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Access Economics

Indirect Local Government Productivity Measurement

Essential Services Commission

Final Report April 2017

Contents

Glossary

Acronym	Full name
ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
ESC	Essential Services Commission
KLEMS	K-capital, L-labour, E-energy, M-materials, and S-purchased services
MFP	Multi-factor productivity

Executive summary

In February 2015 the Victorian Government appointed the Essential Services Commission (ESC) to undertake an independent inquiry and provide advice on the introduction of a rates capping framework for local government.

In September 2015, the ESC published its report on the proposed framework. The Government responded in October 2015, resulting in the Local Government Amendment (Fair Go Rates) Act 2015, assented to December 2015. The framework was applied for the 2016-17 year.

The initial rate cap was set using a formula of 0.6 x Consumer Price Index +0.4 x Wage Price Index - Productivity Factor. The ESC suggested the efficiency factor should be zero for 2016-17 and increase by 0.05% per annum each year.

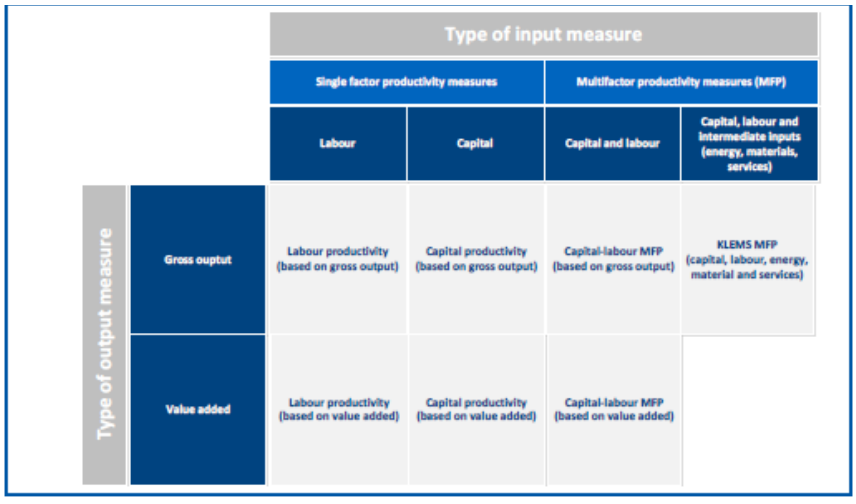
However, the ESC has undertaken to review this efficiency factor and we understand is undertaking two streams of work. The first stream is focussed on directly measuring local government productivity, whereas the aim of the second stream – and the subject of this report – is to identify and calculate indirect measures of productivity improvement which could be used in the rate cap formula.

Overview of report

This report focuses on the productivity factor in the rate-capping formula, and considers estimates for the factor based on indirect measures of productivity.

It considers the seven indirect measures outlined by NERA (2016) using the Organisation for Economic Co-operation and Development's framework (see Figure i:). Deloitte Access Economics also considered alternative indirect measures of productivity but did not identify any that were suitable to add to the OECD's framework.

Figure i: OECD classification of aggregate measures



Source: OECD 2011, cited in NERA 2016

Data was collected from the Australian Bureau of Statistics (ABS) to calculate each of the measures of productivity for the Victorian local government sector. All of this baseline data is publicly available, transparent and independently verifiable.

It is important to note that the ABS does not provide productivity data for three key industries, at least two of which reflect some of the activities undertaken by local government. These are the Public Administration and Safety, Health Care and Social Assistance, and Education and Training industry classifications. This means that data for other industries must be used instead.

This report is supplemented by a spreadsheet, provided to the ESC, which collates the data and calculates each of these measures.

Methodology for estimating productivity

In deciding whether and how to use an indirect productivity measure in the rate-capping formula, decisions need to be made on a range of matters including:

- the period over which productivity is to be measured – averaging over a longer period will produce less 'volatile' results but may result in estimates reflecting historical factors which are not relevant today;
- how to deal with negative productivity results
- whether to use a gross output or a value added approach
- whether to use a labour, capital or multifactor productivity (MFP) estimate of productivity
- which industries to use in the productivity calculation. This choice boils down to whether to use a weighted sub-set of industries that best reflect local government activities, or whether to use the ABS all-industries estimate.

These issues are discussed in section 5 of this report. Ultimately, selection of the best indirect proxy for potential productivity improvement in the Victorian local government sector to use in the rate capping formula is not straightforward. There is no unambiguously preferable measure.

Productivity estimates

We have calculated a range of historic indirect productivity estimates using ABS data over range of periods, including four measures based on gross output and three based on value-added approaches.

The following table summarises these productivity estimates, presented as an average annual productivity growth rate (%). A positive number indicates an average annual improvement in productivity, while a negative number indicates an annual average reduction in productivity.

Note that most estimates in the table below use a weighting of three industries - administrative and support services, arts and recreation services and transport, and postal and warehousing industries based on expenditure data at the Victorian local government level. In the last row we have also shown the 16 sector average for value added MFP (noting that the ABS does not produce a 16 sector average for gross output MFP).

Features of the productivity estimates are that:

- they are quite different depending on the measure used;

- there is significant inter-year variation across most of the individual estimates; and
- slightly more than half of the estimates show negative productivity growth i.e. productivity reductions.

Table i: Gross output and value added productivity growth rates

		Five years to 2014-15	Average since 2005-06	15-year average (since 2000-01)	Average since 1995-96
Gross output	Labour productivity	0.46%	0.66%	0.77%	0.62%
	Capital productivity	-1.32%	-2.43%	-3.63%	-3.23%
	MFP	-0.17%	-0.20%	0.11%	0.29%
	KLEMS MFP	0.16%	-0.12%	-0.01%	0.00%
Value added	Labour productivity	-0.68%	-0.40%	0.08%	0.17%
	Capital productivity	-1.77%	-3.08%	-3.05%	-3.50%
	MFP	-0.95%	-0.90%	-0.45%	-0.46%
	MFP (16 market sector industries)*	0.17%	-0.16%	0.13%	0.47%

* 16 market sector industries as defined by the Australian Bureau of Statistics

The table above shows that the longer term estimates (i.e. averaging over 10 years +) of productivity using the MFP and labour productivity fall in the range of -0.9% to +0.8%: the ESC's current value of +0.05% lies roughly in the midpoint of this.

However, capital productivity measures are much more significantly negative, noting that capital productivity growth has been consistently negative across most Australian sectors for some time. This reflects high levels of capital expenditure and output per unit of capital decreasing as capital is employed to increasingly marginal uses. The mining and oil and gas sectors are a particular example, and indeed much of the output growth in these industries has occurred since 2014-15, meaning that while the input increase is reflected in the productivity estimates, the output growth is not.

Deloitte Access Economics notes that value added MFP may be the measure most suited to estimating productivity growth in Victorian local government. Local government uses both capital and labour inputs and the rate capping formula reflects both capital and labour factors.

Deloitte Access Economics also recommends the use of productivity estimates from industries weighted by actual Victorian Government expenditure. Alternatively, the ABS estimates productivity for 16 market sector industries. The following table summarises the averages using both approaches; while using the three weighted industries is preferred by DAE, both measures are appropriate.

Table ii: Comparison of growth rates using different industries

	5-year average (since 2010-11)	10-year average (since 2005-06)	15 year average (since 2000-01)	20-year average (since 1995-96)
3 weighted industries	-0.95%	-0.90%	-0.45%	-0.46%
16 market sector industries	0.17%	-0.16%	0.13%	0.47%

1 Background

1.1 Local government rate capping framework

In February 2015 the Victorian Government appointed the Essential Services Commission to undertake an independent inquiry and provide advice on the introduction of a rates capping framework for local government.

In September 2015, the Commission published its report on the proposed framework. The Government responded in October 2015, resulting in the Local Government Amendment (Fair Go Rates) Act 2015, assented to December 2015. The framework was applied for the 2016-17 year.

The initial rate cap was set using a formula of 0.6 x Consumer Price Index +0.4 x Wage Price Index - Productivity Factor. The Commission suggested the efficiency factor should be zero for 2016-17 and increase by 0.05% per annum each year.

1.2 Productivity in local government

Achieving productivity improvements in the public sector is an important government goal. In 2013, Deloitte Access Economics considered the key drivers of productivity in the public sector for the NSW Public Service Commission, identifying priority areas where reform could lead to change. These included:

- increasing the contestability of service provision;
- adopting new technologies;
- improving workforce flexibility;
- employment measurement and benchmarking;
- developing a skilled workforce; and
- establishing a culture of innovation.

While it is clear that productivity improvements are of benefit to local government and the broader public (in the form of more efficient use of council resources), in practice, productivity improvements are more challenging to measure.

1.3 Issues with measuring productivity in local government

There are a number of challenges in directly measuring the productivity of councils. Councils provide a wide range of different goods and services, moreover, the range of goods and services generally differ between councils, reflecting the different service needs and preferences of councils and their communities. This makes simplistic comparisons between councils difficult as their outputs are not homogenous.

Further, the same output of two or more councils may not be strictly compatible due to quality differences. A council which expends more resources per kilometre of roads than a neighbouring council would appear prima facie to be less productive if quality is not taken into account. Councils also operate in different environments and can face different labour costs. These factors can significantly affect a council's productivity but can be outside of the council's ability to control. For instance, rural councils may have greater trouble hiring certain highly skilled professionals or achieving economies of scale relative to metropolitan councils.

Finally, many council outputs are non-market-based, for example, libraries or sporting fields. Non-market-based goods often have positive externalities, so are undersupplied by the private sector. However, since there is no price mechanism it is difficult to measure the value created by these goods.

1.4 Direct and indirect measures of productivity

Despite the challenges noted above, well-designed direct measures can provide an accurate estimation of councils' productivity. Although it is a complex task, well-specified models allow for a comparison of the productivity of individual councils.

On the other hand, indirect measures estimate the productivity using a proxy, such as the productivity of a wider sector of the economy. The accuracy of indirect measures, therefore, depends on the extent to which the proxy's productivity mirrors that of an 'average' local government council.

The ABS publishes a number of annual measures of productivity at Australian and New Zealand Standard Industrial Classification (ANZSIC) division level for the Australian economy. These measures are updated annually and are publicly available and free. Indirect measures, therefore, can be a more cost-effective and practical approach to productivity measurement.

1.5 This report

This report focuses on the productivity factor in the rate-capping formula, and considers estimates for the factor based on indirect measures of productivity. It considers the seven indirect measures outlined by NERA (2016) using the Organisation for Economic Co-operation and Development's framework (see Figure 1.1:). Deloitte Access Economics also considered alternative measures of productivity but did not identify any that were suitable to add to the OECD's framework.

Figure 1.1: OECD classification of aggregate measures

		Type of input measure			
		Single factor productivity measures		Multifactor productivity measures (MFP)	
		Labour	Capital	Capital and labour	Capital, labour and intermediate inputs (energy, materials, services)
Type of output measure	Gross ouptut	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital-labour MFP (based on gross output)	KLEMS MFP (capital, labour, energy, material and services)
	Value added	Labour productivity (based on value added)	Capital productivity (based on value added)	Capital-labour MFP (based on value added)	

Source: OECD 2011

Data was collected from the Australian Bureau of Statistics (ABS) to calculate each of the measures of productivity. This report provides an assessment of each of the measures and recommends value-added multi-

factor productivity as the most suitable proxy measure for use in the ESC's rate capping formula.

This report is supplemented by a spreadsheet, provided to the ESC, which collates the data and calculates each of these measures.

2 Data and approach

2.1 Australian Bureau of Statistics productivity data

The productivity data used in each of the measures has been sourced from the Australian Bureau of Statistics (ABS). Specifically, the productivity catalogues used were:

- 5260.0.55.002 Estimates of Industry Multifactor Productivity
- 5260.0.55.004 Experimental Estimates of Industry Level KLEMS Multifactor Productivity

The data in these catalogues is presented at the national level, disaggregated by ANZSIC industries. While data by state is not available from the ABS (either publicly or via request - we made enquiries of the ABS), this is not seen as a major limitation of the data as opportunities for productivity improvements in the local government sector are likely to be broadly consistent across Australia.

There are a number of reasons the ABS productivity data is useful for estimating achievable productivity in the local government sector:

- the data is publicly available, at no cost;
- it is updated regularly (on an annual basis for most measures);
- both gross output and value added measures are available;
- time series data is available to understand changes over time. Data is available from 1995-95;
- productivity measures are indexed to allow for comparability across measures; and
- the ABS Data Quality Framework ensures the collected data is held to a high standard. [1]

However, one key drawback is that the ABS does not estimate productivity in non-market industries (Public Administration and Safety, Education and Training, and Health Care and Social Assistance). This is a problem to the extent that the activities of local government alight reasonably well (although not exactly) with the Public Administration and Safety sector. The ABS notes that in these industries the majority of output is provided free of charge or at prices which are not necessarily related to the cost, supply and demand for the services. Output measures for non-market industries are typically derived using input costs, so by this definition, there is no productivity growth.

2.2 Approach to estimating productivity measures

There are several potential approaches to using the ABS data to estimate productivity measures including:

- using the Administration and Support Services sector as a proxy for the local government sector
- using a small number of relevant sectors, with appropriate weightings;
- using the ABS overall estimate of productivity, which combines the 16 market sectors.

One approach is to use the productivity estimate for the 'Administrative and Support Services' sector as a proxy for the local government sector.[1]

However, we note it can be challenging to measure outputs in the labour-intensive Administration and Support Services sector, and further, the composition of the sector does not exactly reflect the range of activities undertaken by local government. For instance, local government is responsible for general construction (mostly roads and drainage), running public libraries and providing waste management services, which more closely align with other ABS sectors.

Weighting across sectors

The ABS Government Finance Statistics 2014-15 (ABS Catalogue number 5512.0) provide a breakdown of expenditure data at the Victorian local government level, which allows an estimate to be made of the split of services provided by local governments.

The main categories of expenditure by Victorian local government are housing and community amenities (21%), recreation and culture (18%), transport and communications (18%) and general public services (16%), as shown in the following table.

Table 2.1: Victorian local government expenses by purpose, 2014-15

Expense	Proportion of total
General public services	16%
Public order and safety	2%
Education	1%
Health	2%
Social security and welfare	12%
Housing and community amenities	21%
Recreation and culture	18%
Fuel and energy	0%
Agriculture, forestry and fishing	0%
Mining, manufacturing and construction	0%
Transport and communications	18%
Other economic affairs	5%
Public debt transactions	1%
Other purposes	1%

Source: ABS Cat. No. 5512.0 Table 332

It is therefore possible to derive a weighted productivity estimate which reflects a small number of industries which most best reflect local government expenditure. We have used three industries - administrative and support services, arts and recreation services and transport, and postal and warehousing industries.

The ABS also estimates 'GDP per hour worked' based on National Accounts. This is a measure of labour productivity which includes all sectors (including non-market sectors). However, while Public Administration and Safety is an input into this measure it cannot be singled out for analysis.

The ANZSIC industry weights we have used are 18% for the transport postal and warehousing industry (reflecting transport and communications in the table above), 40% for arts and recreation (reflecting recreation and culture and housing and community amenities) and 42% for administrative and support services (reflecting all other expense categories.) Obviously, it would be possible to use alternative weightings, and we have provided the base data in the attached spreadsheet to enable this to be done.

Weighting has been applied to the indices prior to calculation of growth rates over time. To account for variability across years, and the fact that 2015-16 data is available for value added but not gross output measures, an average of productivity growth over the five years to 2014-15 has been used as the estimate in each case. Acknowledging the volatility of measures over time, averages over longer time series are included in Appendix A.

Use of overall market productivity values

Another approach is using the estimate of productivity values for the entire market sector, as defined by the ABS. This approach is used by IPART in its rate peg calculations; to estimate a productivity factor to be applied to the Local Government Cost Index (LGCI).

This approach does not require the estimation of weights by sector, which can be subjective, and hence is also more straightforward in terms of estimation. Using an overall measure can also assist in overcoming difficulties and volatilities associated with individual industry measurement.

That said, this approach includes a number of industries which are not directly related to the operations of local government – for example mining, accommodation and food services, retail trade and agriculture, forestry and fishing. Further, productivity estimates in Australia in recent years have been heavily influenced by the mining sector, which is largely unrelated to local government operations. Finally, these estimates are available for value added measures only. Chapter 4 provides estimates of productivity using the 16 market sector industries identified by the ABS, which includes:

- 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;
- Rental, Hiring and Real Estate Services;
- Professional, Scientific and Technical Services;
- Administrative and Support Services;
- Arts and Recreation Services; and
- Other Services.

3 Gross output measures

There are two broad approaches to measuring productivity at an aggregate level: gross output-based and value added-based. Gross output measures the total output of an industry including the production of intermediate inputs (goods and services sold for the production of other goods and services rather than for final consumption). The value added approach measures total (gross) output less intermediate inputs. This chapter discusses gross output measures, while value added measures are discussed in chapter 4.

3.1 Advantages and disadvantages

The gross output approach also incorporates intermediate inputs (along with capital and labour) and provide a more complete picture of the production process. Gross output measures are also able to account for technological change and improved efficiency.

However, the inclusion of intra-industry flows of intermediate products may result in double counting on both the input and output sides (NERA 2016).

3.2 Labour productivity

Labour productivity measures the amount of gross output for a given amount of time worked. For the purpose of this report figures are based on a 'Quality adjusted hours worked' basis.

Gross Output labour productivity is calculated using tables 16 and 9 of ABS 5260.0.55.002:

$$Labour\ productivity = \frac{Gross\ output\ index}{Labour\ input\ index}$$

$$Labour\ productivity = \frac{Table\ 16}{Table\ 9}$$

The following table provides the growth rates in gross output labour productivity by sector, with a weighted value representing Victorian local government expenditure. However, it should be noted that this measure is sensitive to the substitution of labour, particularly where outsourcing occurs.

Using this measure, it is estimated that average annual productivity growth over the past 5 years was 0.46%. This is the highest positive estimate of productivity growth using the gross output measures.

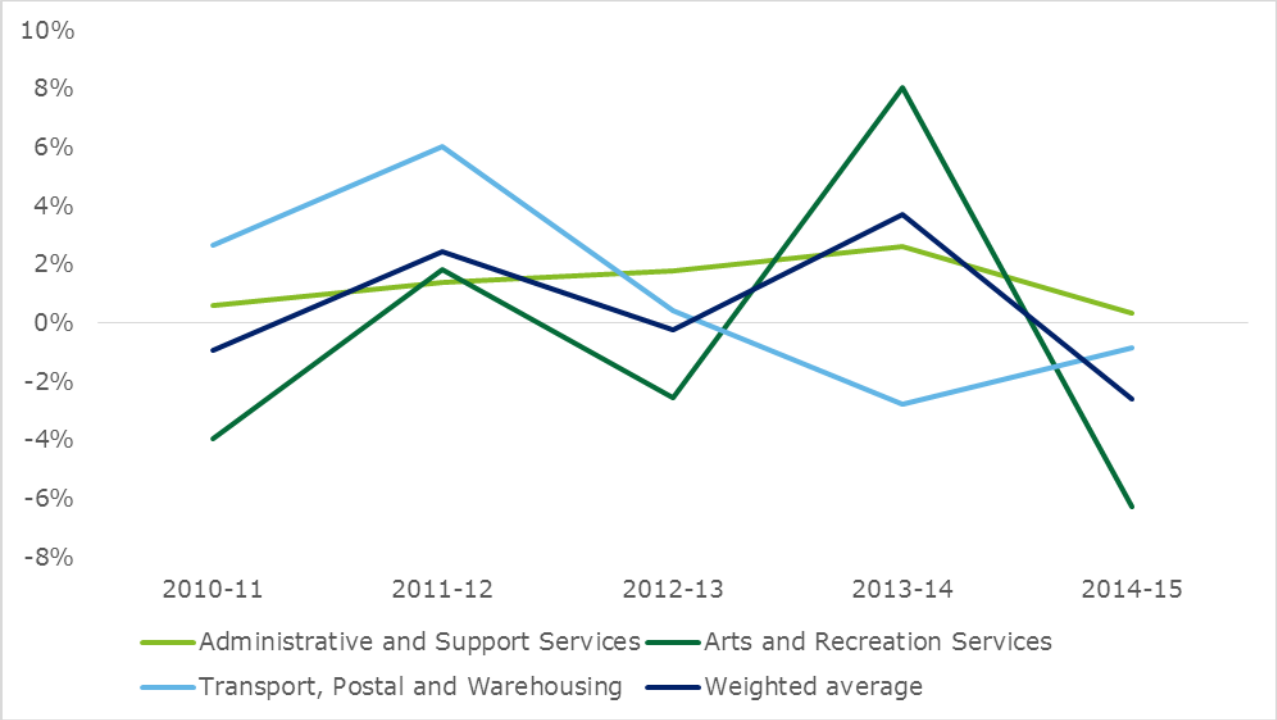
Table 3.1: Gross output labour productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave*.
Admin and Support Services	0.58%	1.36%	1.78%	2.58%	0.34%	n/a	1.33%
Arts and Recreation Services	-3.96%	1.82%	-2.56%	8.02%	-6.29%	n/a	-0.59%

Transport, Postal & W'housing	2.66%	6.02%	0.42%	-2.79%	-0.85%	n/a	1.09%
Weighted	-0.96%	2.41%	-0.24%	3.69%	-2.60%	n/a	**0.46%**

* Note that averages shown in tables are simple (not compound) averages

Chart 3.1: Gross output labour productivity growth rates



3.3 Capital productivity

Gross output capital productivity measures the amount of gross output for a given amount of capital inputs. Capital productivity is calculated using tables 16 and 10 of ABS 5260.0.55.002:

$$Capital\ productivity = \frac{Gross\ output\ indexes}{Capital\ services\ indexes}$$

$$Capital\ productivity = \frac{Table\ 16}{Table\ 10}$$

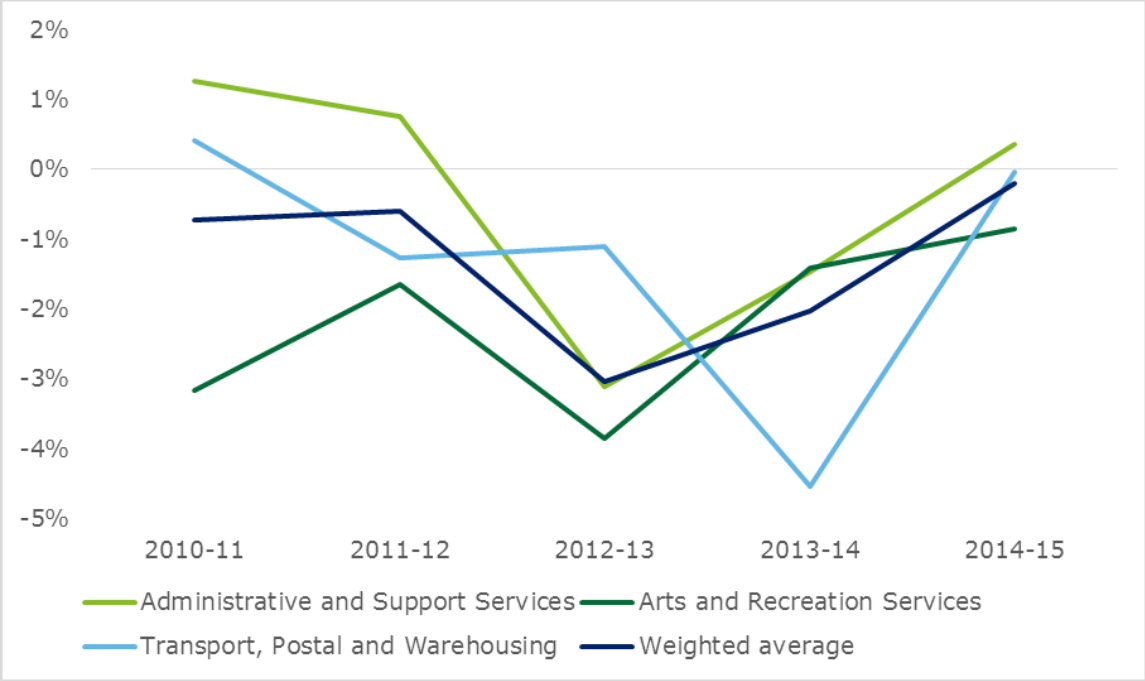
The following table provides the growth rates in gross output capital productivity by sector. The weighted productivity value estimates an average annual decline in productivity of 1.32%. Compared with the gross output measures, this capital measure suggests the worst productivity performance over the period.

Table 3.2: Gross output capital productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	1.26%	0.74%	-3.11%	-1.48%	0.36%	n/a	-0.44%
Arts and Recreation Services	-3.17%	-1.65%	-3.86%	-1.42%	-0.86%	n/a	-2.19%

Transport, Postal & W'housing	0.41%	-1.27%	-1.10%	-4.55%	-0.05%	n/a	-1.31%
Weighted	-0.73%	-0.60%	-3.04%	-2.04%	-0.20%	n/a	**-1.32%**

Chart 3.2: Gross output capital productivity growth rates



3.4 Multi-factor productivity

Capital-labour-intermediate input multi-factor productivity (MFP) measures the amount of gross output for a given amount of labour and capital and intermediate inputs. For the purpose of this report figures are based on quality-adjusted hours worked basis.

The gross capital-labour-intermediate MFP can be found in Table 15. Alternatively it can be calculated using Tables 16 and 17.

$$MFP = \frac{Gross\ output\ indexes}{Combined\ inputs\ (labour, capital\ and\ intermediate\ inputs)\ indexes}$$

$$MFP = \frac{Table\ 16}{Table\ 17}$$

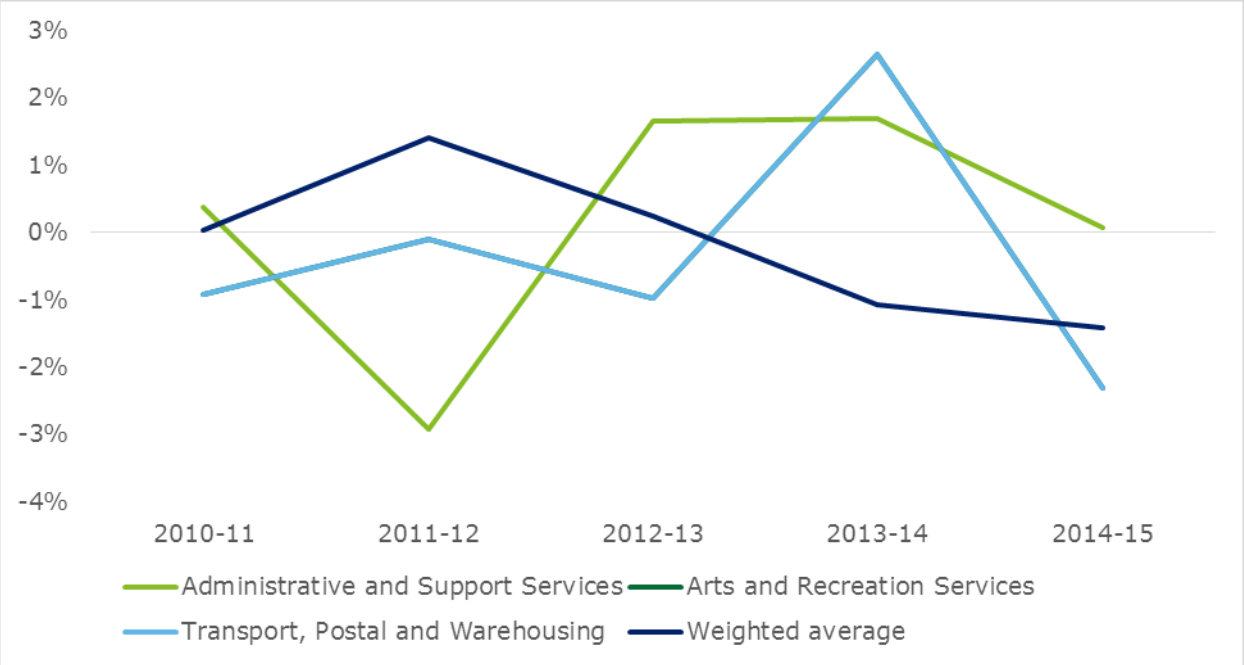
Table 3.3: shows the growth rates in gross output MFP by sector, with a weighted value representing Victorian local government expenditure. It is estimated that there was an average annual decline in productivity, using this measure, of 0.17%.

Table 3.3: Gross output MFP productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	0.37%	-2.93%	1.65%	1.68%	0.07%	n/a	0.17%
Arts and Recreation Services	-0.92%	-0.11%	-0.99%	2.64%	-2.32%	n/a	-0.34%

Transport, Postal & W'housing	-0.92%	-0.11%	-0.99%	2.64%	-2.32%	n/a	-0.34%
Weighted	0.02%	1.40%	0.23%	-1.07%	-1.42%	n/a	**-0.17%**

Chart 3.3: Gross output MFP productivity growth rates



3.5 KLEMS MFP

KLEMS (K-capital, L-labor, E-energy, M-materials, and S-purchased services) refers to categories of intermediate inputs used in the production of goods and services.

Data for the KLEMS MFP was sourced from 5260.0.55.004 Experimental Estimates of Industry Level KLEMS Multifactor Productivity, Australia. KLEMS is provided as percentage change. For comparison with ABS 5260.0.55.002and in order to calculate weighted KLEMS, an index was created.

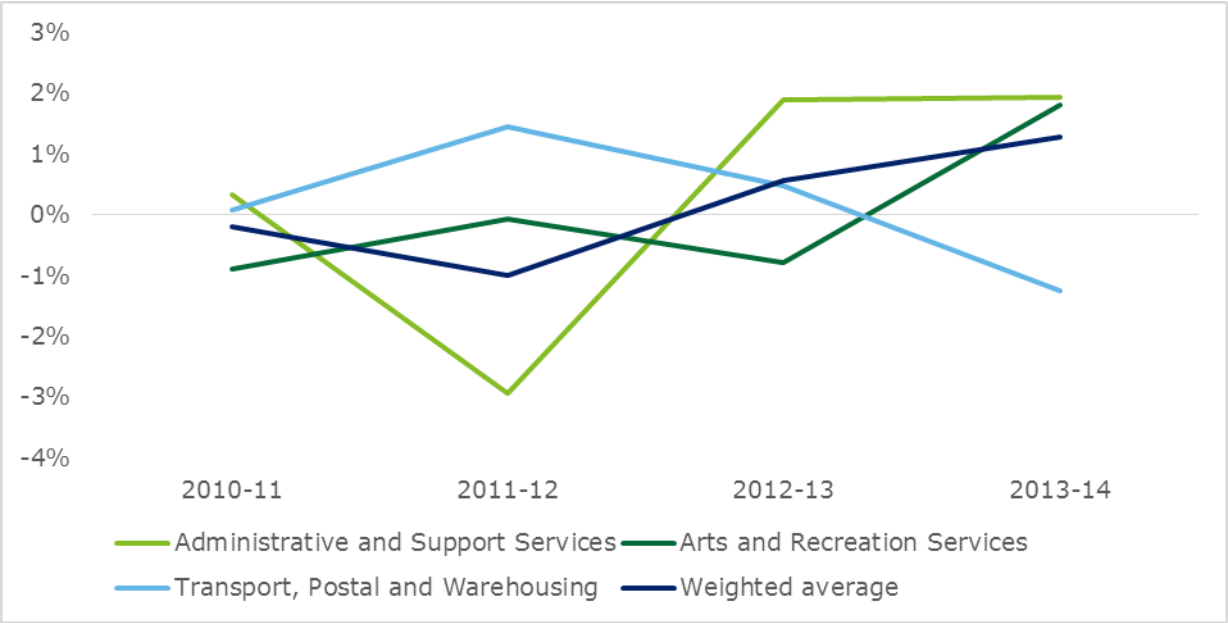
$$Index_t = \frac{Index_{t+1}}{1 + growth_{t+1}}$$

The following table provides the growth rates in KLEMS MFP by sector and weighted to Victorian local government expenditure. Using this measure, it is estimated that average annual productivity growth was 0.16%.

Table 3.4: Gross output KLEMS MFP productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	0.32%	-2.93%	1.89%	1.93%	n/a	n/a	0.30%
Arts and Recreation Services	-0.90%	-0.08%	-0.79%	1.79%	n/a	n/a	0.00%
Transport, Postal & W'housing	0.08%	1.45%	0.48%	-1.25%	n/a	n/a	0.19%
Weighted	-0.21%	-0.99%	0.55%	1.27%	n/a	n/a	**0.16%**

Chart 3.4: Gross output KLEMS MFP productivity growth rates



3.6 Assessment of gross output measures

The four gross output measures present a range of annual productivity estimates from -1.32% (capital productivity) to 0.46% (labour productivity).

Given the estimates are all derived from the same ABS data source, there are no particular data issues associated with the measures and they are all straightforward to calculate and reliable. The range of values alone cannot determine which is the most appropriate measure, however, some considerations about the appropriateness of the measures is presented in section 5.5.

4 Value added measures

4.1 Advantages and disadvantages

The value added approach differs from the the gross output approach in that it does not include intermediate inputs. In the local government context, it represents the contribution of the sector itself to aggregate gross product, and is comparable across industries.

On the other hand, value added measures can be limited by not allowing for substitution of capital and labour with intermediate inputs. This can be an unrealistic assumption as fluctuations in the price or efficiency of intermediate inputs tends to influence the relative use of capital and labour in an industry, as well as overall productivity.

Value added measures also tend to be higher than estimates based on gross output, may distort industry productivity growth rates over time, and may distort inter-industry comparisons of productivity growth (NERA 2016). However, in this instance, the weighted value added estimates are lower than those estimated using gross output measures. The calculated value added productivity estimates also appear to be more volatile than the gross output measures, which limits the ability to use single-year measures of productivity.

As noted in section 2.2, this chapter also includes estimates of productivity based on the 16 market sector industries as defined by the ABS, as a comparator to the weighted estimate calculated by Deloitte Access Economics.

4.2 Labour productivity

Labour productivity measures the amount of output for a given amount of time worked. For the purpose of this report figures are based on Quality adjusted hours worked basis.

Valued-added labour productivity can be directly sourced from Table 6. It can alternatively be calculated using tables 8 and 9 of ABS 5260.0.55.002:

$$Labour\ productivity = \frac{Gross\ value\ added\ chain\ volume\ indexes}{Labour\ input\ indexes}$$

$$Labour\ productivity = \frac{Table\ 8}{Table\ 9}$$

The following table provides the growth rates in value added labour productivity by sector, with a weighted value representing Victorian local government expenditure. Using this measure, it is estimated that average annual productivity growth over the past 6 years[2] was -0.68%.

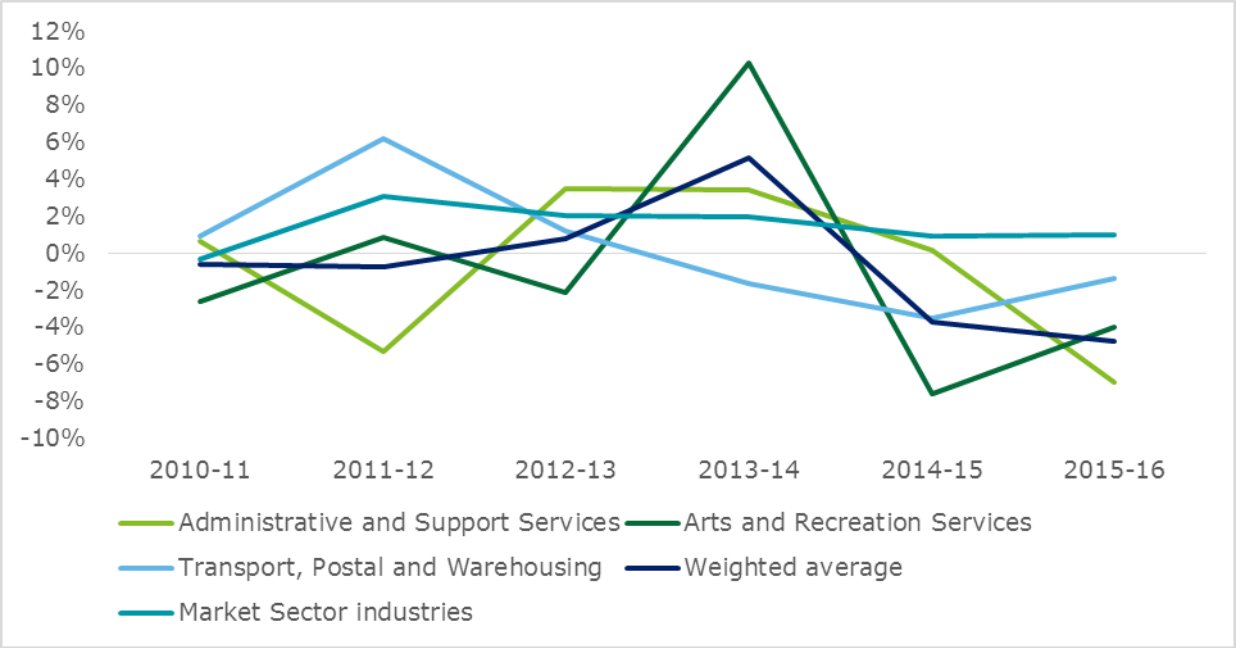
[2] Note that because 2015-16 data is available for value added measures, but not gross output measures, we have included an extra year of data.

Table 4.1: Value added labour productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	0.62%	-5.33%	3.45%	3.37%	0.13%	-6.97%	-0.79%
Arts and Recreation Services	-2.61%	0.83%	-2.11%	10.28%	-7.64%	-4.00%	-0.88%
Transport, Postal & W'housing	0.90%	6.15%	1.16%	-1.68%	-3.52%	-1.36%	0.28%
Weighted	-0.64%	-0.77%	0.75%	5.10%	-3.75%	-4.76%	**-0.68%**
16 market sector industries	-0.34%	3.03%	2.04%	1.91%	0.88%	0.95%	**1.41%**

Note: Average calculated for 2010-11 to 2014-15 for consistency across measures. Market sector industries as defined by ABS.

Chart 4.1: Value added labour productivity growth rates



4.3 Capital productivity

Value-added capital productivity measures the amount of gross valued-added for a given amount of capital inputs.

Valued-added capital productivity can be directly sourced from Table 7. It can alternatively be calculated using tables 8 and 10 of ABS 5260.0.55.002:

$$Valued-added\ capital\ productivity = \frac{Gross\ value\ added\ chain\ volume\ indexes}{Capital\ services\ indexes}$$

$$Valued-added\ capital\ productivity = \frac{Table\ 8}{Table\ 10}$$

Table 4.2: presents the growth rates in value added capital productivity by sector. The weighted value suggests that that average annual productivity declined by 1.77% per year, the largest negative growth estimate across all measures.

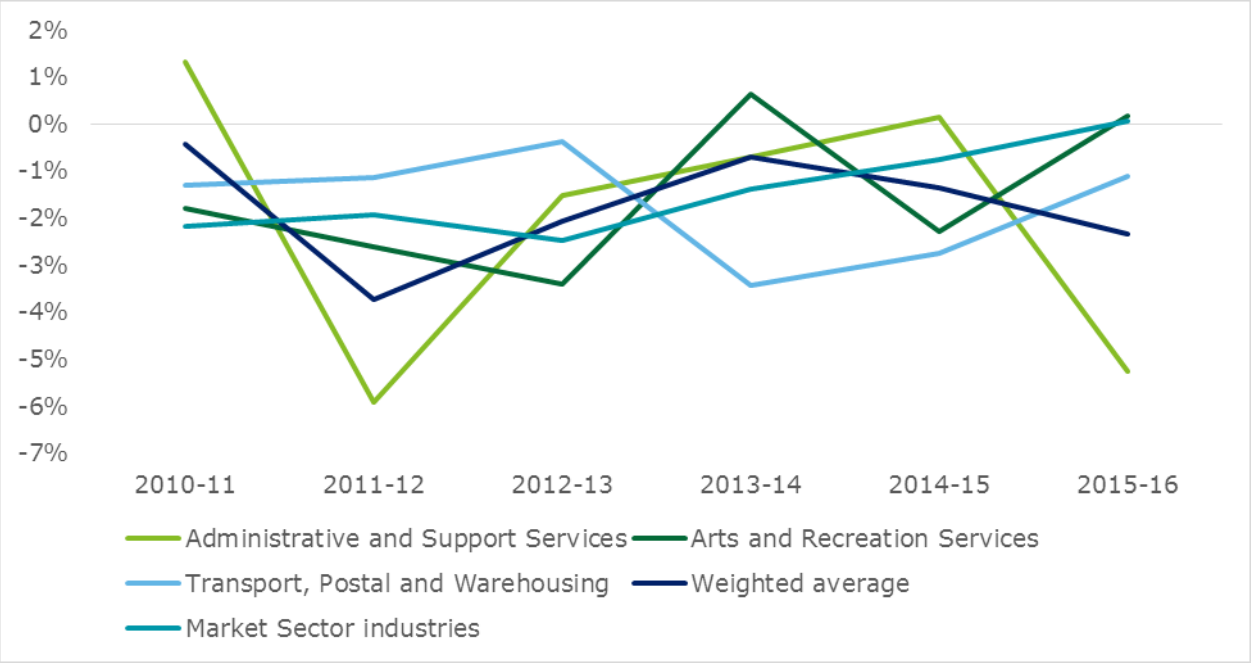
Capital productivity growth has been consistently negative across most Australian sectors over the past half a decade. During this time there has been notable capital deepening in the Australian economy (an increase in the capital to labour input ratio). All else equal, capital deepening generally increases labour productivity as each input of labour has more capital with which to produces goods and services. However, output per unit of capital decreases as capital is employed to increasingly unproductive uses (the most productive use of capital are employed first).

Table 4.2: Value added capital productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	1.31%	-5.91%	-1.52%	-0.72%	0.15%	-5.26%	-1.99%
Arts and Recreation Services	-1.81%	-2.61%	-3.41%	0.64%	-2.30%	0.18%	-1.55%
Transport, Postal & W'housing	-1.31%	-1.15%	-0.37%	-3.44%	-2.75%	-1.12%	-1.69%
Weighted	-0.43%	-3.73%	-2.06%	-0.70%	-1.37%	-2.34%	**-1.77%**
16 market sector industries	-2.18%	-1.93%	-2.48%	-1.39%	-0.74%	0.05%	**-1.45%**

Note: Average calculated for 2010-11 to 2014-15 for consistency across measures. Market sector industries as defined by ABS.

Chart 4.2: Value added capital productivity growth rates



4.4 Capital-labour MFP

Capital-labour MFP measures the amount of output for a given amount of labour and capital (for value added MFP, intermediate inputs are not

included). For the purpose of this report figures are based on quality adjusted hours worked basis.

Value added capital-labour productivity is calculated using tables 8 and 11 of ABS 5260.0.55.002:

$$Capital - labour\ productivity = \frac{Gross\ value\ added\ chain\ volume\ indexes}{Combined\ inputs\ capital\ and\ labour\ indexes}$$

$$Capital - labour\ productivity = \frac{Table\ 8}{Table\ 11}$$

The growth rates in value added MFP productivity by sector are shown in Table 4.3:. This measure also estimates a decline in average annual productivity in the Victorian local government sector, of 0.95% per year.

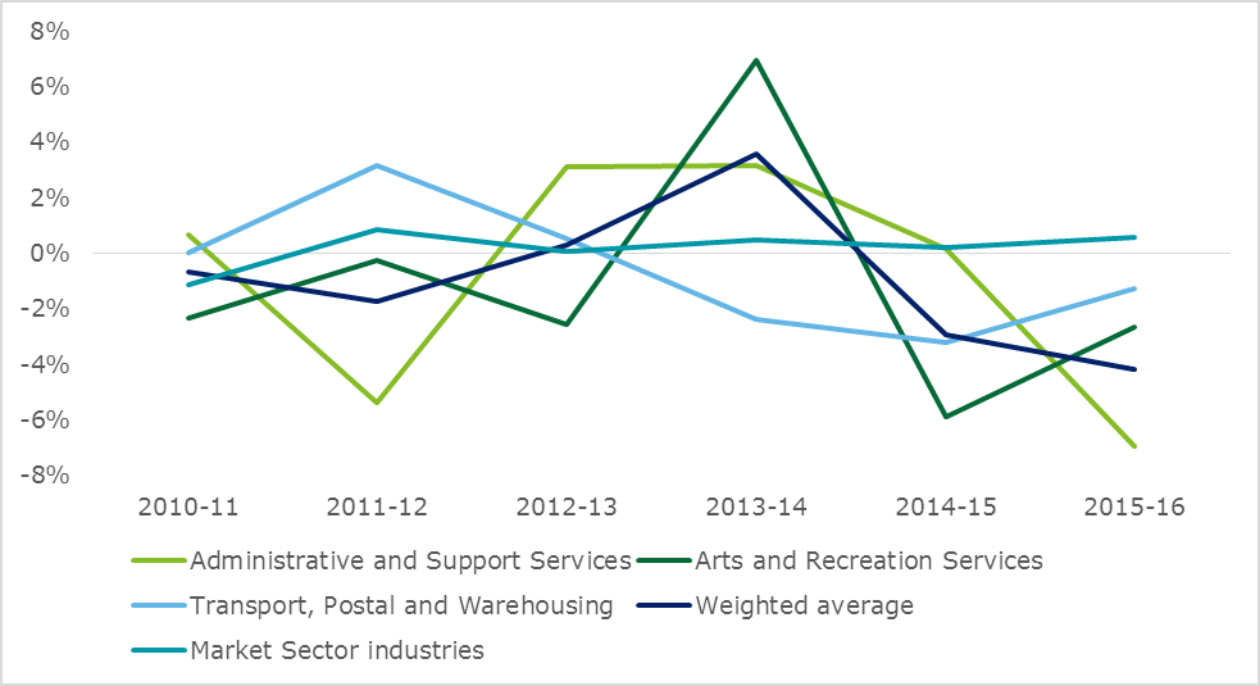
Table 4.3: Value added capital-labour productivity growth rates

Sector	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Ave.
Admin and Support Services	0.68%	-5.38%	3.11%	3.17%	0.13%	-6.93%	-0.87%
Arts and Recreation Services	-2.35%	-0.28%	-2.57%	6.96%	-5.88%	-2.68%	-1.13%
Transport, Postal & W'housing	0.03%	3.17%	0.52%	-2.39%	-3.22%	-1.26%	-0.53%
Weighted	-0.68%	-1.74%	0.29%	3.58%	-2.94%	-4.20%	**-0.95%**
16 market sector industries[3]	-1.15%	0.84%	0.05%	0.49%	0.19%	0.58%	**0.17%**

[3] This is the estimate used by IPART in calculating a productivity factor to be used with its rate peg. IPART uses a 15-year average value, and estimates the value at 0.001% for use with the 2017-18 rate peg. This measure replaces IPART's previous use of the 15-year average of the ABS' market sector gross output measure of MFP, which the ABS discontinued in 2011.

Note: Average calculated for 2010-11 to 2014-15 for consistency across measures. Market sector industries as defined by ABS.

Chart 4.3: Value added capital-labour productivity growth rates



4.5 Assessment of value added measures

The three value added measures of productivity estimate average annual productivity growth to be between –0.68% and -1.77%.

As was the case with gross output measures, value added capital productivity estimates suggested the largest decline in productivity growth on average while the labour productivity estimates presented the strongest pictures of productivity growth. Further considerations about the appropriateness of the measures is presented in section 5.5.

5 Discussion

In the absence of direct productivity measures for local government, our view is that is appropriate to use indirect measures of historic productivity improvement in other sectors order to set a reasonable expectation of what productivity improvements are achievable in the Victorian local government sector.

We support the use of ABS data for this task as it is publicly available, transparent and independently verifiable.

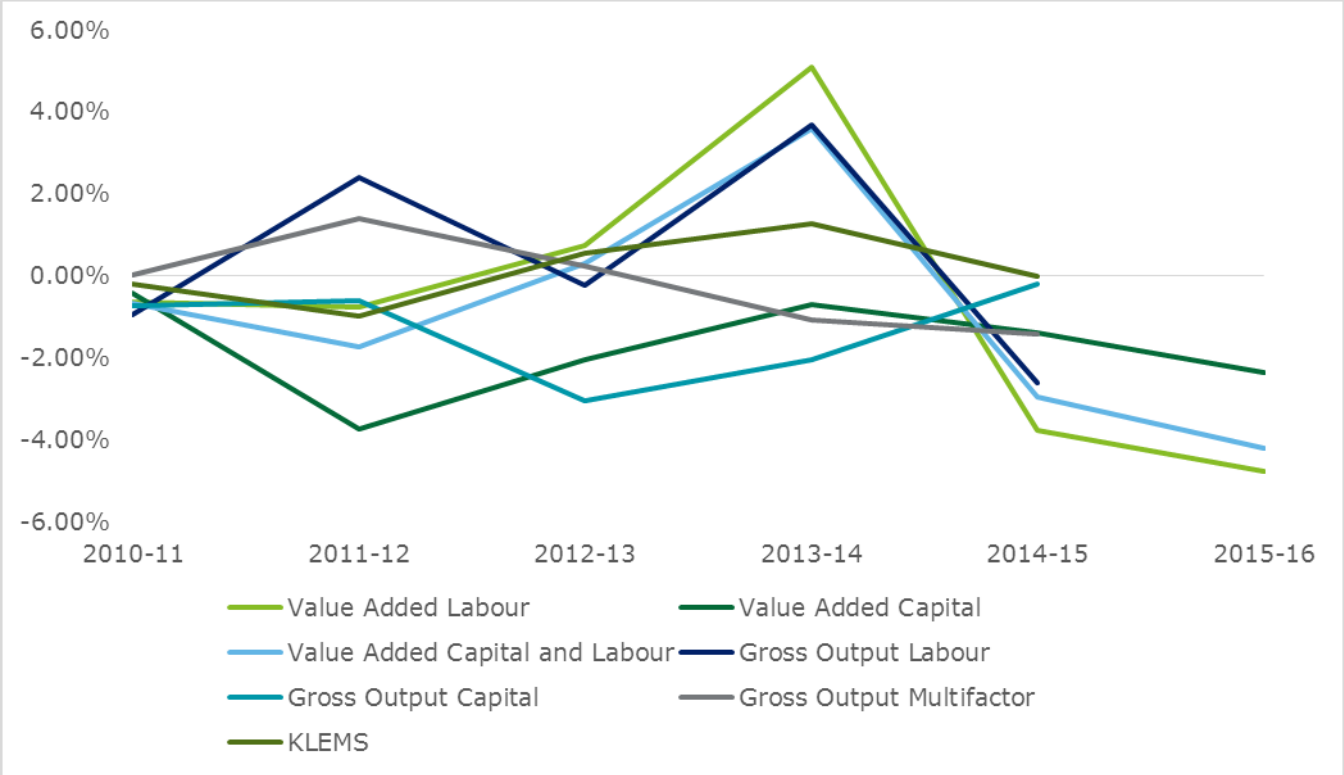
However, as this report highlights, this is not a straightforward task and there are a range of issues around estimating productivity that the ESC needs to consider.

5.1 Overall comparison of measures

As can be seen in the previous chapters, there is a fairly significant variation in productivity estimates, depending on measure. In general, capital productivity measures are the lowest and labour productivity measures are the highest. This is consistent with the trend of capital deepening discussed in 4.3.

Consequently, depending on which measure is chosen there will be a significant difference in the productivity 'hurdle' that is given to local government. The average weighted measures range from 0.46% to -1.77%.

Chart 5.1: Comparison of measures of productivity



5.2 Measurement period

In this report, we have presented productivity data for the most recent five years (for gross output measures) and six years (for value-added measures), and calculated average growth rates in productivity over that period. This approach has the advantage of providing 'smoother' and less volatile estimates of productivity by reducing the influence of one-off factors in particular years.

However, it should be noted that productivity estimates reflect lags between investment (when an input is measured) and when it is utilised in production. As such, productivity estimates for 2010-11 may actually reflect inputs from 2008-09. It can be argued that it is not appropriate to include productivity influences from this far back in the rate-capping formula as technology from seven years ago can be very different to what is available today. The same arguments would apply when examining data over a longer period.

We note that IPART uses a 15 year average for their productivity factor – in our view this is at the longer end of what might be regarded a reasonable period for measurement.

On the other hand, using a single year, or a small number of years of more recent data will make the estimate of productivity more volatile and susceptible to influence of individual factors and years. Using single year estimates in the rate capping formula could result in widely different rate caps from year to year.

These considerations should be balanced when selecting an appropriate measurement period for productivity. A range of 5-10 years may best balance the objective of removing volatility, but still remaining relevant.

5.3 Negative productivity

As can be seen in chapters 3 and 4, the ABS measures of productivity growth can often be negative. In fact, the weighted productivity measure is negative just over 50% of the time. A decision needs to be made as to how best to deal with the issue of negative numbers.

The simplest approach is to allow negative productivity estimates to flow through directly into the rate capping formula. This would provide for a rate cap that is higher than the CPI. However it may be difficult to explain to ratepayers why it is reasonable to expect local government to become less efficient.

Another option would be to set the productivity factor in the rate cap formula to zero in those years when it would otherwise be negative. We understand this is the approach adopted by IPART. However, in doing so it is arguably necessary to adjust productivity factors in subsequent years to reflect the years for which productivity was set to zero. Otherwise local government would implicitly be required to achieve cumulative productivity improvements greater than those achieved elsewhere in the economy.

An example of how this may be done is set out in Appendix B.

5.4 Gross output and value added measures

The main difference between gross output and value added measures are that gross output measures consider intermediate inputs. Practically, the differences in estimates from the two approaches are small at the aggregate level but can be more pronounced at the industry level.

While in this instance, all data is sourced from the ABS, and hence data quality issues are likely to be minimised, some estimates of productivity may still be more 'accurate' than others. This reflects the fact that outputs are more easily measured in some industries relative to others (for example in transport, postal and warehousing, relative to administration and support services).

In the local government sector, gross output is difficult to define, suggesting that value added may be a more relevant measure. Gross output measures can also be more sensitive to substitution between inputs, and, as NERA has noted, the inclusion of intra-industry flows of intermediate products may result in double counting on both the input and output side.

On this basis the use of value-added measures has appeal.

5.5 Labour, capital and multifactor productivity measures

Labour, capital and MFP measures are all valid approaches to productivity measurement. However each has strengths and weaknesses.

- While labour-based productivity is a simple concept, it is more difficult to measure. Further many local government activities tend to be reasonably capital intensive.
- Capital-based productivity can be simpler to measure. However local government capital activities focus on roads, while capital productivity measures take into account a range of other capital infrastructure
- MFP measures are more complex, and use of MFP measures as a proxy rely on relationships between capital and labour being broadly consistent with those in local government. At the same time they are more comprehensive and can reflect the changing mix of labour and capital over time.

Noting the challenges associated with using labour and capital productivity measures, this could suggest that MFP, and specifically value added MFP, may be the measure most suited to estimating productivity growth in Victorian local government. Local government uses both capital and labour inputs and the rate capping formula reflects both capital and labour factors.

5.6 Industries to use

A key issue is which ABS industries to use in the measure of productivity. Given that the ABS does not provide productivity estimates for a range of non-market industries, the choice comes down to using the ABS average across all 16 market industries, or constructing a weighted average across a subset of the most relevant industries.

Our concern with using the broader average across all industries is that it includes a number of industries which are not relevant to local government. In addition, the mining industry has had a large influence on estimates of productivity in Australia over the recent past.

Our suggestion is therefore to use a measure which draws from a subset of three ABS industry data sets - administrative and support services, arts and recreation services and transport, and postal and warehousing industries.

The following table summarises the averages using both approaches; while using the three weighted industries is preferred by DAE, both measures are appropriate.

Table 5.1: Comparison of growth rates using different industries

	5-year average (since 2010-11)	10-year average (since 2005-06)	15 year average (since 2000-01)	20-year average (since 1995-96)
3 weighted industries	-0.95%	-0.90%	-0.45%	-0.46%
16 market sector industries	0.17%	-0.16%	0.13%	0.47%

References

Australian Bureau of Statistics (2016a), Estimates of Industry Multifactor Productivity, 2015-16, Available at: http://www.abs.gov.au/ausstats/abs@.nsf/mf/5260.0.55.002.

(2016b), Experimental Estimates of Industry Level KLEMS Multifactor Productivity, 2013-14, Available at: http://www.abs.gov.au/ausstats/abs@.nsf/mf/5260.0.55.004.

(2016c), Government Finance Statistics, Australia, 2014-15, Available at: http://www.abs.gov.au/ausstats%5Cabs@.nsf/0/F1DC7CA0706C3A03CA25771500031665?Opendocument.

Cobbold, T (2013) A comparison of gross output and value-added methods for productivity estimation. Productivity Commission. Available at: http://www.pc.gov.au/research/supporting/comparison-gross-output-value-added-methods/cgovam.pdf.

NERA Economic Consulting (2016), Forecasting productivity for local government; alternative approaches – A report for ESC.

OECD (2001) Measuring productivity, OECD Manual, Measurement of aggregate and industry level productivity growth. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf.

Appendix A: Use of longer time series in estimating productivity

Estimates of productivity can vary significantly over time, with one-off factors likely to influence productivity growth in a given year. Use of a longer time series of data is one way to overcome the influence of these factors.

While the report uses five-year averages of growth rates in productivity, this appendix presents the averages over:

A the period from 2005-06 to 2015-16;
B the period form 2000-01 to 2015-16; and
C the duration of available data (1995-96 to 2015-16).

However, using a longer time series is not necessarily "better" or more accurate. While one-off factors have less of an impact when there are more data points for consideration, using a longer time series introduces estimates which may not be relevant for the current situation. For example, technologies and operating practices which affected local government productivity 20 years ago may no longer be relevant today. The longer the time period used, the less relevant each additional year's data will be for current estimates.

The following tables present estimates of productivity over these longer time periods, and again show significant volatility depending on the time period under consideration.

15-year averages (average since 2000-01) are presented for comparability with approaches used in other jurisdictions.

Table A.1: Gross output productivity growth rates

	Average since 2005-06	15-year average (since 2000-01)	Average since 1995-96
Labour productivity	0.66%	0.77%	0.62%
Capital productivity	-2.43%	-3.63%	-3.23%
MFP	-0.20%	0.11%	0.29%
KLEMS MFP	-0.12%	-0.01%	0.00%

Table A.2: Value added productivity growth rates

	Average since 2005-06	15-year average (since 2000-01)	Average since 1995-96
Labour productivity	-0.40%	0.08%	0.17%
Capital productivity	-3.08%	-3.05%	-3.50%
MFP	-0.90%	-0.45%	-0.46%

Appendix B: Considerations for negative productivity factors

As noted in section 5.3, when the ABS measures of productivity growth are negative, one approach is to set the productivity factor in the rate cap formula to zero.

If this approach is adopted, there are implications for the future calculation of productivity factors.

Take a simple example, using an approach where the productivity factor is set on an annual basis, based on the previous year's value. Suppose in year 1 there is a productivity decrease of -2.0%, followed by a productivity increase of +4.0% in year 2. If the first year's productivity change is set to zero in the rate cap formula, then the productivity change used in the second year in the rate cap should be set to (4.0% - 2.0%) = 2.0%. [4] The change in the third year can be applied without adjustment (assuming it is positive).

The approach of setting the productivity factor to zero when there is a negative factor becomes more complex when the productivity factor is calculated over a multi-year period, and some simplifications are recommended to keep the calculations transparent.

For example, suppose a five-year value-added MFP measure based on weighted sectors, as recommended in this report. In using a five multi-year average, where there are negatives, either in individual years or overall, then options include:

- Setting individual years to zero in the calculation of the average, where they would otherwise be negative; or
- Setting the overall average to zero where it would otherwise be negative.

The simplest approach is to set the overall average to zero where it would otherwise be negative. And then only apply a positive factor once the overall average becomes positive, taking into account any years that are set to zero.

For example, in A below, when setting the productivity factor to apply in 2005, the average of the previous five-year period is -1%, so this would be set to zero.

[4] Using a simple averaging technique. Using a strictly more mathematically correct compounding approach the second year factor would be 1.92%.

In 2006, the average of the previous five-year period is 0.4%[5] (+2/5), however, this value ignores the negative value for 2005 which was zeroed out. Instead the average should be estimated over 6 years (instead of 5) to account for this. The value is therefore be set to +1/6 = 0.17%.

In 2007 the average of the past 5 years is 0.8% (+4/5) which can then be directly used in the rate capping formula.

A number of other approaches to dealing with the negative factor are possible, and these may be more mathematically 'correct', in terms of perfectly and fully adjusting for negatives being set to zero. However they become increasingly complex and move away from the simple concept of using a 5 year average.

Table B.1: Value added productivity growth rates

	2000	2001	2002	2003	2004	2005	2006	2007	5yr ave.	Set to:
A. Productivity growth rate for 2005	-1%	-1%	-1%	-1%	-1%	6%			-1%	0%
B. Productivity growth rate for 2006	-1%	-1%	-1%	-1%	-1%	6%	1%		0.4%	0.17%
C. Productivity growth rate for 2007	-1%	-1%	-1%	-1%	-1%	6%	1%	1%	0.8%	0.8%

[5] Again, using a simple averaging technique.

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