Essential Services Commission

Local Government – Measuring Productivity Using a Direct Method

Final Report - Summary
December 2017

Inherent Limitations

This report has been prepared as outlined in Section 1 of this report.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, the Essential Services Commission (the ESC) consulted as part of the process.

Predictive Analytics Group (PAG) has indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

PAG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

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In the course of our work, forecasts and/or simulations have been prepared on the basis of assumptions and methodology which have been described in our report. It is possible that some of the assumptions underlying our forecasts and/or simulations may not materialise. Nevertheless, we have applied our professional judgement in making these assumptions, such that they constitute an understandable basis for estimates and projections. Accordingly, readers of this Report must appreciate that, to the extent that certain assumptions do not materialise, our estimates and projections may vary.

PREDICTIVE ANALYTICS GROUP

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Glossary

Constant returns to scale (CRS)	The assumption that the relationship between inputs and outputs is constant. Namely, an increase in inputs results in commensurate and equal change in outputs.
Efficiency	Degree to which the observed use of resources to produce outputs of a given quality matches the optimal use of resources to produce outputs of a given quality.
Input oriented	Type of DEA. An input oriented DEA assumes that entities only have control over the amount of inputs and not the amount of outputs.
Output oriented	Type of DEA. An output oriented DEA assumes that entities only have control over the amount of outputs and not the amount of inputs.
Production frontier	The line or curve plotting the minimum amount of an input (or combination of inputs) required to produce a given quantity of output (or combination of outputs).
Productivity	Measure of the physical output produced from the use of a given quantity of inputs. This may include all inputs and outputs (Total Factor Productivity) or a subset of inputs and outputs (Partial Productivity). Productivity varies as a result of differences in technological change and differences in technical efficiency.
Returns to scale	Relationship between outputs and inputs. Returns can be constant, increasing or decreasing depending on whether output increases in proportion to, more or less than inputs, respectively. In the case of multiple inputs and outputs, this refers to how outputs change when there is an equi-proportionate change in all inputs.
Scale efficiency	The extent to which an entity can take advantage of returns to scale by altering its size towards optimal scale (which is defined as the region in which there are constant returns to scale in the relationship between inputs and outputs).

Technical efficiency	Conversion of inputs into outputs. Technical efficiency is determined by the difference between the observed ratio of combined quantities of an entity's output to input ratio achieved by best practice. It can be expressed as the potential to increase quantities of outputs from given quantities of inputs, or the potential to reduce quantities of inputs used in producing given quantities of outputs.
Technological change	The expansion or contraction of efficiency due to technological changes (i.e. the adoption of new technologies resulting in the expansion or contraction of the production frontier). In essence, this variable indicates how innovative an entity has been with their technology.
Variable returns to scale (VRS)	The assumption that the relationship between inputs and outputs is an increasing or decreasing one.

1 Executive Summary

1.1 Background and Scope

As part of a broader program of works relating to the *Implementing a Fair Go Rates System,* the Essential Services Commission (**the Commission**) engaged Predictive Analytics Group (**PAG**) in December 2016 to measure the productivity of local governments in Victoria and then use the efficiency scores to compute efficiency factors for the Commission to consider. Guided by similar studies undertaken in other jurisdictions across Australia and the academic literature, PAG employed a quantitative method know as Data Envelopment Analysis (**DEA**) to measure productivity.

DEA is widely considered a robust and popular method for measuring the relative performance of organisations, in this case Local Governments, involved in the provision of similar (or the same) services. According to DEA, an efficient organisation is one that uses the lowest amount of inputs to provide a given amount of outputs (contingent on quality) in the context of DEA. *Total factor productivity (TFP)* is also employed to assess the change in efficiency of local governments from year to year.

A salient feature of DEA is that it is a relative measure. The technique uses the available local governments in order to assess which are the most efficient, relative to the other local governments. The implication of this is that even if a local government is judged by the DEA methodology to be fully efficient (or 'on the frontier'), it is still possible for the local government to become more efficient.

Local governments provide a wide variety of services to their municipalities including, but not limited to, public health, traffic, parking, road maintenance, waste collection, community services, local laws and recreation and culture. The scale and scope of activities undertaken by individual local governments may vary depending on the size and nature of their municipality. As such, any analysis into the Victorian local government sector should acknowledge that each local government may have different characteristics.

1.2 Approach

The quantitative approach follows two main stages, namely:

1. **Stage 1**: The development of Total Factor Productivity (TFP) models via the DEA methodology using the existing Victorian Grants Commission (VGC) data.

In the first instance it is necessary to review and consolidate the data, In particular:

- Compile necessary datasets including the aforementioned VGC as well as publicly available data regarding Victorian local governments. In addition to the data provided by the Commission, PAG also obtained data pertaining to the demographic and economic variables of Victorian local governments from the Australian Bureau of Statistics (ABS) and the Australian Government Department of Employment.
- Review the data to determine what information is suitable to enable meaningful comparisons to be made among local governments.

It is also required that preliminary work be undertaken to calculate productivity levels in the local government sector. This includes:

- Applying DEA to the data for the 2015-16 financial year. Five models of input and output pairings (outlined in Table 1-1), were examined. A production frontier for each model was computed and technical efficiencies for each local government were computed under each model.
- Total Factor Productivity was then computed from the 2010-11 financial year to the 2015-16 financial year. Total Factor Productivity is represented by the Malmquist index which provides an indication as to whether the local governments are becoming more or less efficient over time.
- Efficiency factors were then calculated. These were based on the technical efficiencies for the 2015-16 financial year and the Malmquist index from the 2010-11 financial year to the 2015-16 financial year. A number of scenarios were utilised for the consideration of the Commission as to which level of efficiency increases the Commission deems appropriate.
- Sensitivity analysis was conducted. This involved determining the impact that an increase or decrease in inputs would have upon the efficiency scores of local governments.

2. **Stage 2** – Measuring Productivity using Quantitative Methods

This stage involves refining the DEA calculations undertaken in the previous stage to incorporate any new assumptions or updated information in light of consultation with the sector. Throughout this report references are made to 'single group' and 'multiple group' analysis. Single group refers to the assessment of all 79 local councils as one group. The consideration of councils as one group implies that they all have similar attributes, i.e. geographic, financial and other. In contrast, 'multiple group analysis' assumes that there are differences between councils which should be accounted for. As such, to facilitate the multiple group analysis each of the 79 Victorian local governments were categorised according to the following groups:

- Interface
- Large Rural
- Metropolitan
- Regional Centre
- Small Rural

The report compares the results of the single and multiple group analysis

1.3 A brief review of the data and the literature

The following data was provided by the Commission for the financial years 2010/11 – 2015/16:

1. ALG1 Road Length and Expenditure;
2. VCG1 Expenditure and Revenue;
3. ABS1 Capital Outlays and Sales;
4. ABS2 Balance Sheets;
5. VLGAS Region by Council;
6. LGV1 Council Employment; and
7. VCG2 Valuations and Rates.

In addition, data relating to the Local Government Performance Reporting Framework for 2014/15 – 2015/16 as well as the VCG Questionnaire Manuals for 2010/11 – 2015/16 were also provided.

Data was also obtained from the Australian Bureau of Statistics (ABS). In particular, statistics for local government areas regarding the number of households and businesses. Where the data was not reported every year, the data was interpolated and extrapolated where necessary to construct a complete dataset for all the necessary years under consideration in this report.

Availability of data to facilitate TFP analysis

The data provided by the Commission was examined against the data input and output requirements of TFP with a specific focus on DEA methods. Where it was found that the VGC data did not satisfy the requirements, we examined whether data existed in the public domain that could be used to facilitate robust TFP analysis. Table 1-1 and 1-2 below summarise the required inputs and outputs of DEA and the source from which they were obtained.

Table 1-1 – DEA Inputs

Inputs	Definition	Source
Staff (FTE)	Number of staff in Full-Time Equivalent (FTE) units	LGV1 (Heading 2399)
Staff ($)	Total staffing cost	VGC1 (Total Expenses 01999: Employee Benefits)
Capital ($)	Material and other expenses from Income Statement	ABS1 (Total Outlays 02999: TOTAL)
Operational Expenses ($)	Expenditure (not including depreciation and amortisation)	VGC1 (Total Expenses 01999 – Depreciation and Amortisation)
Depreciation ($)	Depreciation and amortisation	VGC1 (Total Expenses 01999: Depreciation & Amortisation)

Table 1-2 – DEA Outputs

Outputs	Definition	Source
Businesses	Number of Businesses in the municipality	Australian Bureau of Statistics: 1379.0.55.001 - National Regional Profile, 2010-14
Households	Number of Households in the municipality	Australian Bureau of Statistics: 1379.0.55.001 - National Regional Profile, 2010-14
Roads	Total length of roads (in kms) maintained by the local government	ALG1 (Length of Roads 2100 Total (kms))
Waste Collected	Amount of waste collected in tonnes	VLGAS (Tonnes Collected)

An extensive review of the DEA literature dating back to 1957 was conducted. It was found that DEA is considered a standard methodology for computing efficiencies in the local government sector. It has been used in many studies regarding Australian local government analysis. These studies include both academic papers and government reports. See, for example:

- Worthington and Dollery (2001): NSW municipal waste management.
- Worthington and Dollery (2000): Efficiency of NSW local governments.
- Worthington (2000): Cost efficiency in Australian local government.
- Drew, Kortt and Dollery (2015): NSW local government efficiency.
- Woodbury and Dollery (2004): NSW municipal water services.
- Gregan and Bruce (1997): Report into the technical efficiency of hospitals in Victoria.

It was also found that the estimation of efficiency scores is typically undertaken using the DEA (VRS) method rather than the DEA (CRS). The main reason for this is that DEA (VRS) employs a non-linear frontier to estimate efficiency scores and thus does not assume, *a priori*, that all local governments are operating at optimal scale efficiency (see for example, Banker, Charnes and Cooper (1984) or the Steering Committee for the Review of Commonwealth/State Service Provision Report (1997)[1]).

In this report, the number of households and number of businesses, as well as road length are used as outputs. This is owing to the fact that Victorian local governments primarily provide services to households and businesses, as well as being responsible for the maintenance of roads. This has been noted in studies such as Drew and Dollery (2014). According to this study, the number of households and businesses is representative of the true output of Victorian local governments. Whilst they do note that some functions not traditionally involved in the domain of local government have become a part of local government function, their study reveals that 'these emerging services…are still relatively insignificant compared with the traditional services to property remit of Australian local governments'.

1.4 Key Findings

DEA 2015 results

Table 1-3 below summarises the efficiency results calculated for the 2015-16 financial year using DEA constant returns to scale (CRS); and DEA variable returns to scale (VRS). DEA (CRS) assumes a linear frontier. The frontier is the line which indicates full efficiency. Full efficiency can be considered as a local government being optimal in terms of its ability to convert its inputs into outputs relative to other local governments.

DEA (VRS) is based on a non-linear frontier as it assumes that not all local governments are operating at optimal scale efficiency.[2] As such, the efficiencies calculated under DEA (VRS) tend to be higher than for DEA (CRS).

Table 1-3 - DEA 2015-16 Results (Single Group Analysis)

Model Number	Model Specification		Mean Technical Efficiency			
	Inputs	Outputs	DEA (CRS)	No. of Local Gov. on the frontier	DEA (VRS)	No. of Local Gov. on the frontier
1	Staff ($) + Capital ($)	H/holds + Businesses + Roads	0.74	9	0.81	20

[1] Available at http://www.pc.gov.au/research/supporting/data-envelopment-analysis

[2] Scale efficiency can be defined as when, for every unit input, there is a corresponding unit output for a local government. Local governments that are not scale efficient, can have more or less than a unit output for each unit input, or for each unit input, more or less than a corresponding unit output.

Model Number	Model Specification		Mean Technical Efficiency			
	Inputs	Outputs	DEA (CRS)	No. of Local Gov. on the frontier	DEA (VRS)	No. of Local Gov. on the frontier
2	Staff (FTE) + Capital ($)	H/holds + Businesses + Roads	0.71	6	0.79	17
3	Staff ($) + Capital ($)	H/holds + Businesses + Roads + Waste	0.76	11	0.83	23
4	Capital ($) + Operating Expenses (excl. Depreciation) ($)	H/holds + Businesses + Roads	0.73	6	0.81	18
5	Operating Expenses (excl. Depreciation) ($) + Depreciation ($)	H/holds + Businesses + Roads	0.76	6	0.82	15

Note, the results presented in Table 1-3 are averages of all 79 local governments and do not represent each local government's performance on an individual level.

Efficiency scores range from 71% (DEA (CRS) Model 2) to 83% (DEA (VRS) Model 3). A robust model is one which encapsulates the following attributes:

1. It includes the broadest range of possible inputs which are common to all local governments;
2. It accounts for the full scale of local government operations; and
3. It covers the broadest range of possible outputs (in terms of services provided) which are common to all local governments.
    a. For example, staffing costs, whether in dollar terms or fulltime equivalent units (FTE), and capital outlays are common to all local governments and account for the majority of local government inputs.

The model specifications which include all three attributes are Models 1, 2 and 3. An alternative specification, which also covers a broad range of local government inputs, is the use of capital outlays and operating expenses (excluding depreciation), denoted by Model 4, or operating expenses (excluding depreciation) and depreciation, denoted by Model 5.

According to the academic literature, the specification of inputs and outputs as specified in Model 1, is considered the most comprehensive and succinct (see Drew, Kortt and Dollery (2015)). It is comprehensive because it covers all inputs and outputs considered relevant to local governments. Further, it does not double count certain aspects of local government inputs or outputs. For example, if population were included as an additional output in addition to the number of households, this could be considered double counting the 'number of households' output measure. [3]

Drew, Kortt and Dollery (2015) specify a number of additional reasons why Model 1 is the preferred model. Firstly, 'staffing costs' provide a more robust measure of the input that staff members have into a local government's operations compared with 'staff FTE' measure (as is used in Model 2). This is because not all staff are paid the same rate and salary - factors that are considered to reflect responsibility, experience and quality of work.

The model with the highest number of local governments being fully efficient is Model 3 under the DEA (VRS) framework. This framework has 23 local governments being stipulated as fully efficient. In addition this framework had a mean technical efficiency score of 83%. The model under the DEA (VRS) framework with the highest mean technical efficiency scores is Model 3, with a mean technical efficiency scores of 83%.

The model with the lowest mean technical efficiency is Model 2 under the DEA (CRS) framework. This model and framework has a mean technical efficiency of 71%. Similar to the results under the DEA (VRS) framework, the models with the highest mean technical efficiency scores under the DEA (CRS) framework are Models 3 and 5. These models have mean technical efficiency scores of 76% under the DEA (CRS) framework.

The mean technical efficiencies presented in Table 1-3 indicate that although some local governments are fully efficient (relative to other local governments), the majority of local governments have room for improvement. The mean technical efficiencies are well above 50%, indicating that local governments are generally performing well. Using these numbers it will be possible to give an efficiency factor which is achievable for local governments to attain.

Figure 1-1 below shows the technical efficiencies for Model 1 DEA (VRS) in which local governments are considered as a single group. From Figure 1-1 it can be seen that under Model 1 DEA (VRS) there are 20 local governments that are fully efficient. The remaining 59 local governments have efficiency scores ranging from 51.2% to approximately 97.33%. The local government with the lowest efficiency score is Regional Centre 7, with a score of 51.2%. The local government with an efficiency score of 97.33% is Metropolitan 17. The mean efficiency score of all local governments under the Model 1 DEA (VRS) framework is 81%.

It should be noted that under different model specifications (in term of input and output specifications) and in different years, the results of the different local governments may be different to both in terms of the number of local governments that are fully efficient, as well as the order in which they fall, as displayed in Figure 1-1.

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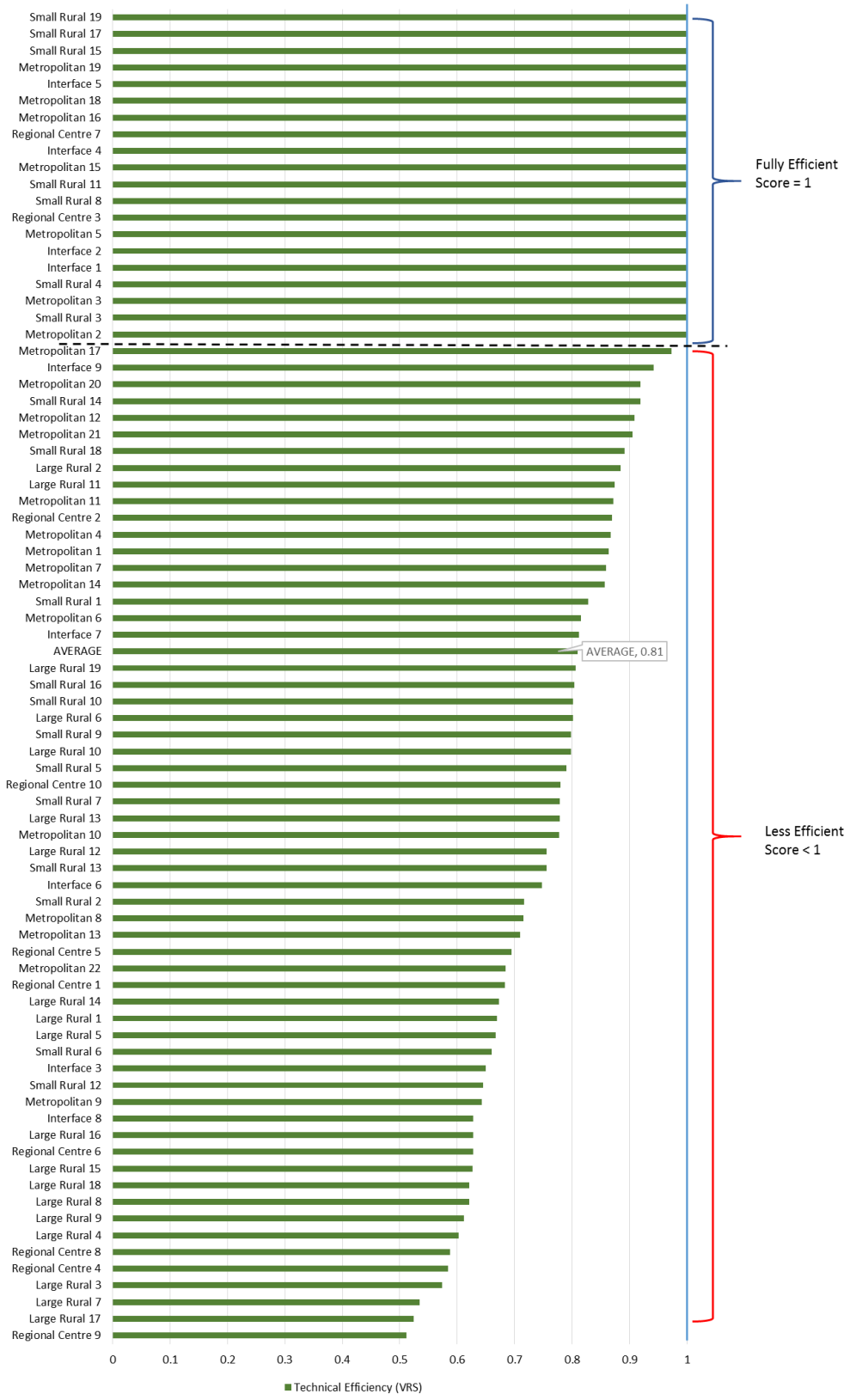
[3] Borrowing costs are excluded as an input as they may act to artificially inflate the inputs rather than contribute to the outputs. The inclusion of borrowing costs may penalise those with debt as the borrowings may not directly map to use for outputs. In addition, the number of households and businesses is considered to be a more stable representation of outputs than population and should be used in preference to population as an output. Also, given the inconsistent treatment of depreciation among local governments, depreciation should be excluded as an input due to the fact that for different local governments the figures have different meanings depending on how the local government chose to report the figure. As such, the specification of Model 1 in terms of inputs and outputs is considered in the literature of Australian local government efficiency to be the preferred model specification

Figure 1-1 - DEA (VRS) Technical Efficiencies for Model 1 (Single Group Analysis) in 2015-16



A summary of the DEA results at the multiple group level have been detailed below.

Table 1-4 - DEA Mean Technical Efficiencies for Interface Group of Local Governments

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
1	Interface	0.89	0.91	0.14	0.14	3	6
2	Interface	0.89	0.92	0.13	0.12	4	6
3	Interface	0.94	0.97	0.10	0.08	4	7
4	Interface	0.94	0.94	0.11	0.11	6	8
5	Interface	0.93	0.94	0.11	0.11	4	6

The Interface group is comprised of 9 local governments. The results indicate that local governments in this group are between 89% and 97% efficient depending on the model.

Table 1-5 - DEA Mean Technical Efficiencies for Large Rural Group of Local Governments

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
1	Large Rural	0.88	0.95	0.11	0.07	3	10
2	Large Rural	0.83	0.91	0.13	0.09	3	8
3	Large Rural	0.91	0.96	0.09	0.06	3	12
4	Large Rural	0.91	0.94	0.10	0.09	6	10
5	Large Rural	0.90	0.95	0.10	0.08	6	11

The Large Rural group of local governments comprises 19 local governments. The difference between the CRS and VRS efficiency results are a lot wider for Models 1 to 3 than for the Interface group.

Table 1-6 - DEA Mean Technical Efficiencies for Metropolitan Group of Local Governments

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
1	Metropolitan	0.88	0.95	0.14	0.08	6	11
2	Metropolitan	0.88	0.95	0.14	0.08	5	12
3	Metropolitan	0.90	0.95	0.13	0.07	8	11
4	Metropolitan	0.88	0.95	0.14	0.07	6	12

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
5	Metropolitan	0.89	0.95	0.13	0.06	6	9

The Metropolitan group of local governments is comprised of 22 local governments. Across the different models and efficiency types, the efficiencies range from 88% to 95%.

Table 1-7 - DEA Mean Technical Efficiencies for Regional Centre Group of Local Governments

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
1	Regional Centre	0.94	0.95	0.09	0.09	6	7
2	Regional Centre	0.96	0.96	0.09	0.09	7	8
3	Regional Centre	0.94	0.96	0.09	0.07	6	7
4	Regional Centre	0.97	0.97	0.06	0.06	7	8
5	Regional Centre	0.97	0.98	0.04	0.04	5	7

The Regional Centre group of local governments consists of 10 local governments. Relative to one another, this group of local governments is highly efficient. In other words, the efficiency scores are quite close to one another, as indicated by the high average technical efficiencies and small standard deviations of the technical efficiencies.

Table 1-8 - DEA Mean Technical Efficiencies for Small Rural Group of Local Governments

Model	Local Government Group	Mean Technical Efficiency		Standard Deviation of Technical Efficiency		On the frontier	
		CRS	VRS	CRS	VRS	CRS	VRS
1	Small Rural	0.91	0.95	0.10	0.07	8	11
2	Small Rural	0.90	0.94	0.11	0.09	8	11
3	Small Rural	0.95	0.98	0.07	0.04	8	15
4	Small Rural	0.92	0.98	0.10	0.05	7	12
5	Small Rural	0.92	0.97	0.08	0.05	8	11

The Small Rural group of local governments is comprised of 19 local governments. Relative to one another, these local governments tend to be highly efficient.

Efficiency Factor (X-factor) results

According to the Environment and Planning Committee's Third Report into Rate Capping,[4] the Commission has in the past recommended that efficiency rate caps should be set using a weighted combination of the Consumer Price Index (CPI) and the Wage Price Index (WPI) minus an efficiency factor (also known as an X-factor). An X-factor is typically computed with reference to the existing and historic levels of local government productivity. Formally, the efficiency factor is computed as follows:

$$\boldsymbol{TFPC} + ((\mathbf{1} + \boldsymbol{p}(\mathbf{1} - \boldsymbol{TE}))^{\mathbf{1}/\boldsymbol{t}} - \mathbf{1}) \times \mathbf{100} \qquad (1.1)$$

where:

- TE is the Technical Efficiency.
- TFPC is the average annual change in Total Factor Productivity.
- This efficiency factor represents the number it would take all local governments to reach an increase in efficiency of 100×*p*% over *t* years.
- The Commission may wish to have a greater or lower increase in efficiency over this time OR a shorter or longer time frame for the increase in efficiencies to be realised.

There are two methods of setting the variable TFPC. We denote them as Method 1 and Method 2. Method 1 is the method whereby the Commission sets a minimum increase in efficiency that it considers appropriate for all local governments. For the purposes of this analysis, the Method 1 TFPC was set at 0.05%.

The second method, Method 2, sets the TFPC to be equal to the average change in the Malmquist Index (in PAG's original report). This method links the TFPC to the performance of local governments over a specified time period (financial years 2010-11 to 2015-16) based on their recent historic and current efficiencies.

In our analysis, three scenarios were considered, i.e. low, medium and high.[5] The low scenario assumes a 2.5% increase in efficiency (i.e. *p* in equation (1.1) is 0.025) over 5 years (i.e. *t* in equation (1.1) is 5). The medium scenario assumes a 5% increase in efficiency (i.e. *p* in equation (1.1) is 0.05) over 5 years. The high scenario assumes a 7.5% increase in efficiency (i.e. *p* in equation (1.1) is 0.075) over 5 years.

Table 1-9 presents the resultant X-factors computed via Method 1.

Table 1-9 - Efficiency Factor (X-factor) Results using Method 1 for Single Group Analysis

X-factor						
	Low 2.5% efficiency increase		Medium 5% efficiency increase		High 7.5% efficiency increase	
Model	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)
1	0.18	0.15	0.31	0.24	0.44	0.33
2	0.19	0.15	0.33	0.25	0.47	0.35
3	0.17	0.13	0.29	0.22	0.40	0.30
4	0.18	0.14	0.32	0.24	0.45	0.33
5	0.17	0.14	0.29	0.23	0.41	0.32

[4] Parliament of Victoria, Legislative Council Environment and Planning Committee (2016), *Third report into rate capping policy*, Victorian Government Printer, Melbourne.

[5] Each scenario proposes a different efficiency increase over time for the local governments as a whole. This in turn affects the value of the final efficiency factor

The X-factor shows the percentage reduction in inputs per year that local governments would have to achieve to attain the specified efficiency gains according to the scenario (i.e. low, medium or high). For example, for Model 1 in the low scenario under the DEA (VRS) methodology, the X-factor is 0.15%. This translates to local governments being required to reduce costs by 0.15% per year to attain the 2.5% increase in efficiency over 5 years.

The results for the low scenario show X-factors ranging from 0.13% to 0.19%. X-factors tended to be higher for the DEA (CRS) technique than the DEA (VRS) technique.

The results for the medium scenario show X-factors ranging from 0.22% to 0.33%. This is higher than the low scenario results and is due to the fact that this scenario assumes a higher increase in efficiencies over the same time period than the low scenario.

The results for the high scenario show X-factors ranging from 0.30% to 0.47%. Again, this increase is due to the fact that this scenario assumes an even higher increase in efficiencies over the same time period as the other two scenarios.

Table 1-10 presents the resultant X-factors computed via Method 2 by the methodology outlined in Section 4.5.

Table 1-10 - Efficiency Factor (X-factor) Results using Method 2 for Single Group Analysis

X-factor						
	Low 2.5% efficiency increase		Medium 5% efficiency increase		High 7.5% efficiency increase	
Model	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)
1	0.13	0.10	0.26	0.19	0.39	0.28
2	0.14	0.10	0.28	0.20	0.42	0.30
3	0.12	0.08	0.24	0.17	0.35	0.25
4	0.13	0.09	0.27	0.19	0.40	0.28
5	0.12	0.09	0.24	0.18	0.36	0.27

The results for the low scenario show X-factors ranging from 0.08% to 0.14%, depending on the technique used to estimate efficiency.

Local governments were also grouped according to similar features in terms of their location in Victoria (e.g. Metropolitan local governments were grouped together, as were Small Rural local governments etc. – see Appendix A for a full list). The groupings and the number of local governments in each group are given in Table 1-11.

Table 1-11 - Local Government Groupings

Group No.	Definition	No. Local Governments
1	Interface	9
2	Large Rural	19
3	Metropolitan	22
4	Regional Centre	10
5	Small Rural	19

Table 1-12 summarises the X-factors computed for multiple groups via Method 1.

Table 1-12 - Efficiency Factor (X-factor) Results using Method 1 for Multiple Group Analysis

X-factor						
	Low 2.5% efficiency increase		Medium 5% efficiency increase		High 7.5% efficiency increase	
Model	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)
1	0.10	0.08	0.16	0.11	0.21	0.14
2	0.11	0.08	0.17	0.12	0.23	0.15
3	0.09	0.07	0.13	0.09	0.17	0.11
4	0.09	0.07	0.13	0.09	0.17	0.12
5	0.09	0.07	0.13	0.09	0.17	0.11

It should be noted that for the multiple group analysis, the X-factor for each individual local government was computed. This was done based on the technical efficiencies computed by grouping the local governments according to the groupings specified in Table 1-11. This means that the efficiencies were calculated only by reference to other local governments within each individual group. The resultant X-factors in Table 1-12 were then computed by averaging all the individual X-factors. The average X-factors were computed across all 79 local government.

The resultant X-factors are lower than the results for the single group analysis. This is owing to the fact that local governments are only compared to other similar local governments. In addition, it is important to note that DEA is a relative, not an absolute method of scoring efficiencies. This means that although a certain group of local governments may have a lower efficiency score as a result of being compared with all other local governments, their efficiencies may be higher when compared only with local governments that have similar attributes. For example, a rural local government may have a lower efficiency score as a result of being compared with metropolitan local governments, but have a higher score when compared only with other rural local governments.

Table 1-13 summarises the X-factors computed for multiple groups via Method 2.

Table 1-13 - Efficiency Factor (X-factor) Results using Method 2 for Multiple Group Analysis

X-factor						
	Low 2.5% efficiency increase		Medium 5% efficiency increase		High 7.5% efficiency increase	
Model	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)	DEA (CRS)	DEA (VRS)
1	0.05	0.03	0.11	0.06	0.16	0.09
2	0.06	0.03	0.12	0.07	0.18	0.10
3	0.04	0.02	0.08	0.04	0.12	0.06
4	0.04	0.02	0.08	0.04	0.12	0.07
5	0.04	0.02	0.08	0.04	0.12	0.06

According to Table 1-13, in regards to the low scenario, the X-factors range between 0.02% and 0.06%. X-factors computed under the DEA (VRS) framework tended to be lower than those under the DEA (CRS) framework. For medium scenario, the computed X-factors range between 0.04% to 0.12%. For the high scenario, X-factors range between 0.06% to 0.18%.

1.5 Conclusions & Recommendations

The following conclusions are made by PAG:

- The models considered for the efficiency computations are robust in terms of encompassing a broad range of inputs and outputs which are common to all local governments.

- DEA was utilised to compute local government efficiency and resultant efficiency factors. Of the DEA techniques utilised, the more robust method of estimating the efficiencies is the DEA with variable returns to scale.
    - This is due to its more realistic assumptions regarding the scale efficiency of local governments. If the Commission chooses to use a DEA framework for the computation of the efficiency factor, PAG recommends using the DEA (VRS) framework.
- On the basis of the literature review, the specification of inputs and outputs of Model 1 is considered to be preferred as it comprehensively and succinctly covers all the necessary inputs and outputs pertinent to local government operations.
- Analysis was conducted by considering all local governments as a single group and by considering local governments in relevant sub groups. The Commission has the choice to utilise results from either form of analysis. The analysis utilising sub groups looked at local governments in groups in which local governments were of a similar nature.
- The calculation of the X-factor scores was robust to a range of alternative specifications. The Commission can choose between a low range of efficiency increase (2.5% increase over 5 years), a medium range of efficiency increase (5% increase over 5 years), and a high range of efficiency increase (7.5% increase over 5 years).
- The Commission has a choice whether to use Method 1 or Method 2 for setting the TFPC in calculating the efficiency factor.
- Based on sensitivity analysis, local governments can improve their efficiency if they decrease their inputs.

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