the lack of market prices. Price deflation can also be used to derive non-market value added – by deflating a current price input measure by an input deflator, and assuming outputs are equal to inputs. This approach, however, means that outputs are dependent on inputs and productivity estimates cannot be compiled.

[3] Capacity utilisation is 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. Applying variable capacity utilisation rates from the Quarterly Survey of Business Opinion, Tipper and Warmke (2012) find this assumption has little material impact on long-term trends in MFP growth, but can affect year-on-year movements.

Volume extrapolation

When market prices are not available, output growth for non-market enterprises can be assumed to be equal to input growth (eg employed labour). However, this leads to the problem that productivity growth will be biased towards zero as outputs are dependent on inputs.

Methods based on volume extrapolation (also referred to as direct-volume measures) show the change in the volume of goods or services, by using indicators that reflect change in activity without price effects. The use of cost weights allows for relative values of different activities to be calculated, and direct volume measures to be compiled. Statistics NZ already uses a direct-volume measure for measuring health care and education output, rather than the 'outputs equals inputs' approach that is usually adopted when market prices are not available. These were used as single indicators with volume extrapolation (where output growth is used to represent value-added growth).

Under this method, growth rates in the volume series are applied to the current-price level of value added in the base year. As the current-price methodology is unchanged, no revisions are made to the base-year value.

Outputs and outcomes

The economic concept of output is the value of goods or a service that can be measured with separate volume and price elements. The national accounting definition of output, which is based on the economic concept, is distinct from other definitions of output often used to understand the activity or performance of non-market institutions. Other definitions include:

- pathways – services received by an individual (eg courses of treatment), which may require a bundle of activities over time
- activities – actions undertaken at an institution (eg operative tests, diagnostic procedures, inpatient stays, outpatient visits, and consultations)
- outcomes – wellbeing or social gains accrued after a service is consumed.

For national accounting purposes, output is based on the 'amount of activity' definition. The pathways approach is inconsistent with the national accounts approach, which measures production in a given time period rather than following an individual over time. The outcomes approach is also inconsistent with the national accounts approach, as the focus is on production – not necessarily whether those outputs have an effective outcome.

Quality part of volume

Quality change in the provision of the service is implicitly captured in the output measure (through disaggregation of activities), but no explicit adjustments are made. Direct measures of output and value added may not capture all the quality change of the service provided (eg cleaner facilities, lower waiting times, improved access). For market services, quality change is often reflected in the price deflator – but without price deflators it may not be captured. Quality adjusting output volumes with measures of outcomes (OECD, 2010) is an option in this case.

Value added may be understated if quality increases, but overstated if quality decreases. Accounting for quality change in education and health is difficult. For example, increasing quantities of services may reduce quality if health practitioners and teachers are spread more thinly, but improving techniques and processes may balance that.

No international standard on quality adjustment for health or education output has yet been determined. Explicit quality adjustments are not yet achievable with available New Zealand data, and the methodology for making such adjustments has not been determined within New Zealand. However, disaggregation (ie compiling at a detailed level) provides some implicit quality adjustment by accounting for compositional change.

Relative values

Creating a volume measure of non-market output requires the growth rates of different types of output to be weighted together in a way that reflects their relative importance. The set of cost weights should reflect the total cost of producing goods or providing services. The key point about weights is that they are relative: they should demonstrate the relative importance of goods or services to all others.

In a perfect market-equilibrium situation, the price is set where marginal cost equals marginal revenue. This market-clearing price reflects the fact that both consumer and producer place equal value on the goods or service at the margin. The equilibrium price is the measure of relative importance to be used to weight the growth rates of different types of output.

In a non-market situation, there is no market-clearing mechanism, and we cannot assume the consumer and producer place the same value on any particular goods or service. Indeed, in the education and health sectors there are very few meaningful prices at all: where payments are made, these are usually heavily subsidised.

The international consensus on how to combine different types of education and health output is that cost weights are appropriate, as costs are systematically available for most types of education and health care provided. Production costs reflect the value placed on the goods or service by the producer. The methods for compiling value added for education and health use this internationally accepted basis. The relative values are updated annually to account for substitution between types of activity.

Inputs

Labour

Labour inputs are a sum of hours paid and do not reflect labour quality or changes in labour composition.[4] The labour volume series is consistent with the approach used for all other industries where productivity is measured. The labour input series are measures of hours paid, sourced from Linked Employer-Employee Data, the Household Labour Force Survey, the Quarterly Employment survey, the Business Demography Database, and Census. Further information on the labour input series is available from section 3 of the productivity statistics sources and methods (Statistics NZ, 2012c).

The labour volume series for health and education were compared with deflated compensation of employees' data and administrative data from Health Workforce New Zealand and the Ministry of Education to determine the robustness of the estimates. The labour volume series movements concur with the expectations provided by these other data sources.

Capital

Capital inputs are measures of the flow of capital services. These are derived by applying user costs to productive capital stock data produced using the perpetual inventory method (PIM) (see Statistics NZ, 2013b for more information on the PIM).

There are 26 asset types specified in the PIM, which are grouped into seven broader asset classes. These asset classes are residential buildings, non-residential buildings, plant machinery and equipment, transport equipment, other construction, intangibles, and land improvements.

The capital input series also includes estimates of the productive stock of land. While land volumes are not estimates using the PIM (as it is a non-produced asset), it is included in the capital input series as an enabler of production and to ensure full asset coverage.

The user cost is the cost of using a capital good for a specified period. It is similar to the wage rate for labour input. Statistics NZ's user cost is determined by four factors:

- the asset price, as new, relative to its base period price

[4] Statistics NZ's quality adjusted labour input series is only available at the measured-sector level: industry level quality adjusted labour input series are not produced as the Household Labour Force Survey and New Zealand Income survey data used in this series are not stratified by industry and there are limited observations at the industry level.

- a real rate of return
- the asset's rate of economic depreciation
- the effective rate of non-income tax on production.

The user cost is used to calculate an asset's cost of capital, which is its user cost (ie rental price) multiplied by its flow of capital services.

The rate of return for the user cost equation can be determined endogenously, exogenously, or via a hybrid model which uses the rates of return for market producers to impute the rate of return for non-market producers (OECD, 2009). Under an endogenous rate of return approach, the rate of return is calculated so that capital income completely exhausts gross operating surplus. When current price output is measured as the sum of input costs (as is the case for non-market producers), there is no gross operating surplus. The derived user costs may in turn be biased. This has implications for calculating user costs and capital services. MFP is therefore biased under an endogenous rate of return approach.

In the New Zealand context, the choice of the approach to determining the rate of return depends on plausibility of the estimates, volatility, relationship to underlying capital stock, alignment with international practice, and fitness for purpose (Macgibbon, 2010).

Statistics NZ has adopted an exogenous rate of return set at 4 percent for all industries (Macgibbon, 2010) and has maintained this rate for the education and health industries. The 4 percent rate of return retains consistency with market based industries and the underlying capital stock. Specifying the same rate of return for market and non-market owned capital also avoids asymmetric treatment of capital services purely on the basis of institutional ownership. A difference in treatment would invoke the implication that private hospitals or schools discount the benefits of health care or education activity differently to non-market providers, which is difficult to establish. An exogenous rate of return of 8 percent (as set by Treasury) was considered as an alternative option. The average long-term rate on government bonds, which could also be used as an exogenous rate of return, is approximately 3–4 percent.

In the context of education and health, many activities and investments are undertaken with a view to the long-term intangible benefits that they may accrue. While an alternative rate of return may better capture the valuation of long-term benefits of outputs, it is not clear what that rate should be.

Total inputs

Labour and capital inputs are combined using a Törnqvist index to derive total inputs. MFP is derived residually as output over total inputs, where the indexes of input volumes are weighted by income shares. Measuring MFP for industries that include significant non-market components is difficult given the absence of gross operating surplus which is used in the capital income share.

For market based industries, capital income is calculated as gross operating surplus, mixed income attributable to capital, and net taxes attributable to capital. The capital weight is derived as capital income over total income. This is the income share approach.

For non-market enterprises, current price output is calculated as the sum of input costs and there is no gross operating surplus. This can bias the capital income share. This will affect MFP growth to the extent that capital and labour inputs grow at different rates. When the capital income share is understated, the capital component of total inputs is understated. This leads to total inputs being understated and MFP overstated.

For the education and health industries, cost shares are used to aggregate capital and labour inputs. Capital cost is calculated as the user cost of an asset multiplied by the productive capital stock. This contrasts with the income share approach used for market-based industries. The cost share approach was considered to be a more appropriate method to estimate the return to capital. It reflects a cost minimisation approach to production, rather than profit maximisation framework.

Cost shares are more appropriate when there are no market prices or imperfect competition in output markets (Jorgenson & Schreyer, 2012). In using this approach however, it is assumed that there are common mark-up factors, no missing assets, and the constant returns to scale assumption holds (Schreyer, 2010a). This approach has been used in the OECD's industry level productivity database. Statistics Netherlands use this approach for non-market producers covered in their productivity series.

Interpretation

Productivity is different from:

- production, which shows growth in economic activity, but not the role of factor inputs
- efficiency, which refers to the maximum achievable level of output per unit of input
- value for money, unless quality change is fully captured in output
- effectiveness. Productivity reflects how much extra output is produced per unit of input, not whether that input has an effective outcome.

Productivity is not a complete performance management tool. There are other indicators that can evaluate performance. Given the differences between productivity and other performance measures, users of these statistics should be clear on what the question is that they are seeking to answer.

Productivity can increase due to either:

- an increase in output, holding input constant
- a decrease in input, holding output constant,
- output growth increasing faster than input growth
- decline in output growth less than the decline in input.

A change in the productivity of the education or health industry reflects only the growth in outputs or inputs for that industry. Output growth for these industries will have flow on effects to other industries, such as a more educated or healthy workforce, which may enable wider productivity gains. However, these effects cannot be observed directly in these statistics.

MFP is often considered a measure of technological change. Certain assumptions must be met for this to be the case, including 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 may be interpreted simply as a measure of output growth to input growth. Given the importance of technological progress as an explanatory factor in output growth, attention often focuses on the MFP measure as though it was a measure of technological change. However, this is not always the case:

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

Declines in MFP may not necessarily be interpreted as technological regress, but could be due to: new impediments or new standards; coordination of the production process (ie the combination of the factors of production) being misaligned; adjustment and reallocation lags; missing assets; or measurement issues such as not accounting for quality change.

Outputs, outcomes, and complementary performance indicators

Output growth reflects the change in the amount of activity undertaken in the education and health industries, but not necessarily the change in outcomes for the individual.

Productivity statistics therefore show how much output is produced per unit of input, not necessarily the outcome generated from the production process. Outputs of the education and health industries contribute to outcomes, as well as behaviours and activities undertaken by individuals: this makes it very difficult to disentangle the outcome due to either institutional or individual activity. This needs to be remembered in interpreting both the productivity and outcome-based performance indicators.

Productivity can be an indicator of overall industry performance, but may not reflect other concepts such as value for money or effectiveness. Quality change is in part accounted for through disaggregation and cost weighting. Additional performance indicators should therefore presented alongside productivity statistics to understand performance as a whole, given that quality or experience of service, or outcomes may be the factor of interest, and may be at odds with productivity growth.

Complementary indicators can be used to compare and contrast productivity measures to understand quality change, aid interpretation of results, and provide commentary on underlying data issues. This process of confronting the productivity estimates with external evidence can also shed light on the performance questions that productivity estimates are not designed to answer, such as equity, effectiveness, and economy. In addition, they can show where some aspects of service quality may not be captured.

Other performance indicators generally cover a subset of activities within an industry. Consideration of this limitation of additional performance indicators is needed when comparing different measures, although the comparisons can still provide insight into performance within the industry.

The relative importance of complementary indicators to output, productivity, or other available indicators is, however, not known. This is a key problem for why output cannot be adjusted for such indicators.

Consistency in the output and input series

Deriving productivity measures requires consistent coverage of outputs, labour inputs, capital inputs, and weights. When the output series includes unmeasured activities, it is assumed that these activities grow at the same rate as measured activities. Invoking this assumption is the most straight forward approach to measuring productivity in this context. Labour inputs could be adjusted if reliable hours paid and hourly wage data (to adjust weights as well) relating to those activities was available. Capital inputs cannot be adjusted in any way to compensate for missing activities in the output measure.

Education and training

Industry composition

The education and training industry includes preschool, school, tertiary, and adult, community and other education. The industry-based approach covers both market and non-market activities. This industry covered 5.0 percent of total GDP in 2010.

Non-market activity accounted for 87 percent of industry GDP in 2010. School education is the largest sub-industry in terms of industry GDP (accounting for 50 percent of industry GDP), followed by tertiary education (33 percent), preschool education, and then adult community and other education.

The contributions to the education and training industry have remained relatively stable since 1996 other than for preschool education which has doubled its share of industry GDP (up to 8.4

percent in 2010 from 3.6 percent in 1996). The contribution from adult, community and other education declined slightly, with activity moving from non-market to market.

Schools education accounted for most of the labour volume (57 percent of total hours in 2011, slightly down from 61 percent in 1996), followed by tertiary education (23 percent), and preschool education (12 percent, up from 6 percent in 1996).

Table 1

Contributions to value added for the education and training industry (1)
March 2010 year

Sub-industry	Market	Non-market	Total
	Percent		
Preschool education	5	4	8
School education	0	50	50
Tertiary education	3	30	33
Adult, community, and other education	5	3	8
Total	13	87	100

1. Figures may not sum to totals due to rounding.

Definition of output

Total value added for the education and training industry is derived by aggregating the series for the new indicators and the components for which the methodology has not been changed.

The non-market output indicators are cost-weighted EFTS measures. While the output measure largely covers the full range of activities, some may not be covered, such as research activity of universities. It is assumed that the volume growth in value added for these activities is the same as that of the output indicator for the relevant sub-industry. As the majority of activity in the education industry is in schools, however, the influence of this assumption is lessened. Enrolment, attendance, and financial data from the Ministry of Education are used to compile cost-weighted indicators for components of the education industry.

The new methodology for preschool education covers kindergartens, playcentres, education and care facilities, kōhanga reo, correspondence facilities, and home-based services. The output indicator is a measure of cost-weighted equivalent full-time students (EFTS) and is split by private market, private non-market, and central government activity. The weights are based on the 20-hours-free rate set in 2007. The preschool education indicator has the lowest weight of the three education indicators discussed here. The new series starts in 2000. The previous central government non-market preschool volume measure was the total number of enrolments in licensed kindergarten services and preschool correspondence facilities. This is now an EFTS measure and both components are weighted to reflect their relative value.

The new schools indicator covers both state and integrated schools of the following types: composite, contributing, correspondence, primary, intermediate, restricted composite, secondary (years 7–13 and years 9–13), and special. The output indicator is a measure of cost-weighted EFTS and is used to represent activity in non-market schools education. The new series starts in 1989. The schools indicator has also moved towards a measure of EFTS, away from total number of enrolments by school type. The components are weighted by expenditure weights.

The new tertiary indicator covers universities, polytechnics, and wānanga. The output indicator is a measure of cost-weighted EFTS and is used to represent activity in non-market tertiary education. The cost weights are based on expenditure. The new output series starts in 1996. The key differences with the previous methodology are that coverage is widened by including wänanga, and that each component is weighted by expenditure.

Single and double indicators

The new methodology continues to use the movements in the output indicator to proxy the movements in value added (single indicator method). The possibility for using double indicator methods was explored, but a number of practical issues were encountered.

For example, under a double deflation approach for tertiary education intermediate consumption grew much faster than output, leading to declining value added in some years. This could reflect real world behavior or it could also result from the output indicator not being able to reflect enough of the activity in this sector.

Two main events could have led to constant-price intermediate consumption growing faster than output from 2003–06:

- change in type of degrees being studied
- change from full- to part-time study.

The number of students studying for engineering and related technologies, and health degrees, increased steadily from 2004–06, while the number of society and culture students dropped (Ministry of Education, 2012). This substitution towards more expensive degrees could have meant more intermediate consumption expenditure but may not be picked up in the measure of EFTS (as it does not distinguish between subjects). From 2004–06, there was growth in the number of doctoral students while the number of master’s and bachelor’s students declined. This may not be reflected in the measure of EFTS, but may affect intermediate consumption. The strongest growth in doctoral students (and the highest level throughout) was in natural and physical sciences, one of the most resource intensive fields of study.

There was also a shift between full-time and part-time study during this time (Ministry of Education, 2012). While the EFTS measure captures this, the growth in part-timers could have a greater impact on intermediate consumption. This is because economies of scale may not be gained from teaching more part-time students. In other words, a part-time student may require relatively more resources than a full-time student. Universities have to ensure they have capacity to provide services on a headcount basis rather than an EFTS basis. This could drive intermediate consumption up more than output, which could reflect real world behaviour. A double indicator method would be appropriate provided there was further disaggregation.

The OECD (2008, p32) points to other examples where this situation has occurred and suggests that quality adjustment would be the ideal solution. Such cases:

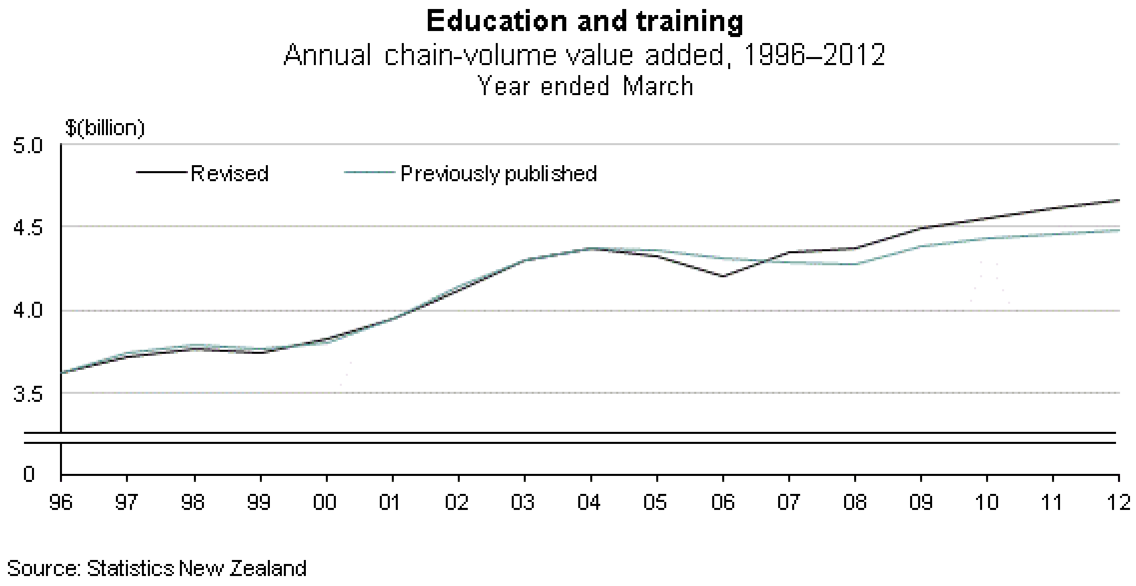
… demonstrate the importance of the right level of stratification. For example, if tertiary education is further broken down by fields of study rather than lumping students of all fields into one stratum, an important step towards quality adjustment is already undertaken and the above criticism of the output measure would no more apply.

The new methodology allows for implicit quality adjustment of the value-added indicator by disaggregating the main types of activity and weighting each type by its relative value (cost weight). However, it may be limited in not reflecting all the quality change that is occurring. Further disaggregation by type of study would not only provide more quality adjustment but would also enable double indicator methods to be considered. Additional data is required before this can be addressed.

Effect of the new methodology on output

Figure 2 compares chain-volume value added using the new methodology with previous published estimates for the education and training industry. The level of value added is unchanged in the base year (1996). This is because estimates are derived using the volume extrapolation method.

Figure 2

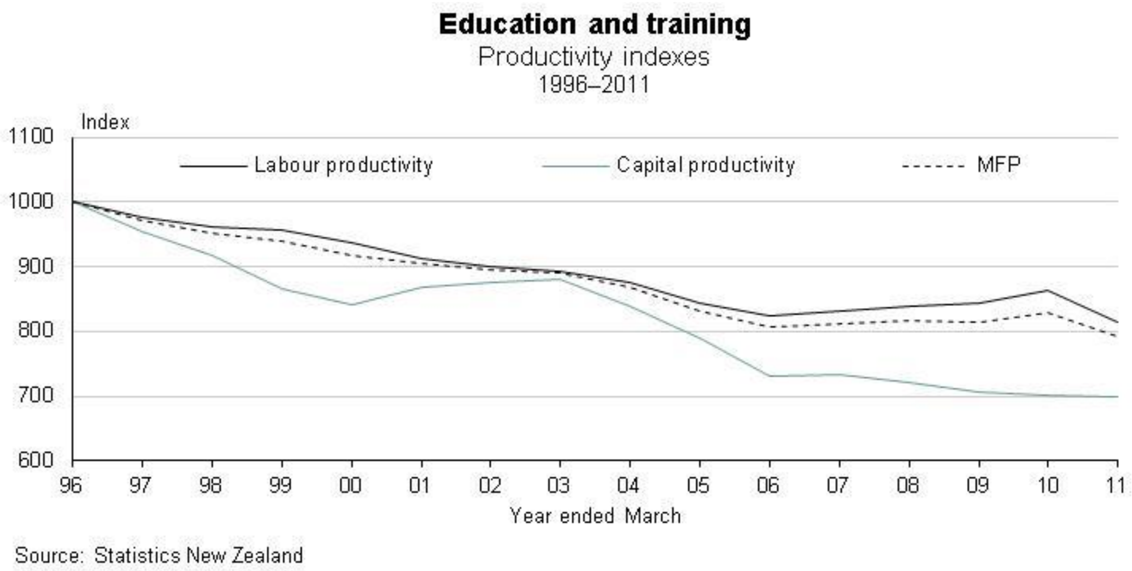


Over the long term, there is stronger growth in value added under the new methodology, especially from 2007. Although there were minimal revisions to the non-market schools indicator, which covers most activity in the education industry, revisions to the tertiary education indicator between 2005 and 2008 led to a drop in education value added. The preschool education indicator showed strong growth under the new methodology, which contrasts with minimal growth under the previous method. However, due to the low relative share of preschool education, this additional growth has not impacted on the industry total.

Productivity

The productivity estimates for this industry show the change in the weighted number of equivalent full-time students (EFTS) relative to the change in inputs (such as labour and capital). An increase (decrease) in productivity shows more (less) education is being delivered to students relative to a given amount of input.

Figure 3

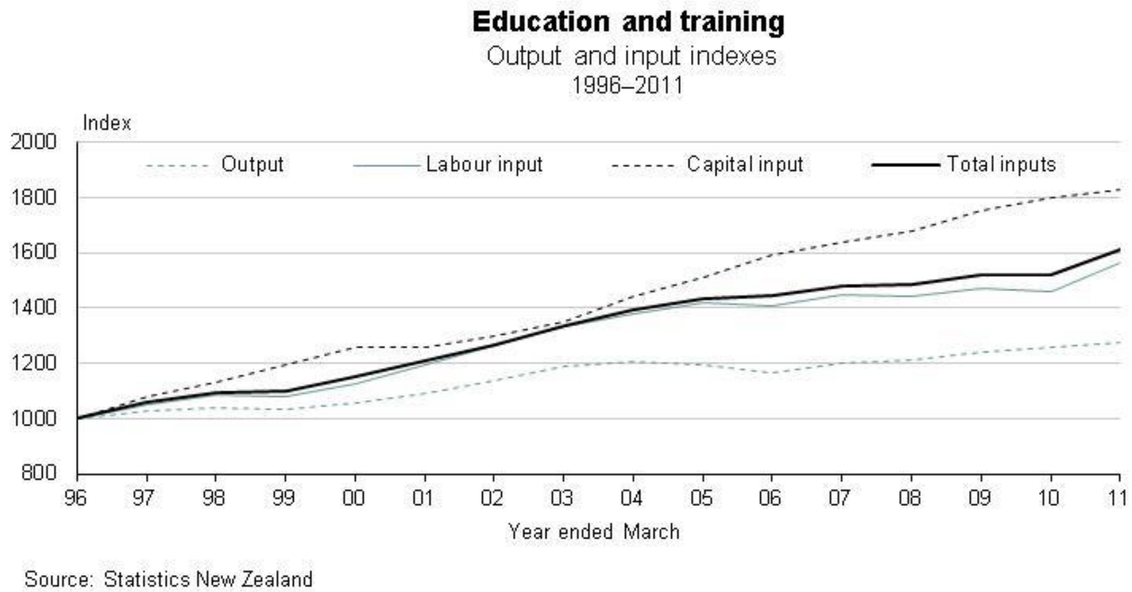


Labour productivity and MFP in the education and training industry increased by 1.1 percent and 0.7 percent per year respectively from 2006–10 (see figure 3). This followed declines of 1.9 percent and 2.1 percent per year in labour productivity and MFP from 1996–2006. From 1996–2011, labour productivity and MFP fell 1.4 percent and 1.5 percent per year respectively. MFP tracks labour productivity, reflecting the labour intensity in this industry.

Output grew at a rate of 1.6 percent per year from 1996–2011 (see figure 4). Following a decline in output from 2004–06, due to slowing tertiary education activity, output grew by 1.9 percent annually from 2006–2011. The decline in productivity in 2011 may be due to the output series not fully capturing growth in EFTS. This is because output growth is based on population movements when EFTS data are not available.

From 1996–2011, labour input grew 3.0 percent annually. Labour input grew throughout the series but was strongest from 2000 to 2005. This growth was observed in all education and training sub-industries.

Figure 4

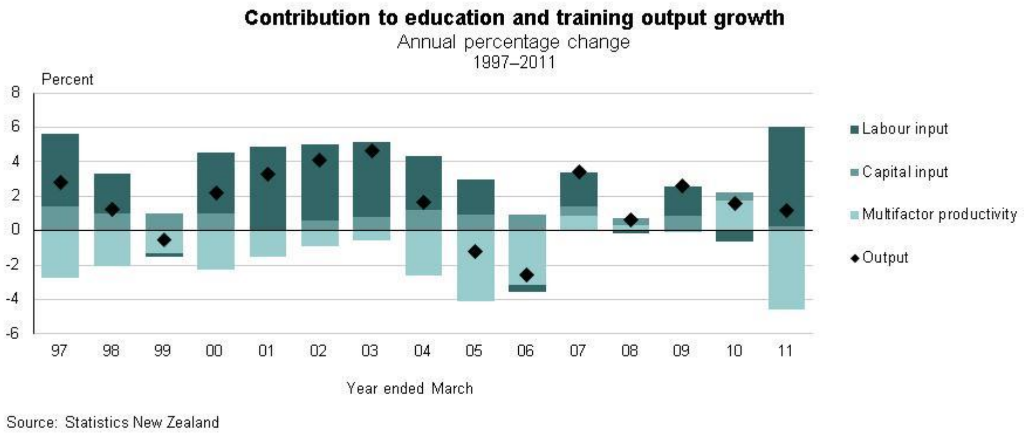


Capital input growth was consistently strong, leading to capital deepening in almost every year. From 1996–2011, the capital-to-labour ratio grew at an average annual rate of 1.0 percent. Non-residential buildings are the main asset in the capital stocks for education. Land and computers also form a significant part of the productive capital stock. Although information technology (computers and software) have become increasingly important for the production of education outputs, these assets still comprise a relatively small proportion of total assets.

Divergences between output and capital input growth can be expected given the different drivers of these series. The EFTS-based output measure captures shifts between full-time and part-time study but capital inputs may not. Capital capacity may need to be maintained to cope with increased headcounts. This could drive capital input up more than output.

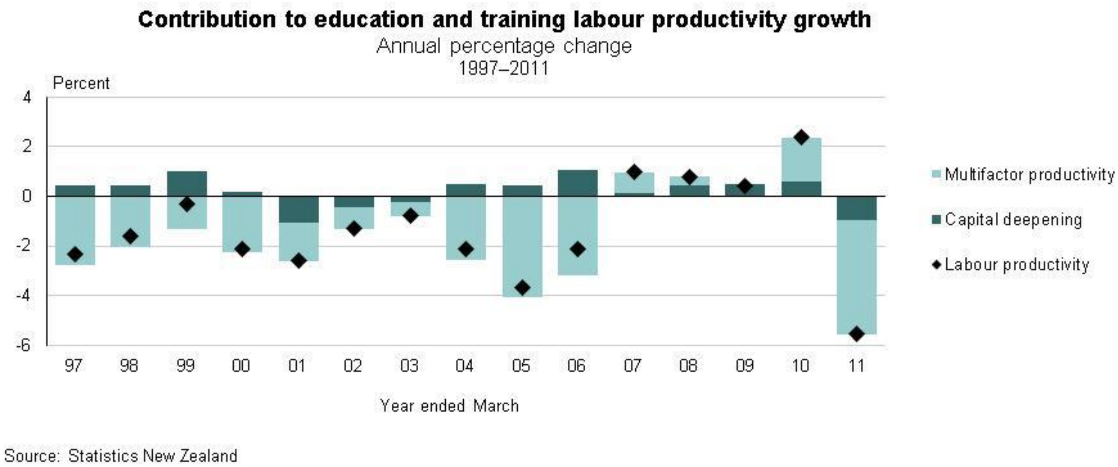
Growth in labour input made the strongest contribution to output growth from 1996–2011, contributing 2.5 percent annually (see figure 5). This was offset by declines in MFP, with the exception of the 2006–10 period. Capital input growth made positive contributions across all years, averaging 0.8 percent annually.

Figure 5



Capital deepening made positive contributions to labour productivity in all years except 2001–03 and 2011 where slow growth in capital inputs led to capital shallowing (see figure 6). Capital deepening contributed 0.2 percent annually to labour productivity growth. The small contributions from capital deepening reflect the low capital weights for the education industry. These contributions were more than offset by declining MFP, contributing –1.5 percent per year.

Figure 6



Complementary indicators

The non-market output series captures the student mix between education institutions and thus captures elements of quality change. Exam scores, school inspection rates, class size, and attendance rates have been argued to provide indications of quality change (Statistics NZ, 2010). For instance:

- The proportion of students achieving NCEA qualifications at all levels increased by approximately 2 percent per annum from 2004–11 (Ministry of Education, nd), which could provide an indication of quality change.
- Following an increase in school absence rates of 0.6 percentage points from 2004 to 2006 to 11.5 percent, absence rates were at their lowest (in the measurement period) in 2011 at 10.2 percent (Ministry of Education, 2012).

It is also worth noting:

- Completion rates for bachelor's degrees was constant from 2004–10, but increased by 11 percent in 2011.

- Completion rates for masters degrees and doctorates increased by 14 percent and 27 percent respectively from 2004–11.

Smart (2009) shows an increase in productivity in research output of universities from 1997-2000 and from 2003-06. These findings, however, depend on output being measured as number of articles or reviews published in the web of science: the number of books, book chapters, and conference papers produced are not measured, and the coverage of publications in social sciences, humanities, and creative arts is likely to be incomplete.

When examining the role of the education industry in its contribution to economic growth, industry level measures of education productivity may not be the key statistic of interest but the contribution of skills to total measured labour productivity may be more insightful. Statistics New Zealand's composition adjusted labour productivity series shows the contribution of experience and qualifications, as proxies for skills, to output growth and its effect on labour productivity. Labour productivity grew 1.4 percent per annum from 1998-2012 and by 1.1 percent for composition-adjusted labour productivity during the same period. The 0.3 percent per year average difference reflects a positive contribution of human capital to labour productivity growth. However, some of the observed effects of increased skill could also be due to an ageing workforce, as well as increased educational attainment.

Data from the Office for National Statistics (2012) shows a decline in education MFP from 2000-08. However, MFP grew by from 1996-2000 and from 2008-10, offsetting the decline during the early 2000s such that MFP grew by 0.5 percent per annum from 1996-2010. The gross output measure, focusing on publicly funded outputs only, adjusts for quality using the change in uncapped average point scores in GCSEs and equivalents achieved by 15-16 year old pupils each year.[5] From 2000-10, Statistics NZs measure of MFP for the education industry declined by 1.0 percent per year compared to 0.2 percent for the Office for National Statistics publicly funded based measure.

Sensitivity to measurement choices

The effect of the rate of return on capital services and MFP

Figures 7 and 8 below compare capital inputs and total inputs using exogenous rates of return of 4 and 8 percent. These rates are set at the industry level. Both scenarios are based on the cost share approach. Varying the exogenous rate of return for these industries has an effect on capital services, but minimal effect on total inputs (and therefore MFP) due to the low capital income weight.

[5] This is applied to pupils in primary and secondary schools for each of the four countries, and in England also for pupils attending CTCs and Academies, to give a final estimate of education output. Initial Teacher Training output is also adjusted by a completion rate factor.

Figure 7

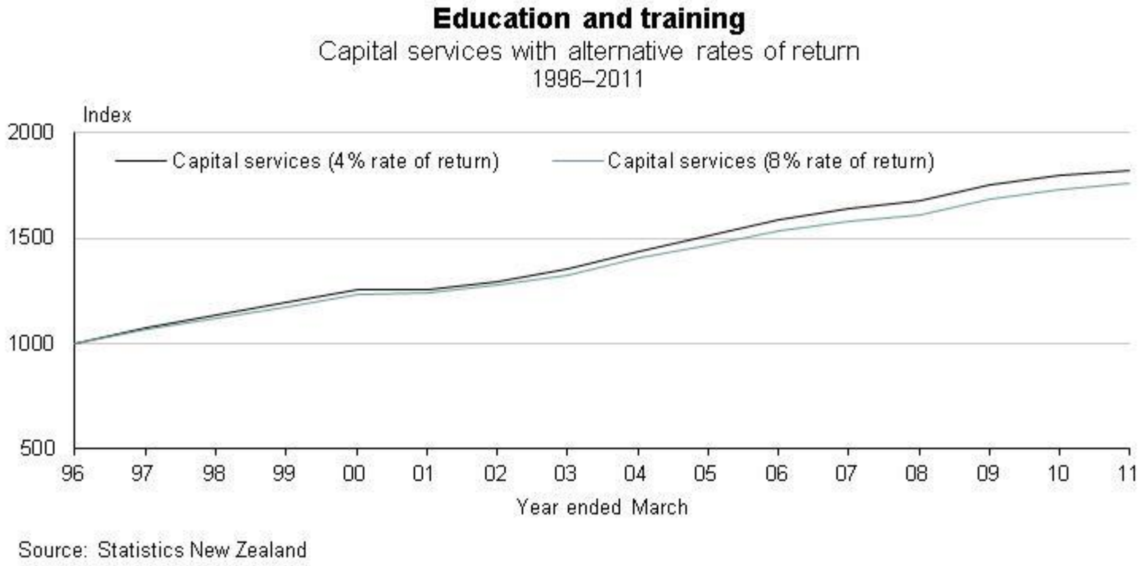
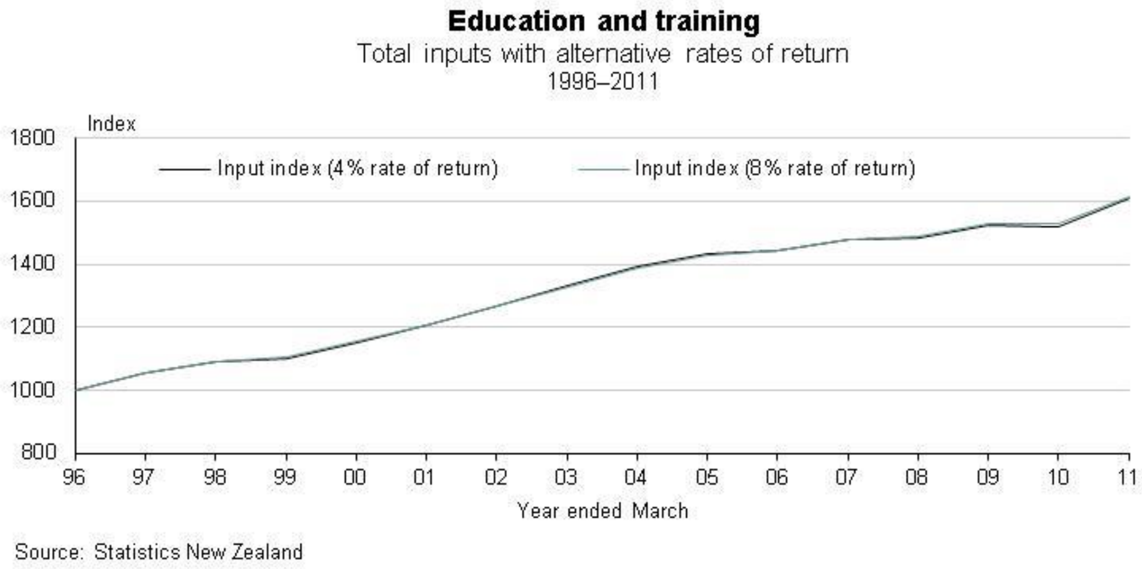


Figure 8



The effect of cost and income shares on MFP

For education and training, there are negligible differences in MFP when calculated using income shares or cost shares from 1996–2006. The cost share approach leads to slightly lower growth in MFP from 2006–11 (see figure 9).

The lower growth in MFP under a cost based approach reflects a greater influence of capital services. As there has been capital deepening in this industry, and the cost share approach leads to higher capital income share, which increases from around 11 percent of total income to 19 percent, MFP growth is lower.

Figure 9

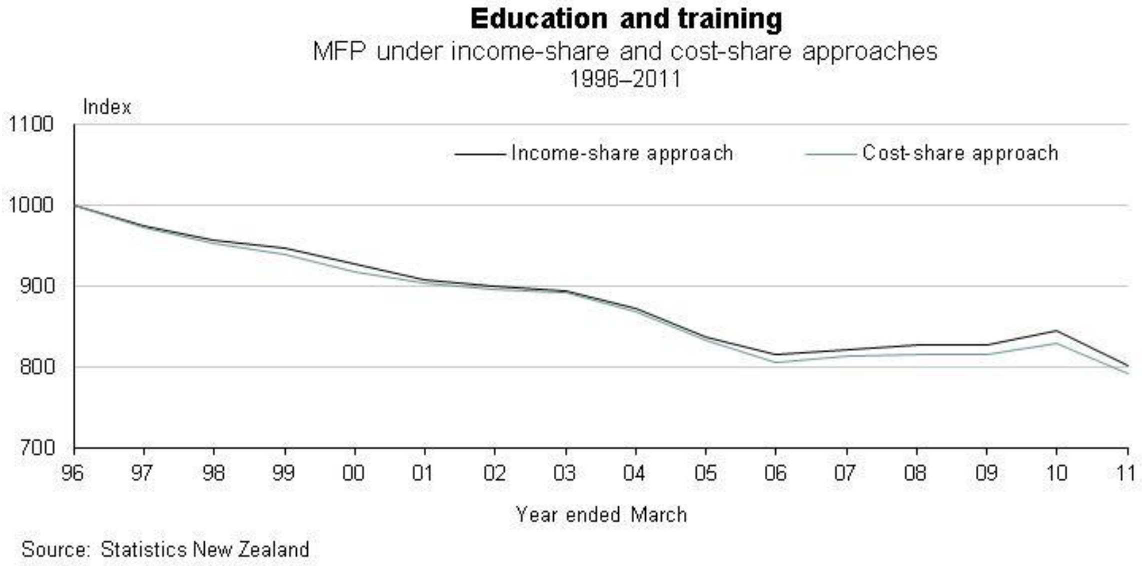
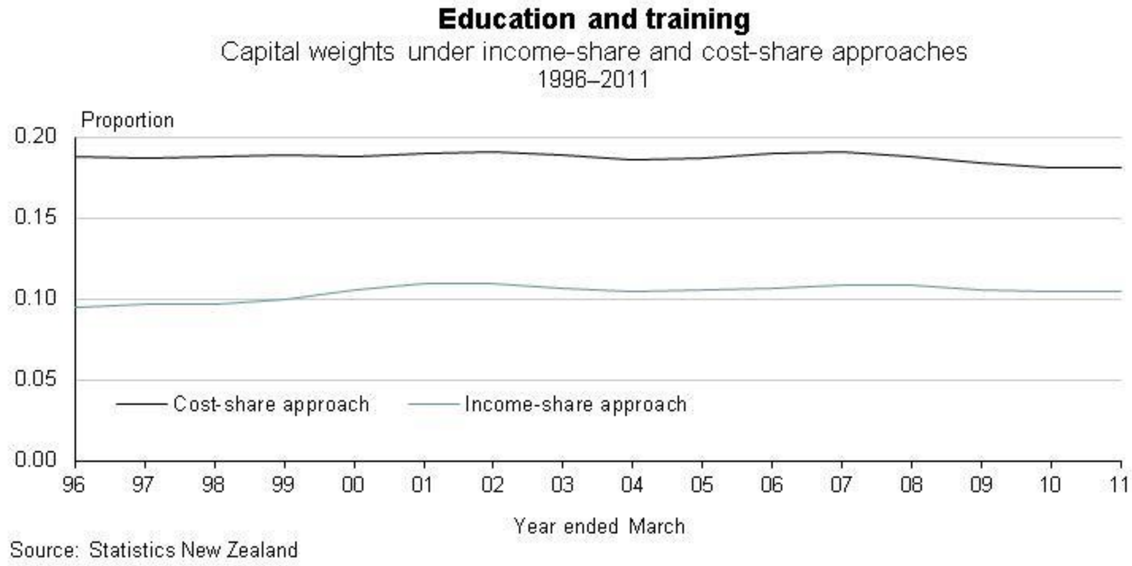


Figure 10



Labour quality

Although quality adjusted labour input measures are not available by industry, some insight into the potential for quality adjustment can be obtained by weighting the labour volumes of each sub-industry with gross earnings data from LEED using a Törnqvist index. This takes account of the changes in relative marginal products of labour between the sub-industries. From 2000-11, both the unadjusted labour input series and the Törnqvist 'implicit quality' index grow at an annual average rate of 2.7 percent. The stronger growth in Törnqvist labour inputs prior to 2005 suggests a decline in the average skill level: in the education industry this reflects the strong growth in labour inputs in pre-school education boosting the weight for this sub-industry despite the average wage growing at a slower rate compared to other industries.

Health care and social assistance

Industry composition

The health care and social assistance industry contributed 6.8 percent to total GDP in 2010. Non-market activity accounted for 57 percent of industry GDP in 2010. Hospitals, medical and other health care services, and residential care services and social assistance are included in this industry. Hospitals are the largest component, accounting for 45.1 percent of industry GDP, followed by medical and other health care services (which includes general practitioners and dentists, and accounts for a further 33.7 percent) and residential care services and social assistance (21.3 percent). Table 2 shows the contribution to health care and social assistance current-price value added by sub-industry, and market and non-market activity in the March 2010 year.

Table 2

Contributions to value added for the health care and social assistance industry
March 2010 year

Sub-industry	**Market**	**Non-market**	**Total**
	Percent		
Hospitals	2	43	45
Medical and other health-care services	30	4	34
Residential-care services and social assistance	11	10	21
Total	43	57	100

The non-market hospitals component accounted for markedly less of total health industry activity in 2010 (43 percent) than it did in 1996 (where it covered 51 percent of value added). Residential care services and social assistance has become increasingly important, with its share of industry GDP increasing from 16 percent in 1996 to 21 percent in 2010, driven by growth in the market sector. A similar pattern is reflected in the labour volume data. Hospitals accounted for 37 percent of labour volume in 2011, down from 42 percent in 1996. With the proportion of labour hours remaining relatively constant for residential care services and social assistance, the decline in the proportion of hospital volume was due to strong growth in labour input in medical and other health care services.

Definition of output

The government non-market output indicator includes inpatient and day patient events, which are weighted according to the patients diagnosis related group (DRG) and length of stay, and are chain-linked with cost-weighted emergency department and outpatient visits (from 2009). Activities not reflected in chain-volume value added for non-market producers include non-casemix[6] funded hospital events, mental health, and residential care. It is assumed that output growth for non-measured activities is the same as that for the non-market indicator of health care value added. The effect of this assumption on productivity is lessened at the industry level due to the market activity of medical and other health care services.

The new non-market health methodology has two main components: inpatient events, and emergency department and outpatient events. It is based on data sources from the Ministry of Health.

[6] Casemix refers to the mix of patients and conditions. Non-casemix events refer to those which are bulk funded and hence low-level weights are not available.

The inpatient series is a casemix adjusted measure of inpatient (admitted overnight) and day-patient (admitted but not staying overnight) events in public hospitals, covering medical, surgical, and maternity care. The data source is the National Minimum Dataset. It covers publicly funded events in private hospitals. Weighted inlier equivalent separation (WIES) weights are used to adjust for casemix and aggregate inpatient and day-patient events. The WIES system applies different weights depending on the type of disease and length of stay. As such, it provides an implicit quality adjustment. The WIES weights, which reflect total resource use, are updated annually by the Ministry of Health. Casemix adjustment reflects changes in the composition of patients, by type of patient and illness. The inpatient series does not include emergency department or outpatient events, which are measured separately.

The emergency department and outpatient (EDO) series is a chain-linked index of emergency department and outpatient visits (secondary care). The data source is the National Non-Admitted Patient Collection (NNPAC). EDO events are weighted by national average cost-based prices, updated annually, to account for the relative value of different types of EDO activity. Including EDO activities led to a more complete and representative picture of public hospital value added, especially as these services are more prevalent in recent years.

While NNPAC can be used to calculate volumes of EDO events, changes in reporting requirements over time have led to discontinuities in raw volumes for some purchase units (eg occupational therapy and physiotherapy). Without accounting for these reporting changes, volumes would be biased upwards. Consequently, only the purchase units (types of activity) where volume movements were stable over time are included in the output measure. Purchase units with strong volume change and a change in reporting requirement were only included from the time it became mandatory to report. The assumption is that the excluded observations grew at the same rate as other purchase units before the change in reporting requirements.

The inpatient and day-patient series is chain-linked with the EDO series. National medical/surgical prices are used to form the expenditure weight for inpatients and day patients. The expenditure weight for EDO volumes is a sum of average prices multiplied by the number of events. These weights are updated annually.

The new methodology for the non-market indicator applies from 2003, due to data availability. Prior, the non-market indicator is a composite volume series of inpatient events (85.5 percent weight), day cases (7.5 percent weight), and bed nights (7 percent weight). This series is an output indicator that represents value added, and non-market activity in all three health sub-industries: hospitals, medical and dental services, and residential care.

The previous method separated inpatients and day patients (those in hospital for more than three hours but not admitted overnight). The distinction led to the use of arbitrary fixed base weights, which are no longer required. Because day-patient volumes are now cost weighted on the same basis as inpatient volumes (using WIES), they are no longer distinguished and reweighted.

The previous non-market health value-added index included a measure of the number of bed nights. This reflected the flow of service (a night’s stay) for a patient. Bed nights were calculated as the mean length of patient stay times the number of inpatient discharges. Conceptually, bed nights are already included in inpatient discharges as the WIES methodology accounts for average length of stay. As such, this is no longer an indicator for non-market health value added. Table 3 summarises the differences between the two non-market methodologies.

The estimated outputs cover all public hospitals, but not necessarily all activities within the hospital (or outside the hospital setting). Total current-price costs, derived from the new methodology, were compared with expenditure data from district health board financial information templates – to assess the degree of coverage. Coverage is estimated at just under three-quarters of public hospital activity, up from around half of all expenditure when not including EDO visits. This increased coverage of activities is a key step in improving the representativeness of the value-added index.

Table 3

		New method (from 2003)	Previous method
Activity indicator	Inpatient events	Casemix adjusted using WIES weights	Casemix adjusted
	Emergency department and outpatients	Chain linked Laspeyres index from 2009	Not included
	Average length of stay (ALOS)	Not used as a volume measure. WIES weights account for ALOS	Used to calculate total number of bed nights
	Day cases	WIES weighted	Unweighted
Compilation	Activity indicator aggregation method	Annually reweighted using expenditure weights	Fixed base weights: Inpatient stays (casemix adjusted) 85.5%; day patient stays 7%; average length of stay 7.5%
	Value added	Double indicator method accounts for output and intermediate consumption in the value-added calculation	Single indicator method (uses output movements to proxy value added)

Coverage could be further improved by including indicators of mental health activities and residential care. The number of bed nights for specific providers could form an indicator for non-market residential-care providers. However, there are very few central government non-market residential-care facilities, which means that the impact of including these activities may be small. For activities not included in the output index we assume the volume growth is the same as for measured events.

The government non-market series is combined with private-market and private non-market value added to derive the total value added for the health care and social assistance industry.

Double indicator approach

The double indicator method was implemented for the new methodology only (from 2003), reflecting the more-recent availability of privately provided but publicly funded activity data. Volume extrapolation is used for the output data. The volume of intermediate consumption is derived using price deflation: current price intermediate consumption, from district health board financial statistics and Crown financial institutions statistics, is deflated with a sub-index of the producers price index for the health care and social assistance industry.

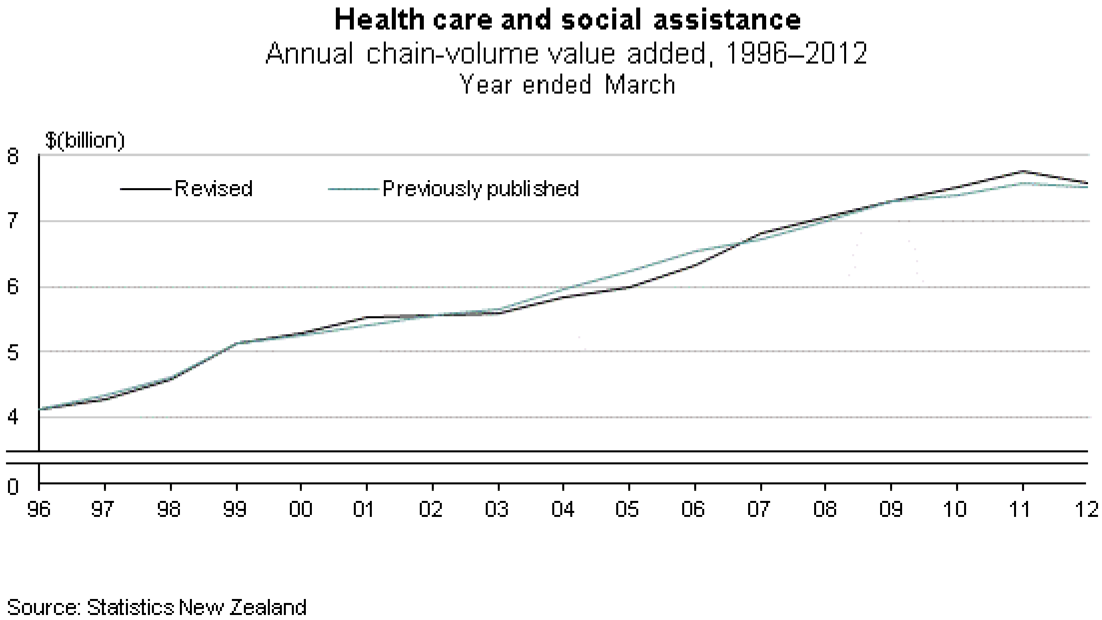
In intermediate consumption, complete inpatient events funded by the public system, but provided privately (ie outsourced surgery), are bundled together with other outsourced services such as laboratory tests (which should, and do, form part of intermediate consumption). Therefore, there are both market- and non-market-provided activities that cannot be unbundled in intermediate consumption.

The output indicator includes complete inpatient outputs funded by the public system, but provided privately (ie outsourced surgery). Incorporating publicly funded events occurring in private hospitals into the non-market hospital output measure enables the output indicator to be on the same basis as intermediate consumption. However, as a double indicator method is being used, the value added of the private hospital providers is excluded from the non-market hospital value added measure.

Effect of the new methodology on output

Figure 11 compares chain-volume value added using the new methodology with previous published estimates for the health care and social assistance industry. The level of value added is unchanged in the base year (1996). This is because estimates are derived using the volume extrapolation method.

Figure 11



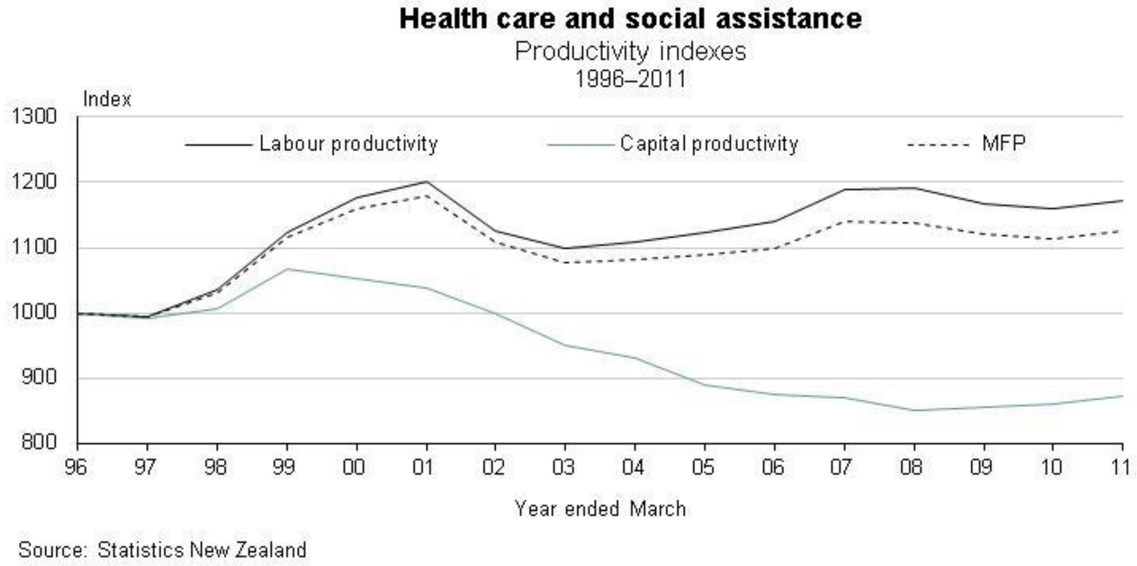
Over the long term, chain-volume value added grows at a similar rate under the new and previous methodologies. There are revisions throughout the series, with the revised series showing slower growth for 2003–05 and 2012, but faster growth for 2006–07 and 2009–11. These revisions are due to a combination of the new method for inpatients and day patients and growth in intermediate consumption that differs from that of the input indicator. Revisions after 2009 reflect EDO events being included, and the input indicator being replaced with a direct-volume measure. Revisions before 2003 are due to financial intermediation services indirectly measured being allocated to intermediate consumption of the market component of the health industry.

Productivity

For health care and social assistance, the productivity estimates show the change in weighted health care activities (provided by both market and non-market producers) relative to the change in inputs (such as labour and capital). An increase (decrease) in productivity means that more (less) health events are experienced by patients relative to a given amount of input.

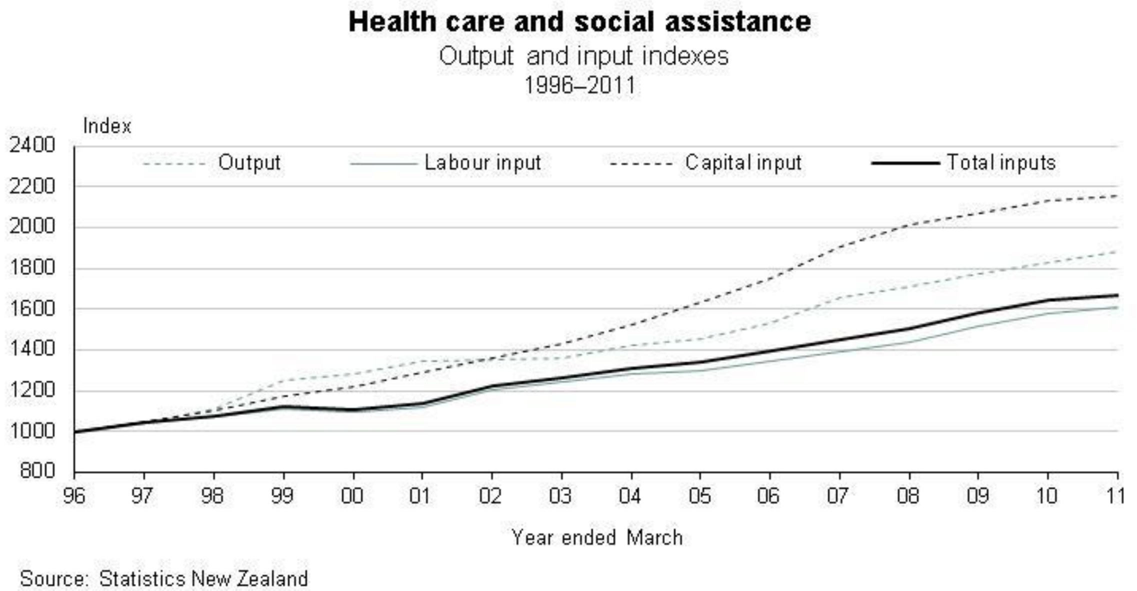
Labour productivity and MFP grew at annual average rates of 3.7 percent and 3.3 percent from 1996–2001 (see figure 12). Following two years of decline, labour productivity and MFP grew again until 2008. Labour productivity in 2011 is at a similar level to 2008. From 1996–2011, labour productivity and MFP grew by 1.1 percent and 0.8 annually respectively. MFP tracks labour productivity, reflecting the strong labour intensity of this industry. Capital productivity declined at a rate of 0.9 percent per year since 1996.

Figure 12



Output grew 4.3 percent annually from 1996. Outputs diverged from inputs in 1999 where output growth grew sharply while labour and capital input growth remained steady, leading to strong growth in productivity (see figure 13). The growth in output was due to strong growth in market health activity in this year.

Figure 13



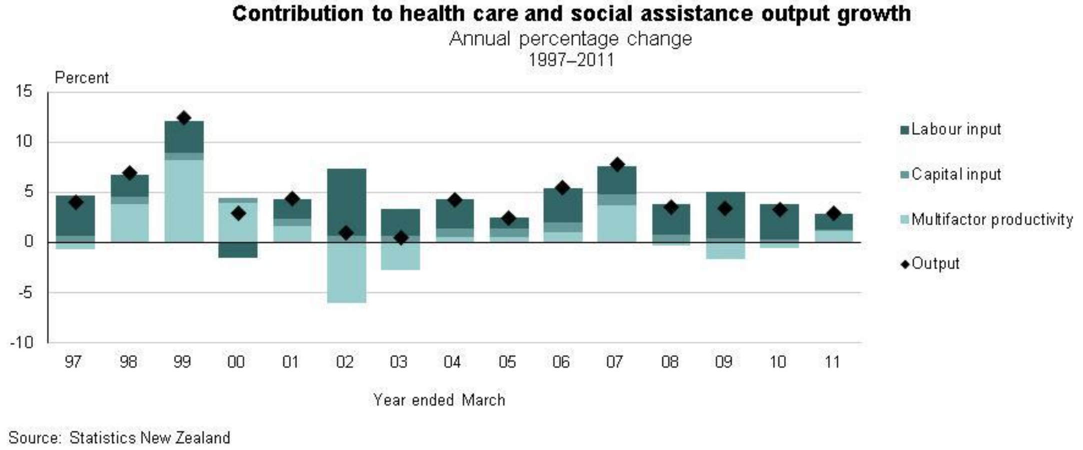
The decline in productivity during 2001–03 reflects slowing output growth and strong growth in labour input, particularly in the hospitals, and residential care sub-industries. From 2002, growth in labour input in all three health care sub-industries has been consistent. Labour input grew at an annual average rate of 3.2 percent per year from 1996.

Capital inputs grew by 5.3 percent per year from 1996. The productive capital stock for the health industry consists mainly of non-residential buildings, with electronic plant and machinery and computers becoming increasingly important over time.

Strong capital input growth drove an increase in the capital-to-labour ratio of 2.0 percent per year from 1996. From 2008, however, there has been capital shallowing with the capital-to-labour ratio declining by 1.3 percent annually.

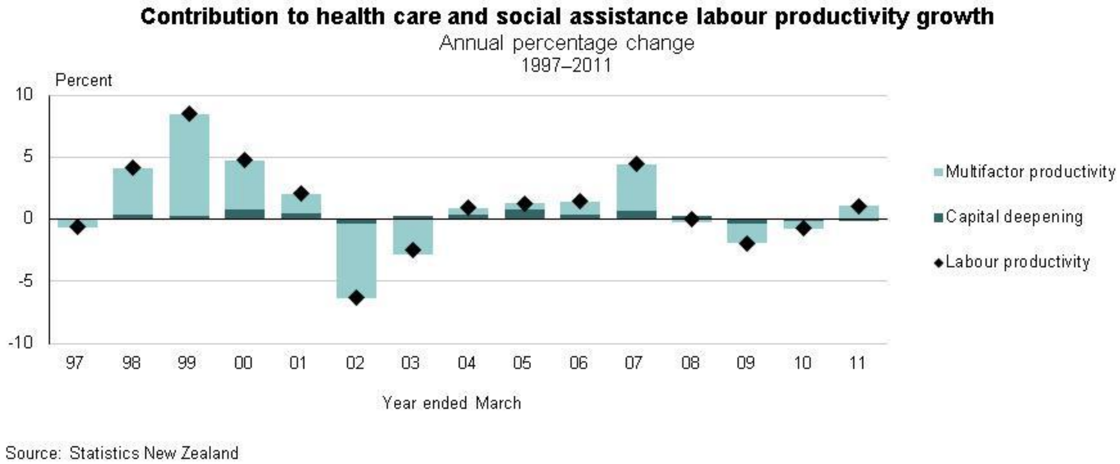
Labour and capital input growth made positive contributions to output growth in nearly all years, and these contributions averaged 2.8 percent and 0.7 percent annually (see figure 14). From 1996–2011, MFP provided an average contribution of 0.8 percent per year to output growth, with much of this occurring from 1997–2000.

Figure 14



MFP was the main driver of labour productivity in most years, and contributed to 0.8 percent annually to labour productivity growth across the series (figure 15). The contribution of capital deepening averaged 0.3 percent per year. While there was strong growth in the capital-to-labour ratio, the low weight of capital in the production process meant this had minimal impact on labour productivity.

Figure 15



Complementary indicators

Performance measures for New Zealand's health system are produced by the Ministry of Health. This includes information on the health targets, introduced in 2007/08, which includes shorter stays in emergency departments, improved access to elective surgery, shorter waits for cancer treatment, increased immunisation, and focus on preventative measures. Overall, the system has met or almost met most of the targets and made significant progress towards achieving others (Ministry of Health, 2012, p.215). Productivity improvement is not a target in itself but can contribute towards meeting these goals.

Key findings from the Ministry of Health (2012) include:

- The ambulatory sensitive hospitalisations rate (avoidable admissions if services were more efficient) was constant from 2001–11.
- Elective day case procedures have increased by double the target amount since 2008.
- Amenable mortality (deaths that may have been prevented if services were more efficient) has gradually declined over time.
- The percentage of New Zealanders satisfied with certain health services increased from 68 percent in 2007 to 72 percent in 2012.
- Waiting times of four months or more for elective surgery have shown a strong decline from 2001 to 2010.
- New Zealand's rates of hospital mortality as a percentage of all hospital discharges have been declining since 2001, particularly for all age groups over 45 years.
- Offsetting some of the improvements in most health targets are increases in serious events (one that led to significant additional treatment) from 2008 to 2011.

Labour productivity estimates produced by the Ministry of Health show a decline in the labour productivity of public hospitals of 1.2 percent between 2004 and 2010. Maniparathy (2008) also finds a steady decline in labour productivity in public hospitals from 2001 to 2006, following a sharp increase in 2000-01. The estimates presented here differ in terms of sector and activity coverage. Differences in defining output (eg gross output compared to value added) and input measures (eg using FTEs rather than hours paid) also contribute to differences in productivity estimates.

Sensitivity to measurement choices

The effect of the rate of return on capital services and MFP

The graphs below compare capital inputs and total inputs using exogenous rates of return of 4 and 8 percent. These rates are set at the industry level. Both scenarios are based on the cost share approach. As shown in figure 16, an exogenous rate of return leads to slower growth in capital services. However, there is little effect on MFP, given the low weight of capital in the production process (see figure 17).

Figure 16

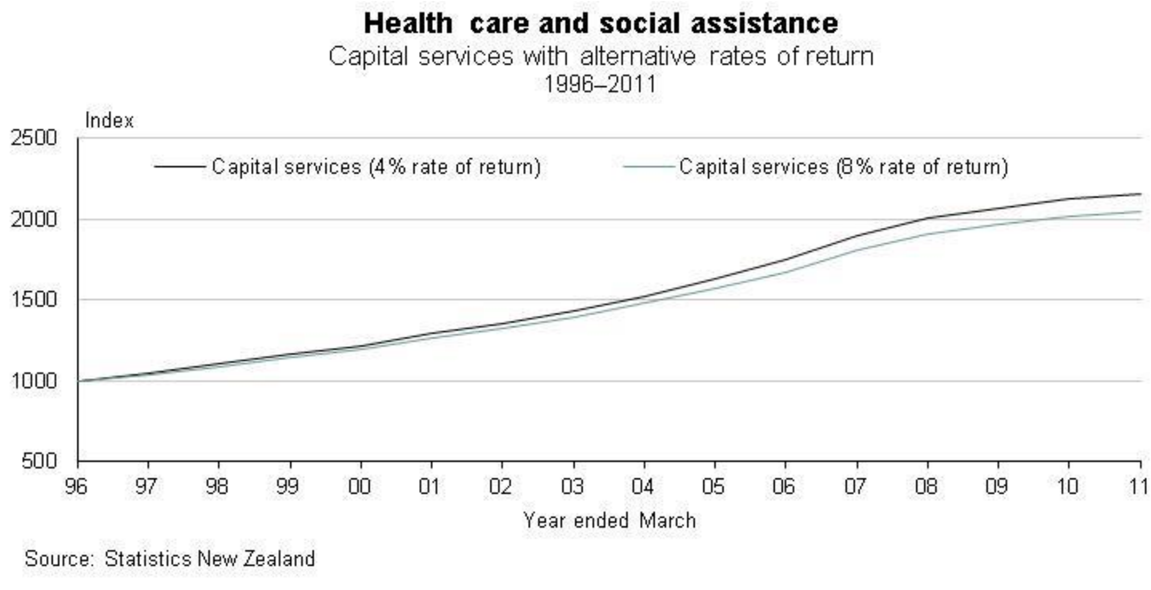
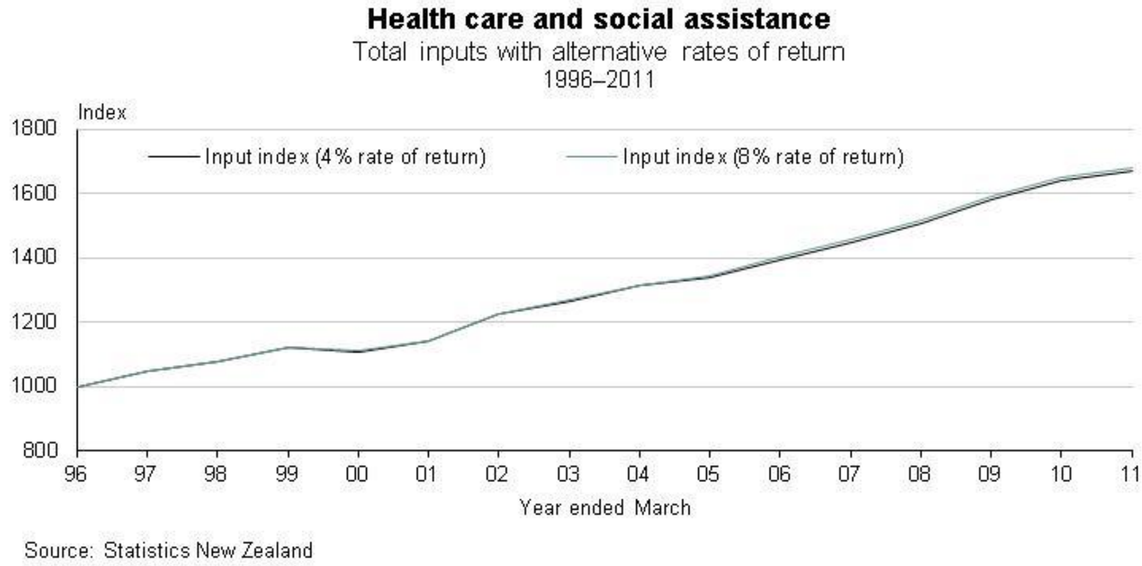


Figure 17



The effect of cost and income shares on MFP

For health care and social assistance, the use of cost shares shows an increase in MFP over the long-term compared to the income share approach (see figure 18). The difference in the two approaches begins in 2003, widens until 2007 and remains thereafter. The long-term trend in MFP, however, remains unchanged.

The cost share approach leads to a lower capital weight for health (see figure 19). A lower weight could be the result of deficits, a mis-specified rate of return, or missing assets. The cost share approach is also less dependent on gross mixed income attributable to capital. Mixed income, which is split between capital and labour based on the proportions of total income, is higher for the health care industry due to the larger proportion of working proprietors (general practitioners and dentists for example) and may therefore affect the comparability between the income and cost-share approaches. In addition, the positive gross operating surplus (which may reflect supernormal profits) is removed from the calculation of capital cost.

Figure 18

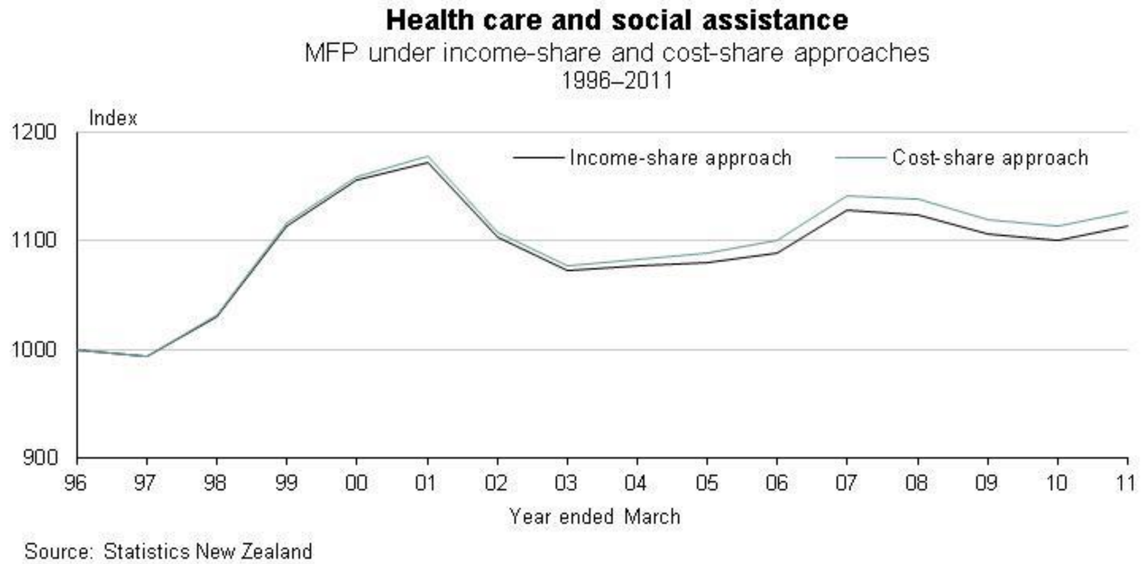
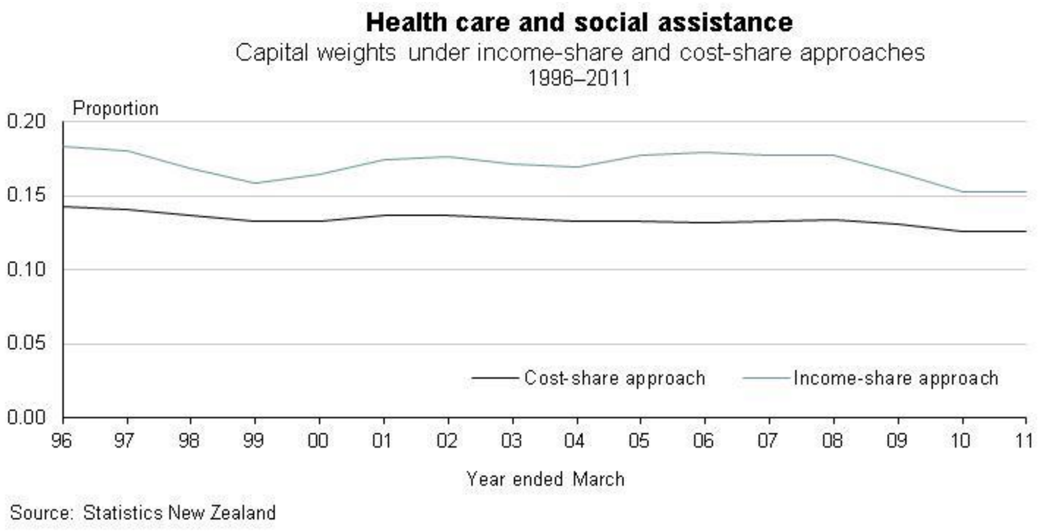


Figure 19



Labour quality

As with education, an implicit quality adjusted labour input index using LEED total gross earnings shows comparable growth with the unadjusted labour input index (both increasing at a rate of 3.6 percent per annum from 2000-11). The potential for declining skill levels is also present in 2004 and 2007 (reflecting stronger growth in residential care and social assistance), but skill levels increased in 2008 and 2010 (reflecting relatively stronger growth in hospital labour inputs).

Summary

This paper has presented the new methodology for measuring value added in the education and health industries. The improved measures of value added, defined as activities, have enabled measures of productivity to be developed, showing the change in efficiency with which health care and educational services are being delivered by the combined activities of market and non-market producers. Further work on measuring additional activities would be worthwhile to improve the non-market output indicators that underlie the industry totals.

Productivity estimates for the education and health industries were presented within a growth accounting framework. The sensitivity of MFP to measurement choices was shown, and it was found that the exogenous rate of return had no effect on MFP but the choice of factor weights is relatively more important.

The use of complementary statistics has been emphasised in this paper, to show how other outcomes have developed over time that may or may not be captured in productivity estimates. This approach may also be useful for market-based industries, particularly those industries which produce inputs that are consumed by other industries (eg transport, postal, warehousing, and construction) and thus impact on the productivity of the wider economy. Similarly, such indicators could be useful for arts and recreation services which provide intangible benefits.

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