Queensland Government

Office of Economic and Statistical Research, Queensland Treasury

An Historical Analysis of Productivity in Queensland

Report

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A report prepared by Queensland Treasury

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Abbreviations

ABS	Australian Bureau of Statistics
ASNA	Australian System of National Accounts
CVM	Chain Volume Measure
GDP	Gross Domestic Product
GSI	Gross State Income
GSP	Gross State Product
MFP	Multifactor Productivity
QSA	Queensland State Accounts

1 Introduction

1.1 Background

This report provides measures of multifactor productivity (MFP) for Queensland and the Rest of Australia for the period 1985-86 to 2004-05. It is an historical perspective of Queensland's productivity performance analysed in terms of productivity cycles, the last of which ended in 2004-05.

A longer term goal is to undertake additional research to produce industry-level productivity estimates to enhance the analytical tool-kit available to understand Queensland's economic performance. This information will allow for a more in-depth decomposition of the aggregate economy-wide productivity, and offer insights into the possible drivers of productivity growth in Queensland.

1.2 The concept of productivity

Productivity is a broad concept that refers to the relationship between economic output and inputs. The level of productivity is the amount of output produced per unit of inputs consumed. It measures how an economy is using resources (labour and capital) in the production process in order to deliver a final output (goods and services).

Productivity growth is the difference between the growth rate of output and the growth rate of inputs, that is, productivity will increase if output grows faster relative to inputs. This simple relationship means that productivity growth can be realised through any of the following four combinations:

- a larger increase in output than inputs;
- an increase in output with no change in inputs;
- output remaining unchanged while inputs fall; or
- a smaller decline in output than inputs.

The final point indicates that it is possible for productivity to increase (and have a positive influence on economic growth) while an economy is entering a downturn. However, because productivity tends to be cyclical in nature, it is best analysed over the long term (at similar points in the economic cycle). Short term movements may not accurately reflect true productivity trends due to distortion created by economic cycles.

Productivity growth can be achieved through innovations in the production process. Broadly defined, innovation is the behaviour or activity in which new economic possibilities are tested via purposeful changes to products and production techniques[1]. The ability to create new products or to increase the production efficiency of existing products leads to more output being produced from available inputs, increasing productivity. Successful innovative activity

[1] Industry Commission (1995), *Research and Development*, Report No. 44, AGPS, Canberra.

across the economy emerges from decision makers acting on both new technical possibilities and new market opportunities.

At the aggregate economy level, most interest centres on the two measures of productivity: labour productivity and multifactor productivity.

Labour productivity is real output per unit of labour (usually measured as hours worked). It is clear that increases in output can be obtained by adding additional employees or using the existing employees more intensely (through extra hours). Labour productivity is an attempt to account for these changes in order to measure the movement in efficiency of an hour worked. In other words, it is the increase in output not attributable to an increase in labour inputs.

Labour productivity is the most common productivity measure, due to its ease of calculation and the availability of data at the state and national level. However, despite its name, it is only a partial measure of technological progress, which represents much more than just the efficiency or productivity of workers. Because of the way it is measured, labour productivity also captures any changes in the amount of capital available to workers. This increase in capital per worker hour, measured as a rise in the capital to labour ratio, is termed 'capital deepening'. Hence, labour productivity is often decomposed into capital deepening and a 'pure' productivity component called multifactor productivity.

Capital Deepening is the application of more capital per unit of labour (an increase in the ratio of capital to labour). It means that the workforce has, on average, access to more capital and can therefore generate more output.

Multifactor productivity (MFP) is real output per combined unit of labour and capital. It measures the change in output once labour and capital inputs have been accounted for. Growth in MFP can be driven by enhanced efficiency (finding superior techniques to combine inputs in the production process) and by advances in available technology (achieved predominately through human capital investments and innovation).

In principle, MFP is a better measure of efficiency. It measures how efficiently the main factors of production labour and capital combine to generate output.

By definition, the contribution of MFP and capital deepening equate to labour productivity.

1.3 Why is productivity important?

The key goal for an economy is to allocate finite resources in such a way that an optimal standard of living given current performance and production technology is achieved. It is useful to understand the way in which different drivers contribute to improvements in living standards. An economy wide measure of the material standard of living for Queensland is Gross State Income (GSI) per capita, that is, the income generated in the State per person. Overall living standards, or GSI per capita, are determined by Gross State Product (GSP) per capita and by movements in the terms of trade. This indicator of standard of living is not intended to be an all encompassing measure of wellbeing. Instead, it is a purposefully defined measure that is constructed within the scope of economic measurement and which does not capture, for example, social and environmental changes which may impact on the wellbeing of a region's population.

The terms of trade represent the purchasing power of exports in terms of the imports they can buy. Higher terms of trade (for example, through higher mineral export prices) means that for a given level of export income, domestic consumers have more purchasing power and therefore higher living standards.

Economic growth can assist in achieving a better living standard as the more goods and services that can be produced from an economy's resources, the more is available for consumption. Economic growth can be achieved via increases in the level of inputs used in production (labour and capital) or by increases in the efficiency with which these inputs are combined to form output. Broadly speaking, GSP per capita is determined by the number of people of working age, the extent to which they are employed (labour utilisation), and their productivity.

Growth in labour utilisation can be a result of more employment (employing a previously unemployed person), increased participation (more people of working age entering the labour force for a given employment rate) or greater intensity (employees working 'harder' or increasing effort in terms of hours worked).

MFP is widely acknowledged as an important driver of economic growth. Particularly, as an economy pushes up against capacity constraints and the labour market is approaching full employment, one way to further increase output is by using available inputs more efficiently.

The increase in living standards arising from MFP growth can be manifested in a number of ways, for example, in higher wages for workers, higher profits for the owners of capital, and/or lower prices for consumers. Productivity growth effectively reduces the cost of labour inputs[2] (per unit of output) as a firm can produce more with the existing quantity of labour. Alternatively, it can allow firms to increase real wages for a given level of output without leading to an increase in its labour costs.

Increasing productivity is the key to maintaining or improving relative living standards (for example, by comparison with OECD economies) and international competitiveness. Continual changes and improvements are necessary simply to maintain competitiveness – even more is required to improve on it. For example, while Queensland's rich endowments of agricultural land and mineral resources are well documented, substantial productivity improvements in agriculture and mining have still been required to maintain competitiveness in international markets. The relative abundance of these natural resources is an advantage, but is not sufficient in itself, to ensure a competitive advantage in international markets over an extended period of time.

1.4 Measuring productivity

The measurement of economic output, inputs and productivity is not simple, and the results depend critically on methodology and assumptions. The relationship of output to inputs is typically '*one-to-many*' as a single product may require inputs of labour, capital, land and

[2] Labour costs have both a price component (wages) and a quantity component (hours worked). In this example it is the quantity element that is effectively reduced.

other natural resources. In productivity measurement, it is desirable to hold quantity and quality constant for as many inputs as possible, in order to ascertain how productively those inputs are transformed. The methodology behind productivity estimates in this publication accounts for changes in labour and capital inputs but does not include any quality adjustments[3]. This will be the subject of further research.

Economy wide productivity growth depends not just on productivity improvement within individual industries or firms, but also on the extent to which the weight of output shifts from firms with lower productivity to firms with higher productivity. This implies that as industry composition within an economy changes, so too will measured aggregate productivity levels.

Output

The Australian Bureau of Statistics (ABS) aggregate measure of MFP[4] is based on 'twelve selected ANZSIC06 industries', comprising: agriculture, forestry and fishing; mining; manufacturing; electricity, gas, water and waste services; construction; wholesale trade; retail trade; accommodation and food services; transport, postal and warehousing; information, media and telecommunications; financial and insurance services; and arts and recreation services. The ABS selected these industries as it is this grouping that most closely reflects the previous market sector and relates broadly to marketed activities for which the ABS have satisfactory estimates of the growth in the volume of output.

There are an additional four industries included in an updated definition of the 'market sector': rental, hiring and real estate services; professional, scientific and technical services; administrative and support services; and other services. Although the ABS produce an aggregate measure of MFP based on the updated definition, a full time series is not currently published. The ABS is working on estimates for each of the additional industries in the expanded definition of the market sector.

There are three industries excluded from the market sector and these are known as the 'non-market sector': public administration and safety; education and training; and health care and social assistance. The ABS excludes these industries as the volume estimates of gross value added are derived using a method in which inputs data are used as measures of output (although ongoing ABS work is improving the measurement of output for industries currently in the non-market sector). As a result, meaningful productivity measures cannot be derived for these industries at present as the measure of real gross value added effectively assumes that there has been no change in productivity. The ABS also excludes the special industry, ownership of dwellings[5].

In this paper, the measure used to estimate economic output is real Gross State Product (GSP), which includes the market sector and the 'non-market sector' as defined by the ABS less output from the ownership of dwellings industry. This reflects the difficulties in sourcing data on capital investment by industry at the state level to facilitate the estimation of capital

[3] For Australia as a whole, the ABS produces, in addition to its hours worked measure of labour input, a quality adjusted hours worked measure of labour input for its aggregate market sector estimates.
[4] ABS (5260.0.55.002), *Experimental Estimates of Industry Multifactor Factor Productivity*, 2008-09.
[5] Ownership of dwellings is an artificial industry created to measure the gross rent of dwellings.

inputs for the market sector, and consequently estimates of market sector MFP for Queensland and the Rest of Australia. The ownership of dwellings industry is excluded because it has substantial capital inputs but no corresponding labour inputs (as measured in the National Accounts). For the remainder of this report the terms 'GSP' and 'output' will refer to the measures which exclude the ownership of dwellings industry.

Labour inputs

The measure used for labour inputs is total hours worked. Using hours worked rather than the number of persons employed allows for a more accurate measure of labour inputs. While hours worked is currently the best available measure of labour inputs, there is scope for improvement in quantifying the impact that a change in the quality of labour used has on productivity performance. For example, deriving productivity estimates using the summation of hours worked across all employees in an economy implicitly assumes a homogenous labour force. Therefore, over time, there is no adjustment to labour inputs for any compositional change in the skill set or experience of labour used. As this compositional change is not captured as an increase in labour inputs it will be reflected in the MFP estimates.

As noted previously, MFP is a better measure of productivity than labour productivity as it controls for changes in capital inputs. However, the estimation of capital inputs is a complex task at the state level due to the paucity of data.

Capital inputs

The measure used for capital inputs by the ABS is capital services, defined as the amount of 'service' each asset provides during a period. This is calculated by the ABS by weighting the chain volume measure of the productive capital stock by asset type, by their rental prices. The estimates of capital services in this paper were compiled by first estimating net capital stock by asset type for Queensland and the Rest of Australia. These estimates by asset type were then scaled by the corresponding ratio between the Australian capital service index and the Australian net capital stock index for the twelve selected industries.

Multifactor productivity

The construction of MFP estimates requires a combination of hours worked data (labour inputs) and capital services data (capital inputs) to form an inputs index. This process is accomplished using a Tornqvist index (for more details see OESR (2011), *Methodology for Compiling State Estimates of Multifactor Productivity*). The output measure is then divided by this combined inputs index to derive an MFP estimate.

2 The Contribution of MFP, Labour and Capital to Economic Growth

This section discusses Queensland's economic growth and the contribution from inputs and productivity between 1985-86 and 2004-05, along with a comparison with the Rest of Australia. An overview of the estimates is followed by a more detailed discussion of each of the three components: labour productivity, capital deepening and MFP.

2.1 Productivity cycles

Short term movements in productivity should be interpreted with caution as productivity estimates are volatile from year-to-year. Year-to-year changes in measured productivity may not be truly indicative of changes in productivity as these short term fluctuations could reflect business cycle issues such as the degree to which firms are utilising their capital stock or that employment growth tends to lag output growth. A common method of examining changes in productivity over an extended period involves identifying and dividing the data into productivity 'growth cycles'[6]. By analysing average productivity performance over a complete productivity growth cycle, the impact of business cycle distortions can be minimised, allowing better analysis of the components of growth in different periods.

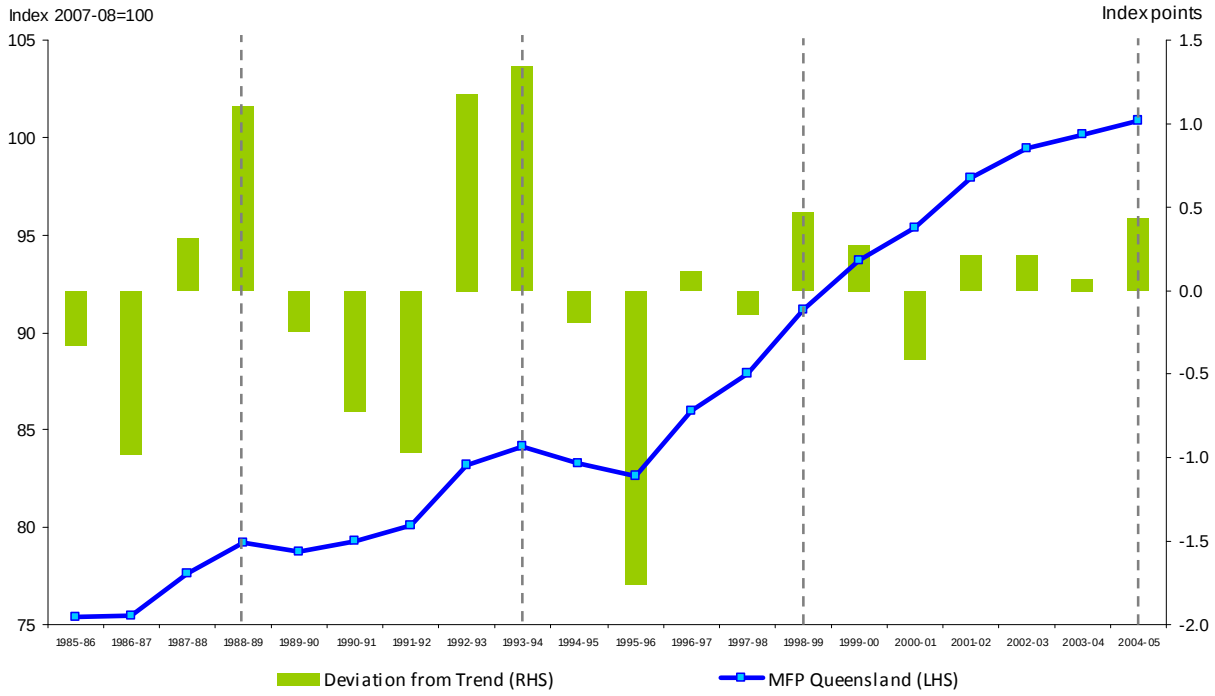
For the market sector, the ABS determines productivity growth cycles by comparing the annual MFP estimates with their corresponding long term trend estimates compiled by applying an 11-term Henderson moving average to the original MFP series[7]. The maximum deviation of the MFP index above its trend is the primary indicator of a growth cycle peak. A similar approach has been adopted to analyse Queensland MFP results.

The green bars in Figure 2.1 represent the deviation of the original MFP series from the trend MFP series, where a positive deviation indicates that the original MFP estimate is greater than its trend equivalent in that year. The tallest (positive) green bars represent the years in which these differences are at a maximum and therefore the opening/closing of a productivity growth cycle. These points allow for the best comparison of productivity performance over time, as they represent periods in which factors of production are utilised to similar degrees.

[6] For more information on growth cycles, see ABS (5204.0), Australian System of National Accounts, 2007-08.

[7] For more information on applying the Henderson moving average, see *Trend estimates* section of *Queensland State Accounts*, OESR, Queensland Treasury (www.oesr.qld.gov.au/releases/qsa).

Figure 2.1: MFP Index and Deviation from Trend, Queensland



Source: OESR estimates.

For the purpose of comparing productivity performance over time, productivity growth cycles for both Queensland and the Rest of Australia need to be identified and comparable in terms of timing and duration. For Queensland, the clear growth cycle peaks are 1988-89, 1993-94, 1998-99 and 2004-05 (see Figure 2.1). However, 1985-86 to 1988-89 represents only part of a productivity growth cycle due to its unidentifiable start-point. This report focuses on the cycles 1988-89 to 1993-94, 1993-94 to 1998-99 and 1998-99 to 2004-05.

Although the Queensland growth cycle peaks in 1998-99 and 2004-05 are less pronounced than other cyclical turning points, they are much more prominent local maxima in the productivity growth cycles of the Rest of Australia. This facilitated the comparison of productivity performance between Queensland and the Rest of Australia over the same growth cycles in this report.

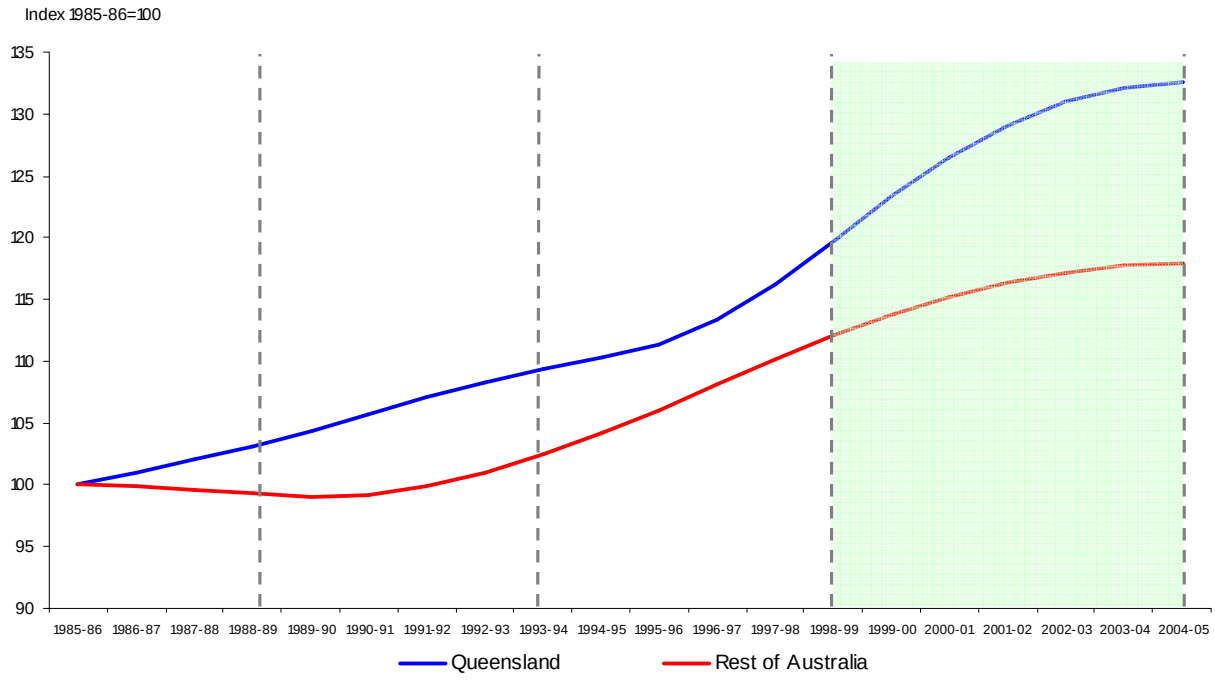
In general, due to the likelihood of data revisions in the years immediately following a release, productivity cycles may only be identified some time after the reference year. Further, the 11-term Henderson trending procedure uses individually tailored end-weights to overcome the end-point problem. This means that the trend estimate for the last five years may be revised as additional data becomes available[8]. The closing of the final productivity cycle has been confirmed by recent data and, therefore 1998-99 to 2004-05 can be analysed as a full productivity cycle.

[8] These end-weights more closely reflect the irregularity of the series being trended. See section on *Trend estimates* in the explanatory notes of *Queensland State Accounts*, OESR, Queensland Treasury (www.oesr.qld.gov.au/releases/qsa).

Recently, 2007-08 has been identified as the possible end-point of a new productivity cycle. However, to determine 2007-08 as a turning point in productivity growth, several more observations are required to ensure that any revisions or new data do not significantly alter the outcome that 2007-08 is an end-point of the current productivity cycle. As the period 2004-05 to 2007-08 may only represent part of the current productivity growth cycle, this report identifies the latest growth cycle as the period ending in 2004-05.

As shown in Figure 2.2, MFP growth in Queensland accelerated over each of the three productivity growth cycles, with particularly strong productivity gains in the mid-to-late 1990s and into the early part of the subsequent decade. This acceleration through the 1990s coincided with an extended period of economic expansion in Queensland in an environment where productivity gains were also contributing to robust growth in the national economy following the recession earlier in the decade.

Figure 2.2: Multifactor Productivity, Trend, Queensland and Rest of Australia



Source: OESR estimates.

The notable feature of Figure 2.2 is the stronger growth in MFP in Queensland, particularly over the 1998-99 to 2004-05 productivity cycle, than in the Rest of Australia.

Once the data are divided into the three distinct productivity cycles discussed above, it can be seen that Queensland recorded solid economic growth through each cycle. Output growth accelerated over the three periods, from 3.6 per cent and 4.8 per cent over the first two cycles respectively to a peak of 5.1 per cent average annual growth between 1998-99 and 2004-05 (see Table 2.1). Further, Queensland experienced stronger economic growth than that of the Rest of Australia in each of the three identified productivity growth cycles.

Table 2.1: Economic and Productivity Growth and Related Measures [(a)]

Average annual growth	1988-89 to 1993-94	1993-94 to 1998-99	1998-99 to 2004-05
Queensland	Per cent	Per cent	Per cent
Output	**3.6**	**4.8**	**5.1**
Multifactor productivity	**1.2**	**1.6**	**1.7**
Labour productivity	1.5	2.0	2.1
less Capital deepening	0.2	0.4	0.4
Combined labour and capital inputs[(b)]	**2.4**	**3.1**	**3.4**
Labour	2.1	2.8	2.9
Capital	2.9	4.1	4.3
Rest of Australia			
Output	**1.8**	**4.3**	**2.9**
Multifactor productivity	**0.7**	**1.9**	**0.6**
Labour productivity	1.6	2.5	1.4
less Capital deepening	0.9	0.5	0.8
Combined labour and capital inputs[(b)]	**1.0**	**2.3**	**2.3**
Labour	0.1	1.8	1.4
Capital	3.3	3.6	4.1

(a) Sum of component contributions to growth may not add as they are multiplicative rather than additive.
(b) Weighted in terms of labour and capital income shares.
Source: OESR estimates.

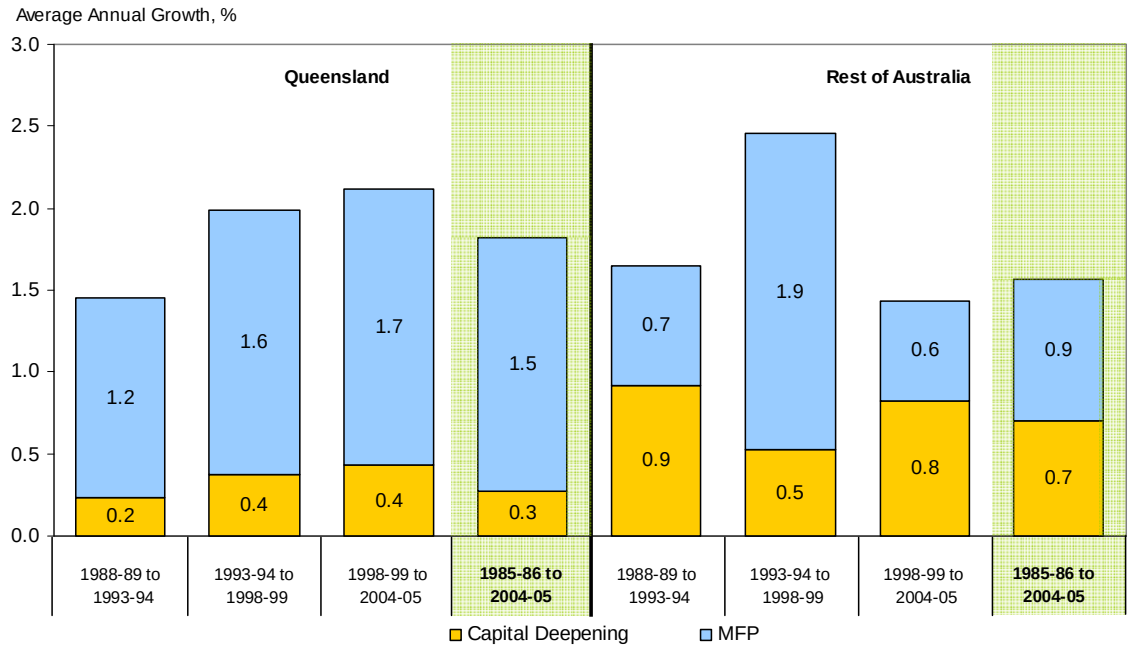
The sustained economic growth in Queensland has been driven by a strong rise in the growth of combined inputs, led in particular by solid capital investment. The rate of growth in combined inputs rose over each of the productivity cycles to 3.4 per cent in average annual terms between 1998-99 and 2004-05. As noted, this growth was driven by a strong rise in capital services (4.3 per cent) with labour hours worked rising by 2.9 per cent over the same period. Additionally, growth in labour and capital used for production in Queensland has been higher than in the Rest of Australia in each of the three growth cycles outlined above.

The second contributing component of output is MFP. Queensland MFP growth improved steadily over the three cycles and accounted for approximately one third of overall economic growth. MFP growth in Queensland rose from 1.2 per cent to 1.6 per cent between the first and the second productivity cycle and again to 1.7 per cent between 1998-99 and 2004-05. In contrast, MFP growth in the Rest of Australia was more volatile over the three cycles, rising from an average annual growth of 0.7 per cent between 1988-89 and 1993-94 to a peak of 1.9 per cent between 1993-94 and 1998-99, before moderating to 0.6 per cent in the final cycle. Queensland MFP growth of 1.7 per cent in the latest cycle was 1.1 percentage points higher than that recorded for the Rest of Australia.

As highlighted above, MFP and capital deepening (the amount of capital available to workers) combine to form labour productivity. The contribution of MFP to labour productivity growth is, by definition, also its contribution to output. As MFP contribution to output is already discussed above, this section focuses on capital deepening.

Figure 2.3 decomposes Queensland and the Rest of Australia labour productivity growth into its two components: MFP growth and capital deepening. Estimates are presented for the full period 1985-86 to 2004-05 and the three identified productivity cycles (1988-89 to 1993-94, 1993-84 to 1998-99, 1998-99 to 2004-05). Detailed annual data are presented in Appendix 1.

Figure 2.3: Labour Productivity Growth and its Components over Productivity Cycles



Source: OESR estimates.

The rate of growth of capital deepening in Queensland had a relatively modest contribution to labour productivity growth in the three growth cycles, and averaged 0.3 per cent per annum between 1985-86 and 2004-05. This indicates that labour productivity for this period in Queensland was largely achieved by improvements in production processes rather than augmenting labour inputs with increased capital services. The level of a region's capital to labour ratio is particularly dependent on the region's industry structure given labour and capital intensities vary significantly between industries. Additionally, an increase in a region's capital to labour ratio can reflect both increasing investment opportunities within an industry and changes to a region's industry structure towards more capital intensive production.

2.2 Contribution of MFP to living standards

A common way of quantifying the contribution of productivity growth to material living standards at the state level is by decomposing the historical increase in real Gross State Income (GSI) per capita into its components. GSI is a traditional measure of living standards and is defined as GSP adjusted for the terms of trade (for more details see OESR (2011), *Methodology for Compiling State Estimates of Multifactor Productivity*).

The linkage of productivity and other factors to real GSI per capita provides a useful framework for understanding productivity, as illustrated in Figure 2.4 below. Broadly, income growth can be achieved by improvements in the terms of trade, increasing labour inputs

(average hours worked, employment rate and participation rate), increasing capital inputs (via capital deepening) and MFP improvements.

Figure 2.4: Understanding Income Per Capita Growth

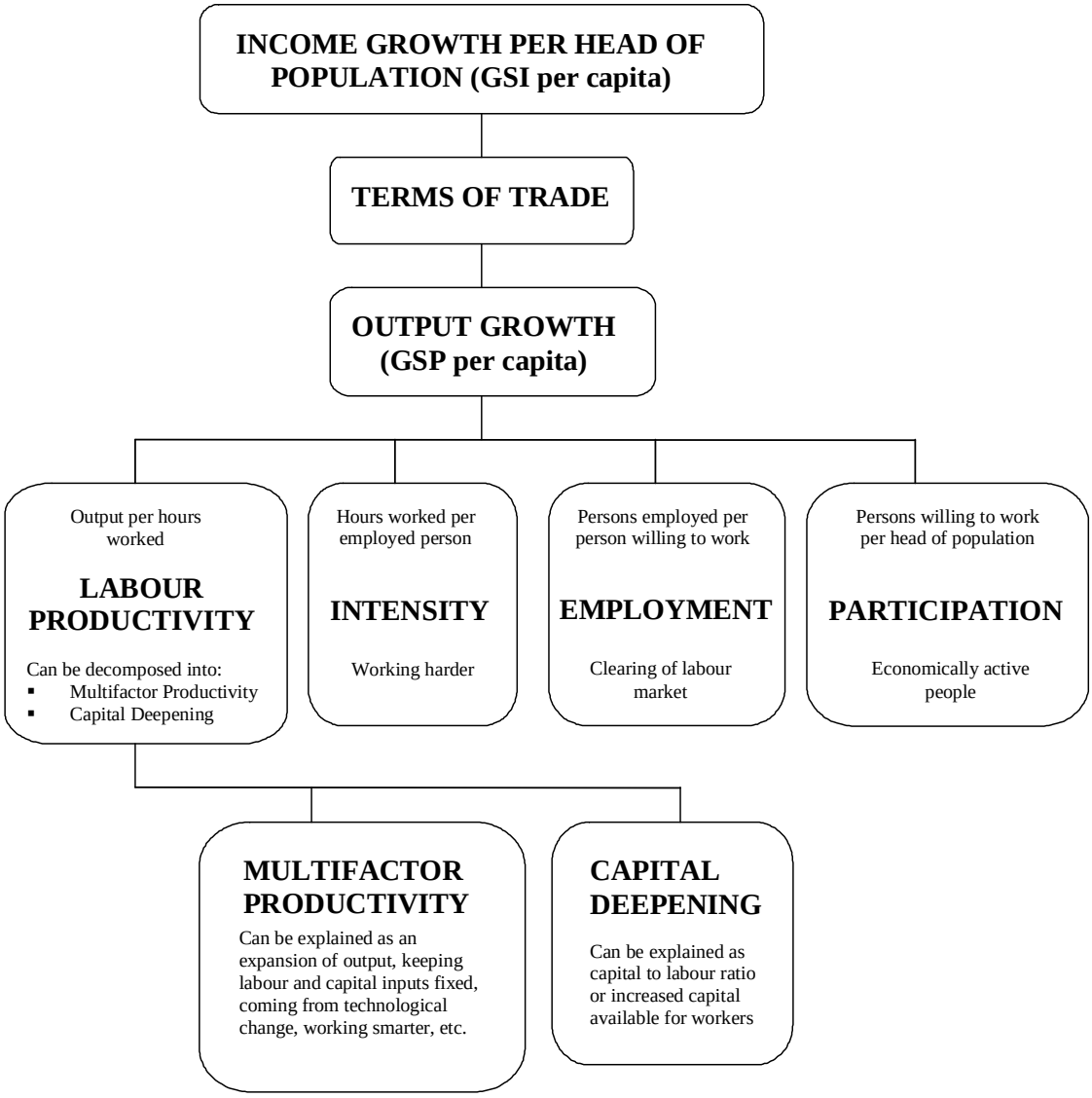


Figure 2.5 illustrates a decomposition of GSI per capita growth in Queensland over the period 1998-99 to 2004-05. The decomposition methodology is also explained in OESR (2011), M*ethodology for Compiling State Estimates of Multifactor Productivity.*

Queensland real GSI per capita (in 2007-08 dollars) rose from $36,736 in 1998-99 to $44,542 in 2004-05, recording average annual growth of 3.3 per cent, to which the terms of trade contributed 0.4 percentage point and real GSP per capita contributed 2.9 percentage points. In turn, the main contributor to growth in real GSP per capita was labour productivity (2.1

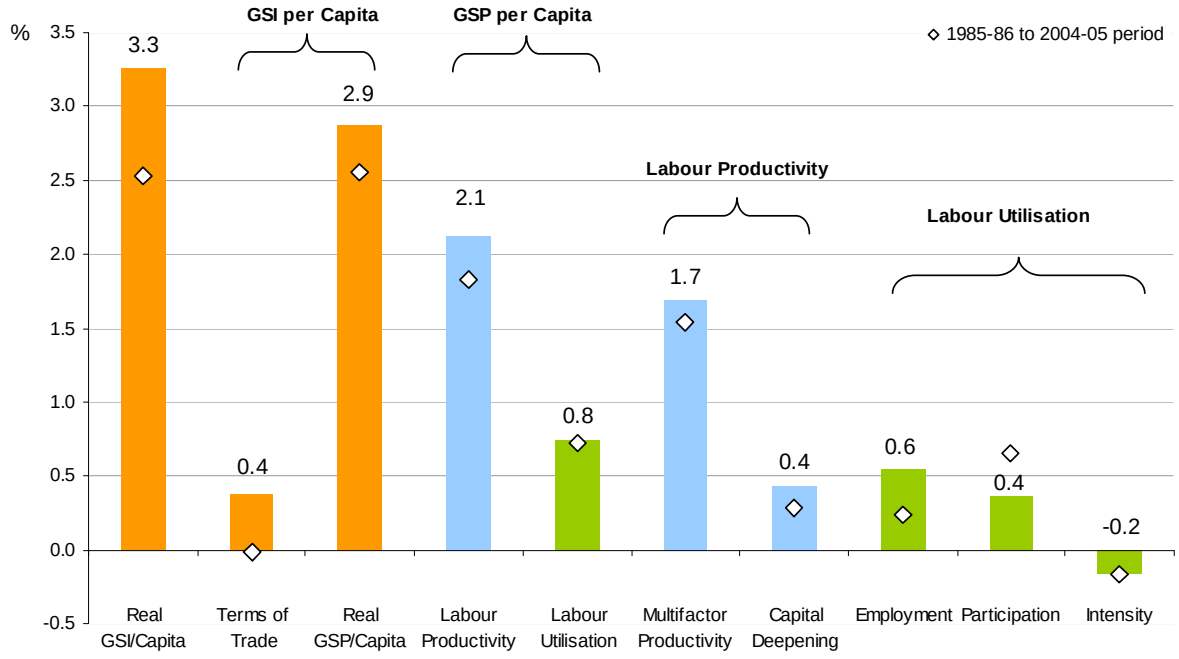
percentage points). The three components of labour utilisation contributed 0.8 percentage point, less than half of the labour productivity contribution to GSI per capita over this period.

The contribution of labour productivity can be further decomposed into MFP growth and capital deepening. MFP growth accounted for the majority of the contribution to labour productivity (1.7 percentage points) with capital deepening accounting for the remaining 0.4 percentage point. Overall, over the 6 year period MFP growth accounted for approximately 52 per cent of the increase in real GSI per capita in Queensland.

The main contributors to the 0.8 per cent growth in labour utilisation were employment growth (a reduction in the unemployment rate) and an increase in the labour force participation rate. Employment and participation contributed 0.6 and 0.4 percentage point respectively, while intensity detracted 0.2 percentage point in average annual terms. This fall in the intensity component represents a decrease in the average hours worked per employee.

Figure 2.5 also shows that the decomposition of growth in Queensland GSI per capita for the 1998-99 to 2004-05 productivity cycle was not significantly different to the long run average (1985-86 to 2004-05, represented by diamonds in Figure 2.5 below).

Figure 2.5: Decomposition of growth in Queensland GSI per capita, 1998-99 to 2004-05[(a)]



(a) Sum of component contributions to growth may not add as they are multiplicative rather than additive.
Source: OESR estimates and ABS 3101.0 and 6202.0.

3 Further Research

Further research will be undertaken into whether reliable industry estimates of MFP can be compiled for Queensland. Finally, during the construction of the productivity estimates presented in this report, several methodological components were identified for further research. These include:

- Improving the procedure to create state public capital stock estimates;
- Research into quality adjusted hours worked data from the ABS; and
- Developing a Queensland series of productive capital stock.

4 Glossary of Terms

The majority of definitions provided in this section are sourced from the ABS[9].

Assets

Entities functioning as stores of value and over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits may be derived by their owners by holding them, or using them, over a period of time (the economic benefits consist of primary incomes derived from the use of the asset and the value, including possible holding gains/losses, that could be realised by disposing of the asset or terminating it).

Capital deepening

Capital deepening is an increase in capital intensity as measured by the capital to labour ratio. It is the capital stock available per labour hour spent.

Capital rental price

This is also referred to as the user cost of capital. The rental price is the unit cost for the use of an asset for one period, that is, the price for employing or obtaining one unit of capital services.

Capital services

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

Capital stock

Capital stock estimates provide information about the stock of capital available in an economy at a particular point in time. Net (or economic) capital stock estimates are the written down values of an economy's gross capital stocks. They represent the net present values of the future capital services to be provided by the assets. The difference between the net and gross value of an asset is accumulated depreciation. Net capital stock is essentially a measure of wealth and is shown in an economy's balance sheet.

Chain volume measures

Chain volume measures (or real) provide time series of estimates which are free of the direct effects of price changes. Current price estimates have two components: a price and a quantity. Because these two components change from one period to the next, estimates of current price growth reflect both changes in quantity and price. In order to estimate changes in the underlying 'volume' between two periods, the price effect needs to be removed. This is achieved by measuring the variable in question in each period using the same unit prices

[9] See ABS (5216.0), *Australian National Accounts: Concepts, Sources and Methods*, 2000.

(that is, the prices from a reference year). Chain volume measures are therefore derived to estimate the 'real' movement in variables over time.

Dwellings

Dwellings comprise houses and other dwellings (flats, home units, villa units, duplexes, mobile homes, caravans used as the principal residences of households, etc.). Expenditure on the construction of hostel-type accommodation, prisons and motels is included in non-dwelling construction.

Employment rate

This rate represents the ratio of employed persons to the labour force, or the complement of the more common unemployment rate – an increase in the employment rate is equivalent to a reduction in the unemployment rate.

Gross mixed income

The surplus or deficit accruing from production by unincorporated enterprises. It includes elements of both compensation of employees (returns on labour inputs) and operating surplus (returns on capital inputs).

Gross operating surplus

The operating surplus accruing to all enterprises, except unincorporated enterprises, from their operations in a region. It is the excess of gross output over the sum of intermediate consumption, compensation of employees, and taxes less subsidies on production and imports. It is calculated before deduction of consumption of fixed capital, dividends, interest, royalties and land rent, and direct taxes payable, but after deducting the inventory valuation adjustment. Gross operating surplus is also calculated for general government and it equals general government's consumption of fixed capital.

Gross state income

Gross state income is equal to gross state product adjusted for changes in a state's terms of trade. An alternative estimate of the volume of exports of goods and services is calculated by deflating exports of goods and services at current prices by the implicit price deflator of imports of goods and services. This provides a better measure of income generated by domestic production than chained volume gross state product.

Gross state product

GSP is defined equivalently to gross domestic product (GDP) but refers to production within a state or territory rather than to the nation as a whole.

Gross value added

The value of output at basic prices minus the value of intermediate consumption at purchasers' prices. The term is used to describe gross product by industry and by sector.

Hours worked

The hours worked by all labour engaged in the production of goods and services, including hours worked by civilian wage and salary earners, employers, self-employed persons, and persons working one hour or more without pay in a family business or on a farm. It is the product of average hours worked and total employment.

Intensity

This ratio represents the average hours worked per worker over a given time period (here one year). For given hours, increased output may be caused either by an increase in productivity, with the same effort by workers ('working smarter') or by an increase in effort, or greater intensity, by workers ('working harder'). All other things being equal, if workers reduce their time worked, output will decrease, although not necessarily proportionately.

Labour productivity

Labour productivity estimates are indexes of real GSP per person employed or per hour worked. They have been derived by dividing the chain volume measure of GSP by employment (or hours worked). Labour productivity indexes reflect not only the contribution of labour to changes in product per labour unit, but are also influenced by the contribution of capital and other factors affecting production.

Multifactor productivity

MFP estimates are indexes of real GSP per combined unit of labour and capital. They have been derived by dividing chain volume estimates of GSP by a combined measure of hours worked and capital services. The estimates of GSP included in this report exclude the Ownership of dwellings industry.

Ownership of dwellings industry

Ownership of dwellings is an artificial industry created to measure the gross rent of dwellings (actual rent paid in the case of tenanted dwellings and an imputed rent for owner-occupied dwellings). It is excluded from the GSP estimate and productivity measures reported in this paper.

Participation rate

This ratio is the proportion of the population that is willing and available to work.

Productive capital stock

This is a measure of productive capacity and forms the basis for the measure of capital services. Productive capital stock estimates are derived as the written down value of each asset in accordance with its decline in efficiency due to age.

Terms of trade

This measures the relative price movements of imports and exports. It is calculated by dividing the export implicit price deflator by the import implicit price deflator and multiplying by 100. An improvement (or increase) in the terms of trade raises real income as a country can now purchase more imports per unit of exports sold.

Tornqvist index

MFP construction requires that an output index be divided by a single inputs index. The Tornqvist index is a methodology used to combine input indexes into one aggregate index. MFP requires the inputs of both labour and capital to be fixed and therefore the combining of these two indexes is essential in its calculations. The Tornqvist methodology uses labour and capital income shares derived from gross operating surplus, compensation of employees and gross mixed income to combine the labour and capital indexes.

Utilisation

Defined as the ratio of hours worked to population, labour utilisation is the extent to which the population is engaging in the labour force (in paid work). It is composed of labour intensity, employment and participation ratios (see above).

Appendix 1 Long term indexes of productivity and related measures

Index 2007-08=100	Productivity				Output		Inputs					
	MFP		Labour				Total inputs		Hours worked		Capital services	
	QLD	ROA	QLD	ROA	QLD	ROA	QLD	ROA	QLD	ROA	QLD	ROA
1985-86	75.4	85.0	69.0	72.3	35.8	51.5	47.4	60.6	51.8	71.2	39.3	41.7
1986-87	75.5	84.1	69.0	72.0	37.3	52.3	49.4	62.2	54.1	72.7	40.9	43.5
1987-88	77.6	85.0	71.3	72.9	39.7	55.0	51.2	64.6	55.7	75.3	42.8	45.5
1988-89	79.2	84.4	72.2	72.7	43.1	56.9	54.4	67.3	59.7	78.2	44.8	47.8
1989-90	78.7	83.8	71.4	72.7	45.1	58.3	57.2	69.5	63.1	80.2	46.6	50.1
1990-91	79.3	83.5	72.9	73.6	45.3	57.8	57.2	69.2	62.2	78.5	47.9	51.9
1991-92	80.1	83.8	73.9	74.7	46.5	57.7	58.1	68.9	62.9	77.3	49.1	53.3
1992-93	83.2	86.5	76.9	77.9	49.4	59.8	59.4	69.1	64.3	76.7	50.3	54.8
1993-94	84.2	87.6	77.6	78.9	51.4	62.0	61.1	70.8	66.3	78.6	51.6	56.3
1994-95	83.3	87.7	76.0	78.8	53.9	64.5	64.7	73.5	70.9	81.8	53.4	58.0
1995-96	82.6	89.7	75.8	80.9	54.9	67.6	66.5	75.3	72.4	83.6	55.5	59.9
1996-97	86.0	91.4	79.9	83.1	57.9	69.9	67.4	76.5	72.4	84.1	58.1	62.1
1997-98	87.9	93.5	81.9	85.8	61.2	72.9	69.6	77.9	74.7	84.9	60.5	64.8
1998-99	91.2	96.4	85.7	89.1	65.1	76.5	71.3	79.4	75.9	85.8	63.1	67.2
1999-00	93.7	96.0	88.5	88.9	69.1	79.1	73.8	82.4	78.1	89.0	66.1	70.0
2000-01	95.4	96.6	90.9	90.4	71.4	80.3	74.8	83.2	78.5	88.9	68.4	72.3
2001-02	97.9	99.4	94.1	94.0	74.6	83.3	76.2	83.8	79.3	88.6	70.8	74.8
2002-03	99.4	99.0	95.6	94.2	78.9	85.4	79.4	86.2	82.6	90.7	73.8	78.0
2003-04	100.1	100.6	96.5	96.6	82.7	88.8	82.5	88.3	85.7	91.9	77.2	81.6
2004-05	100.9	99.9	97.2	97.0	87.7	90.6	87.0	90.7	90.3	93.4	81.3	85.6
Growth rates over productivity cycles (%)												
1985-86 to 1988-89	1.7	-0.2	1.5	0.2	6.4	3.4	4.7	3.6	4.8	3.2	4.4	4.6
1988-89 to 1993-94	1.2	0.7	1.5	1.6	3.6	1.8	2.4	1.0	2.1	0.1	2.9	3.3
1993-94 to 1998-99	1.6	1.9	2.0	2.5	4.8	4.3	3.1	2.3	2.8	1.8	4.1	3.6
1998-99 to 2004-05	1.7	0.6	2.1	1.4	5.1	2.9	3.4	2.3	2.9	1.4	4.3	4.1
Growth rates over full period (%)												
1985-86 to 2004-05	1.5	0.9	1.0	1.0	4.8	3.0	3.2	2.1	3.5	2.3	3.9	3.9