4 September 2023

Dear Adam

AER 2023 Annual Benchmarking Report – preliminary analysis

We appreciate the opportunity to provide feedback on the AER's preliminary benchmarking results and the Quantonomics report.

Through the review of the preliminary benchmarking results, several significant issues have been identified to which we wish to draw your attention.

Regarding the preliminary multilateral total and partial factor productivity (MTFP / MPFP) indices, we note that the MTFP and MPFP have not been modelled based on the outcome of the AER's review into assessing the impacts of DNSP's different capitalisation practices on benchmarking, published in May 2023, nor have output weights been updated.

The analysis should be updated to reflect the AER's final decision of including capitalised corporate overheads in the opex series for benchmarking purposes (option 5) based on the Cost Allocation Methodology (CAM) used by DNSPs in 2022. Undertaking the opex MPFP analysis using opex inclusive of capitalised corporate overheads has a material impact on the efficiency scores, relative rankings, and convergence of scores over time, as shown in the appendix, which should not be ignored.

Further, given the substantial changes to the methodology used in benchmarking and significant data revisions, and consistent with the annual update of output weights in the opex econometric cost function models, the output weights should also be updated in the MTFP and MPFP indices. Updating the output weights also materially changes DNSP efficiencies and rankings, as shown in the appendix.

Regarding the econometric cost function models, we are concerned by the significant statistical issues present in this year's modelling, which renders the estimated efficiency scores invalid and unreliable. The number of changes which have occurred in the input and output data as well as the significant efficiency gains achieved by Australian networks, an indication of the success of the AER's focus on opex efficiency, has resulted in more statistical issues arising than in the past and the econometric cost models are no longer fit for purpose.

We urge the AER to set out a program of work as a matter of priority to investigate ways to improve the statistical validity and reliability of its econometric models. Importantly, the AER should apply extreme caution in interpreting results from the benchmarking models for the purpose of setting regulatory allowances until such time that the substantial limitations in the model specification, detailed in Quantonomics report and outlined below, are addressed.

We welcome continued engagement with the AER on benchmarking matters. Given the significance of these issues, we welcome an opportunity to discuss the benchmarking analysis with your team, Quantonomics, and Frontier Economics, who are supporting us with benchmarking. Please contact [redacted] if you would like to discuss further.

Yours sincerely

Megan Willcox
General Manager Economic Regulation

Appendix: Assessment of draft Quantonomics 2023 draft benchmarking

MTFP and MPFP index analysis

There have been no changes in the methodology for the MTFP and MPFP index analysis compared to the 2022 benchmarking report. However, the methodology should be modified to address the following critical issues, particularly since the opex MPFP analysis appears to be used as a cross-check on the results of the econometric analysis.

Issue 1 – Output weights have not been updated

Determining the output weights for the MPFP/MTFP index analysis involves the estimation of Leontief cost functions. Quantonomics has not undertaken the analysis to update the output weights for the following reason:

> "This cost analysis was last carried out by Economic Insights (2020) and the method is described in Appendix A. This report does not repeat that analysis because the resulting weights are intended to be held constant for several years before updating them (Economic Insights 2020a)."[1]

However, for the analysis in the 2023 draft benchmarking report, not only are there three additional years of data compared to the Economic Insights 2020 analysis, but the current analysis also incorporates a number of revisions to the historical data, in addition to revisions made in previous years. The revisions for the 2023 draft report are listed in Box 1 below. Some of these changes involves correcting errors in the historical data.

Box 1: Revisions of historical data[2]

- Evoenergy: revised maximum demand for the years 2015 to 2021;
- Ausgrid and Essential Energy: updates made to opex in 2021 relating to reversing the software as a service (SaaS) and lease accounting changes;
- Ausnet Services: opex series and RAB for the years 2019 to 2021 were adjusted for reversing SaaS and lease accounting changes;
- Ausnet Services: circuit length data adjustment relating to removing 22km of 66kV line that was found to be duplicated in AND's database for the years 2013 to 2021;
- Essential Energy: Regulatory Asset Base (RAB) in 2021 relating to SaaS and leases; and
- Evoenergy: RAB in 2020 and 2021 relating to incorrect inflation calculation in the past.

[1] Quantonomics, *Economic Benchmarking Results for the Australian Energy Regulator's 2023 DNSP Annual Benchmarking Report DRAFT*, 17 August 2023, p. 7
[2] Quantonomics, *Economic Benchmarking Results for the Australian Energy Regulator's 2023 DNSP Annual Benchmarking Report DRAFT*, 17 August 2023, p. 5

Whenever the inputs and/or outputs change, the output weights also change. Changes in the output weights can have a major impact on a DNSP's MTFP and MFPF index scores and rankings. We can see no methodological justification for not updating the output weights for the index analysis on an annual basis, analogous to the way the elasticities and outputs weights are updated annually for the econometric benchmarking models—particularly when revisions to the historical data have been made to correct data reporting errors. Output weight estimates based on erroneous historical data will be contaminated by those errors, and really ought to be revised to reflect the corrected data.

Revised weights using the data provided by Quantonomics are presented in Table 1 below.

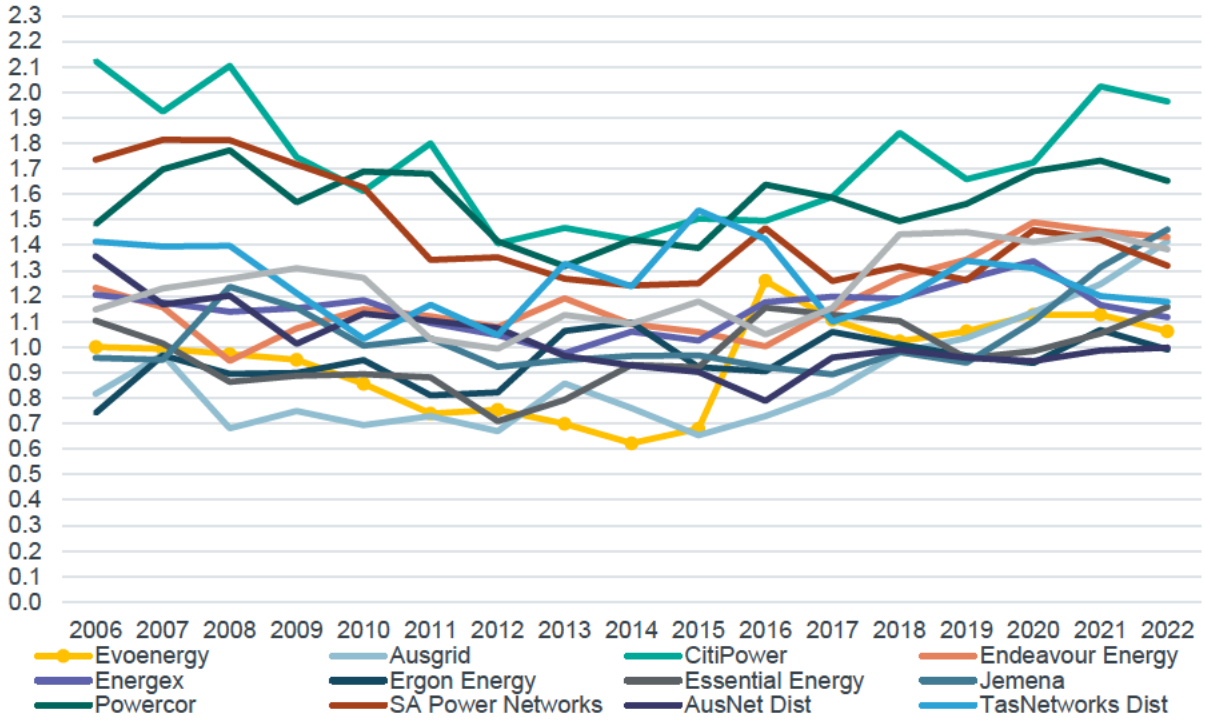
Table 1 Output weights – standard opex

	Energy Delivered	Customer Numbers	Circuit Length	RM Demand
Original weights (2006-2018 data)	8.58%	18.52%	39.14%	33.76%
Revised weights (revised 2006-22 data)	6.54%	19.06%	29.16%	45.24%

Source: Frontier Economics analysis

Revised estimates of Opex MPFP scores are illustrated below in Figure 1. Using the revised output weights, Evoenergy is ranked 11th in 2022 with a score of 54 per cent. By contrast, in Quantonomics' draft analysis, Evoenergy is ranked 13th in 2022 with a score of 53 per cent.

Figure 1 Opex MPFP scores, revised output weights



Source: Frontier Economics analysis

Issue 2 – MPFP/MTFP analysis has not been presented for Option 5 opex

Evoenergy notes that, in contrast to the econometric benchmarking analysis, Quantonomics has only undertaken the MPFP/MTFP index analysis for the standard definition of network services opex, and not for the AER's final decision to calculate opex for benchmarking inclusive of capitalised overheads. We see no valid reason for not undertaking the MPFP/MTFP index analysis using the AER's preference to adopt its Option 5 definition of opex. While to some extent the capitalised corporate overheads may appear both in the opex and the capital cost, it is crucial that the opex measure is consistent across benchmarking models, especially given the AER's reliance on these models to assess regulatory determinations. Further, we note that the impact on efficiency calculations of changes in the annual user cost of capital input used to derive the total MTFP and capital MPFP is highly immaterial compared with the impact of including capitalised corporate overheads into the opex benchmark series and opex MTFP.

If the AER's final decision to include capitalised corporate overheads in the benchmark opex series is used to derive the output weights, the revised output weights shown in Table 2 below are obtained.

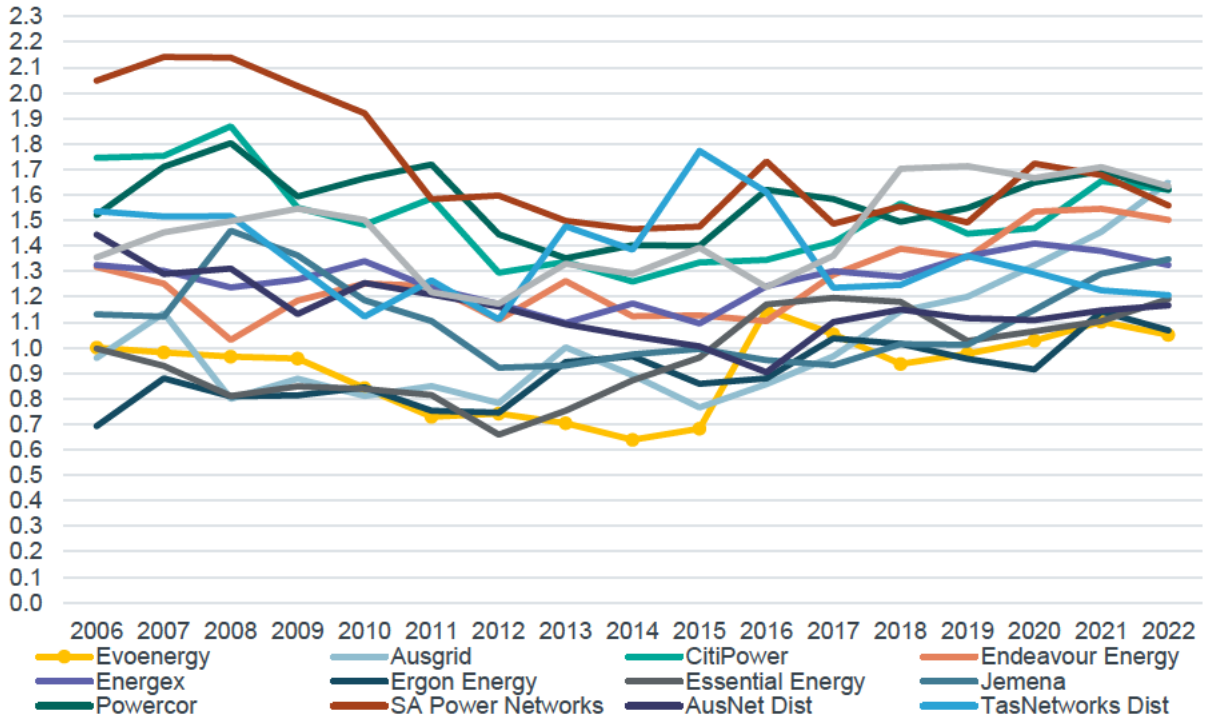
Table 2 Output weights – Option 5 opex

	Energy Delivered	Customer Numbers	Circuit Length	RM Demand
Original weights (2006-2018 data)	8.58%	18.52%	39.14%	33.76%
Revised weights (revised 2006-22 data)	7.69%	15.07%	27.51%	49.73%

Source: Frontier Economics analysis

Revised estimates of opex MPFP scores are illustrated below in Figure 2. Using the revised output weights and opex data inclusive of capitalised corporate overheads, Evoenergy is ranked 12th in 2022 with a score of 64 per cent, a materially different efficiency score compared with the Quantonomics report.

Figure 2 Opex MPFP scores, using Option 5 opex and revised output weights

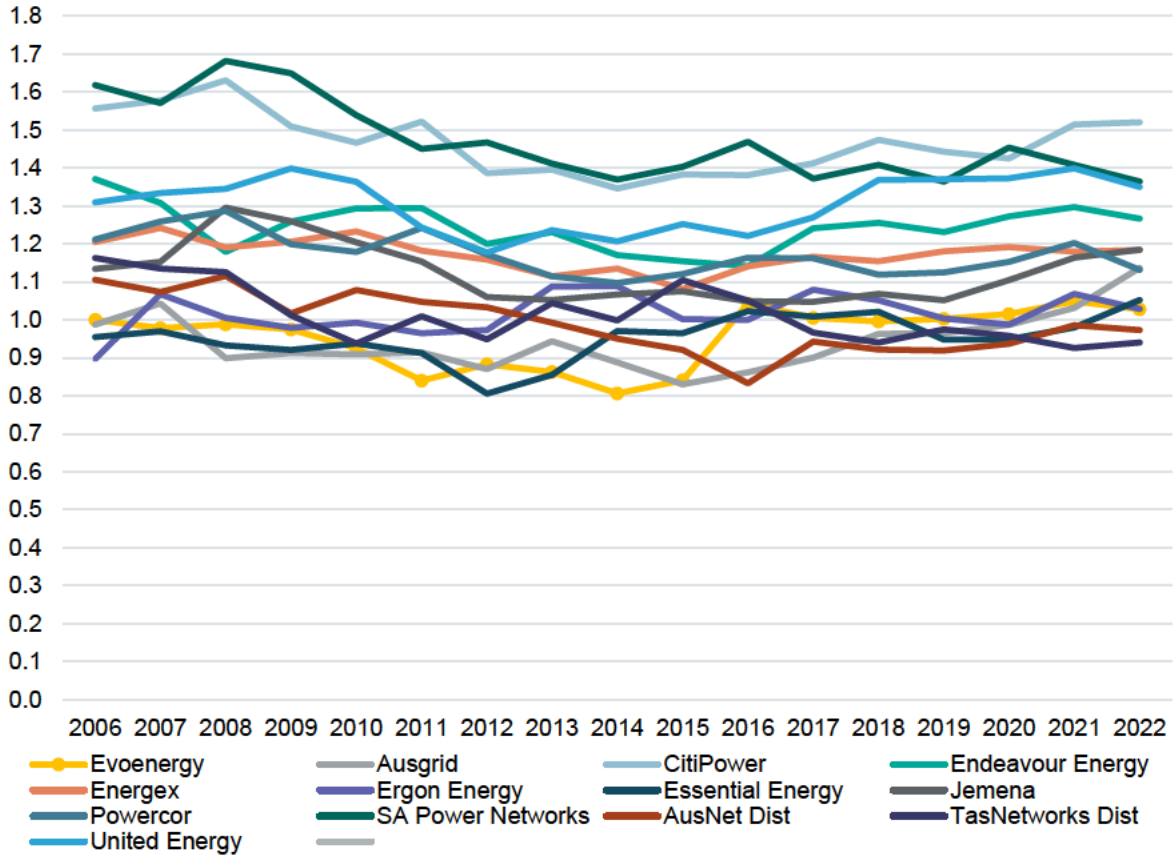


Source: Frontier Economics analysis

Interestingly, there is a significant convergence in opex MPFP scores over the benchmarking period, which is more pronounced when the analysis is adjusted for the AER's final decision to address differences in capitalisation of corporate overheads and updating the output weights for data revisions.

Revised estimates of the total MTFP scores are illustrated below in Figure 3**Error! Reference source not found.**. Using the revised output weights, Evoenergy is ranked 9th in 2022 with a score of 67 per cent.

Figure 3 Total MTFP scores, using Option 5 opex and revised output weights



Source: Frontier Economics analysis

Econometric cost function models

The draft Quantonomics benchmarking analysis report for 2023 presents the results for two different approaches to measuring opex. The first approach, referred as the 'Standard' approach uses the same methodology for calculating opex as in the 2022 benchmarking report and earlier reports. In the second approach, referred to as 'Option 5':

> "…. opex is defined to include all corporate overheads expenditure (including capitalised corporate overheads) and DNSPs' 2022 cost allocation methods (CAMs) are used instead of 2014 CAMs. This is consistent with the findings of the AER's Final Guidance

Note (2023) on how it will address differences in DNSP capitalisation practices in the benchmarking framework."[3]

Evoenergy has identified several issues with the current econometric approach, which should be addressed, including:

1. The Cobb-Doublas models are mis-specified;
2. Time trends are mis-specified; and
3. Estimation of the (short) SFA translog model has identified a local rather than the global maximum of the log likelihood function.

Each issue is detailed in the following section.

Issue 1 – The Cobb-Douglas models are mis-specified

Quantonomics undertakes a statistical test of the Cobb-Douglas specification versus the Translog model specification. The Cobb-Douglas specification is a special case of the Translog specification with a less flexible functional form. The null hypothesis for this test is that the restrictions imposed on the Translog model to obtain the Cobb-Douglas are consistent with the data.

Quantonomics presents the results of this test for the Standard approach to opex in Appendices C.1 and C.4 of the draft report, and notes that the Cobb-Douglas simplification of the Translog model is rejected in all cases. Though not reported in the draft report, the supporting files for the draft report show that the same applies when the Option 5 definition of opex is used. The results are summarised in Table 3.

Table 3 Adequacy of the Cobb-Douglas model versus the Translog model – probability values

	Standard approach opex Long sample	Standard approach opex Short sample	Option 5 opex Long sample	Option 5 opex Short sample
LSE CD vs TLG	0.0000	0.0000	0.0000	0.0000
SFA CD v TLG	0.0047	0.0001	0.0005	0.0000

Source: Frontier Economics analysis of results in supporting files for Quantonomics' 2023 DNSP draft benchmarking report.
Note: The probability value (p-value) is the probability that the estimated parameters in the Translog model are consistent with a Cobb-Douglas cost function. The null hypothesis that the data is consistent with the Cobb-Douglas simplification of the Translog specification is rejected if the p-value is smaller than the chosen significance level, which is usually taken to be 0.05. The p-values in this table are far smaller than any commonly used level of significance.

[3] Quantonomics, *Economic Benchmarking Results for the Australian Energy Regulator's 2023 DNSP Annual Benchmarking Report DRAFT*, 17 August 2023, p. 5

Table 3 shows that the hypothesis that the data is consistent with the Cobb-Douglas simplification of the Translog opex cost function specification is very soundly rejected in all cases. This indicates that the Cobb-Douglas model is seriously mis-specified and that the Translog model, which allows for more flexibility in the specification of the output elasticities, fits the data significantly better than the Cobb-Douglas model. In view of this, it is difficult to find a statistical justification for including estimates derived from the Cobb-Douglas models in the assessment of the efficiency of the DNSPs. However, Quantonomics always includes the results of the Cobb-Douglas models in its assessment of DNSPs' efficiencies despite the models being mis-specified from a statistical point of view.

However, a criterion of adequate performance that Quantonomics does apply is that an estimated model must satisfy the principle that an increase in any output results in an increase in opex. Any violation of this principle is called a monotonicity violation.

The Cobb-Douglas models impose constant output elasticities across all DNSPs and time periods, and the estimated models always satisfy this criterion. For the Translog models the elasticities depend on the level of the outputs and they differ across DNSPs and time periods. Quantonomics notes that for the latest Translog models:[4]

> "These results represent a significant deterioration in the monotonicity performance of the Translog models in the long sample period when compared to the results reported in 2022 and 2021."

Quantonomics also notes that:

> "The monotonicity results obtained using the shorter period from 2012 to 2022 also represent a deterioration compared to the results obtained for the shorter sample period in the previous reports."[5]

Quantonomics does not include the results of a Translog model in its calculation of the average efficiency score for a DNSP if more than half the observations for that DNSP have a monotonicity violation.

For Evoenergy, the results of the following Translog LSE models are excluded from the calculation of its average efficiency scores:

- Short sample Standard opex definition – SFA Translog
- Long sample Standard opex definition – none are excluded
- Short sample Option 5 opex definition – both the LSE and SFA Translogs
- Long sample Option 5 opex definition – none are excluded.

[4] Quantonomics, *Economic Benchmarking Results for the Australian Energy Regulator's 2023 DNSP Annual Benchmarking Report DRAFT*, 17 August 2023, p. 32
[5] Quantonomics, *Economic Benchmarking Results for the Australian Energy Regulator's 2023 DNSP Annual Benchmarking Report DRAFT*, 17 August 2023, p. 33

Indeed, for the short sample with the Option 5 opex definition, both the both the LSE and SFA Translogs are excluded for all DNSPs because there are excessive monotonicity violations for more than half the DNSPs. The leads to the dilemma that the efficiency score calculations in this case are based solely on the Cobb-Douglas model estimates, which are seriously mis-specified.

Issue 2 – Time trends are mis-specified

Inspection of the opex MPFP results in the 2023 draft reports shows that, overall, opex productivity of the Australian DNSPs has been increasing since about 2014. This increase in productivity is most likely due to increased efficiency resulting from the AER's regulatory efforts, including the application of economic benchmarking. As far as we are aware, regulators in the other jurisdictions in the dataset have not had the same focus on opex efficiency.

There is no variable in the econometric benchmarking models that captures this improvement in opex efficiency in the Australian DNSPs. To gain some insight into the potential divergence in the efficiencies between jurisdictions, minor extensions of the Cobb-Douglas and Translog models have been estimated, allowing allow the time trends in the models to be different for the three jurisdictions.

These models fit the data significantly better than Quantonomics' models, which impose the same trend for all three jurisdictions. For all eight models, the specification with the two additional variables (interactions between the year and the two jurisdiction dummies) perform statistically significantly better, with Chi-square statistics ranging from 42-90 (LSE models) to 145-338 (SFA models). These are all significant, with p values of 0.0000.

This provides strong evidence that all of Quantonomics' econometrics models (i.e., the Cobb-Douglas and the Translog models), are seriously mis-specified. These extended models produce estimated elasticities that, at times, are vastly different to Quantonomics' models. For some models, the monotonicity properties are also much better than the corresponding Quantonomics models.

It is important to note that, although the extended models fit the data much better than Quantonomics' models, they do not capture the increase in opex efficiency of the Australian DNSPs appropriately, since they ascribe this improvement in efficiency to a gain in productivity rather than an increase in efficiency. A gain in productivity is a long-term small trend due to industry-wide changes in technology and practices that impact utilities internationally. By contrast, the fairly dramatic improvement in opex achieved by the Australian DNSPs is a shorter-term response to the AER's efforts to improve efficiency that is specific to the Australian DNSPs and that are unlikely to be sustainable at the same level in the long term.

Capturing the recent improvement in opex efficiency of the Australian DNSPs appropriately in the econometric benchmarking models requires a different approach that is more difficult to implement than the extended models mentioned above. Given the limited time available, the extended models have been specified primarily to establish that the Australian industry has diverged from the other jurisdictions in the sample with respect to opex expenditure, while recognising that these models do not ascribe this divergence properly to a gain in efficiency. Hence, we do not recommend using these extended models in their current form. Rather, what

the analysis shows is that there are serious weaknesses in Quantonomics' models in that they do not allow for the Australian DNSPs to diverge from the other jurisdictions in terms of opex expenditure over time, when there is clear evidence that this has been the case. This is likely to seriously bias the parameter estimates in the model, in particular the estimates of the output elasticities, since, for each DNSP, the outputs are closely correlated with the time trend. This casts strong doubt on the suitability of Quantonomics' models for regulatory purposes in their current form. As such, further model development is needed to produce model specifications that adequately capture the trend in opex efficiency improvement that has occurred in the Australian DNSPs over the last decade.

Issue 3 – Estimation of the (short) SFA Translog model has identified a local rather than the global maximum of the log likelihood function

While the LSE models are straightforward to estimate, in that the estimates can be directly calculated, the SFA models are more challenging to estimate as the estimation involves starting at a specified starting point and searching for a better fit, and stopping when a better fit cannot be found. With such estimators there is a risk that the solution provided is a local maximum rather than a global maximum: the estimates derived are not the best estimates. We have found that the SFA-TL estimates for the short sample as estimated by Quantonomics, in fact the fit is improved substantially, the log-likelihood increasing from 485.6 to 500.8.

The estimates are however unusual, with all Australian DNSPs failing monotonicity for customer numbers for all years. Moreover, the efficiency estimates are incompatible with previous results, with very low estimates for several DNSPs including United Energy at 19 per cent. The results are presented in Table 4.

Table 4 Efficiency estimates – SFA TLG short sample

DNSP	Quantonomics	Corrected
Evoenergy	51.8%	46.3%
Ausgrid	37.9%	3.2%
CitiPower	76.7%	36.7%
Endeavour Energy	58.7%	13.6%
Energex	48.6%	7.5%
Ergon Energy	72.0%	82.5%
Essential Energy	80.9%	96.3%
Jemena	54.8%	32.7%
Powercor	93.4%	58.0%

SA Power Networks	90.2%	56.6%
AusNet Dist	64.4%	37.6%
TasNetworks Dist	94.3%	96.6%
United Energy	66.8%	19.3%

Source: Frontier Economics analysis

While this model would not be used due to monotonicity violations, the results as presented by Quantonomics should not be relied upon as they are not the correct estimates. Moreover, these results raise concerns as to misspecification of SFA TLG models. The absurd efficiency estimates arise due to the negative mu estimated for the inefficiency term.