Analysis supporting Ausgrid's, Evoenergy's and Jemena's submission to the Australian Energy Regulator's review of its approach to forecasting operating expenditure

20 December 2018

Ausgrid, Evoenergy and Jemena

FINAL REPORT

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EXECUTIVE SUMMARY

Ausgrid, Evoenergy and Jemena have engaged Cambridge Economic Policy Associates (CEPA) to undertake analysis to support their submission to the Australian Energy Regulator's (AER's) draft decision paper on 'Forecasting productivity growth for electricity distributors' (hereafter referred to as the 'Draft Decision Paper').

Electricity Distribution Network Service Providers (DNSPs) are expected to make ongoing efficiency improvements that reflect achievable frontier shift, for example by adopting new technology and working practices. This is a key premise of incentive regulation.

The AER currently rejects the use of the negative 'productivity' estimate derived from the econometric models, i.e., the positive coefficient on a time trend variable, for forecasting operating expenditure (opex). Instead, it has set productivity changes to opex forecast to zero. We consider that it is important to note that a positive time trend (i.e., increasing opex over time) does not necessarily mean that the DNSPs are not achieving productivity gains, particularly in the context that DNSPs are incentivised to achieve opex savings. The econometric models are restricted to a narrow set of output measures and do not incorporate any adjustments for quality of service. Therefore, the positive time trend may reflect changes in outputs and/ or quality not adequately captured in the models.

Review of Draft Decision Paper options

We support the AER's proposition of using multiple sources of data rather than relying on a single model/ estimate for frontier shift, and this approach is consistent with regulatory practices in other jurisdictions. However, we have concerns with the applicability of some of the sources/ estimates set out in the Draft Decision Paper. Our main concerns are that:

- The AER's recent (November 2018) econometric models, using only 2012-17 data, indicate that DNSPs' opex needed to increase to deliver the outputs used to drive the AER's opex forecasts (the DNSPs were incentivised to reduce opex over this period).[1] Introducing an external productivity challenge, not captured in the econometric models, and therefore not aligned with the outputs used to drive the opex forecasts, increases regulatory risk.[2] This risk is higher for those DNSPs for which the AER makes a catch-up efficiency adjustment as the catch-up adjustments are only based on the outputs used in the econometric modelling.
- The gas networks' opex productivity results in the reports cited by the AER have a number of statistically insignificant coefficients on the time variable (i.e., the coefficients are not statistically significantly different from zero). Taking this information into account indicates a range of 0% to 0.7%, after taking account of results, rather than the AER's interpretation of around 0.5%.[3]

[1] Economic Insights (2018), pages 20-21. The coefficients on the time variable in the models using the 2012-17 data range from 1.5 to 1.8, which are similar to those using the longer data set, 1.8 to 1.9.

[2] As the AER noted in AER (2013), page 179, As the AER noted in 2012, "*The econometric cost modelling offers a more coherent approach to forecasting opex escalation as it explicitly models input price changes, output growth and efficiency and productivity gains as cost drivers. By jointly accounting for the change in these factors, it* ***mitigates the risk of double counting*** *or* ***inappropriately accommodating the drivers of the rate of change in opex***." [Emphasis added]

[3] We also note that the underlying choice of variables in the gas networks modelling is different to the electricity sector, with the specifications in the reports cited by the AER including the regulatory asset base (RAB) as a variable. If it were also included in the DSNPs econometric modelling it would likely have a significant impact on the results.

- Undergrounding is not a productivity driver. Undergrounding is undertaken for a variety of reasons, and in recent years largely in response to regulatory requirements. Using the average growth rate across all DNSPs to set a frontier shift target would set perverse incentives for the DNSPs to achieve a certain level of undergrounding regardless of whether it was prudent or efficient.
- The AER proposes using the opex multilateral partial factor productivity (MPFP) estimates only for the period 2012-2016. The approach of using such a short time period is not consistent with best practice in productivity studies, and in particular we note that:
    - the DNSPs' 2012 opex is an outlier (the AER's own review of opex during this period indicates a substantial amount of opex due to 'one-off' events);
    - the DNSPs' reported opex performance, including the upper quartile performers, can be affected by capitalisation which is not related to frontier shift or catch-up efficiency;
    - the AER's econometric modelling of the 2012-17 period indicates that opex has been increasing over time in contrast to the AER's interpretation of MPFP change based on the 'not inefficient DNSPs';
    - the 'not materially inefficient' DNSPs' year-on-year efficiency results do not appear to be solely down to frontier shift (i.e., we do not consider negative frontier shift and frontier shift of 7.7% per annum are plausible indicators of future frontier shift);[4] and
    - as average annual growth rates are only dependent on the start and end points of a period, the AER could assess the extent to which 2006 opex is affected by new regulatory obligations it has cited, and whether 2006 and the most recent RIN opex data is affected by catch-up, capitalisation practices, and/ or one-off costs (using 2006 as the start point and the most recent year available would give the AER a much longer time-series to estimate frontier shift over).
- The AER relies on ABS productivity data for 2012 to 2017. However, ABS data should only be considered on the basis of full productivity cycles or a very long time period. This minimises the influence of temporary effects (such as underutilisation of capacity) that can occur. This means that the estimates from only the 2012 to 2017 period should be excluded as they are based on an incomplete cycle. In addition, we do not consider that the utilities sector estimates should be used due to issues with the make-up of the sector (i.e., that it includes the DNSPs and other regulated networks, and therefore may capture catch-up efficiency, and state-owned companies that may not face the same pressures to achieve productivity gains).

Therefore, from the AER's options we believe only the 'status quo' and the gas networks' productivity estimates (after adjusting the range to reflect insignificant coefficients) should remain sources of evidence and these estimates do not support the AER's Option 6 estimate of 1%.

[4] We do not consider that choosing 'upper quartile' performance only would correct for the underlying issues identified with the MPFP analysis of 2012 to 2016.

Proposed additional/ alternative options

We have undertaken research and analysis in order to provide the AER with alternative sources of evidence to replace, or improve, some of the AER's options. This includes:

- Developing an alternative (unweighted) labour productivity estimate using sectors that are less susceptible to the issues captured in the ABS' utilities sector. [5]
- Estimating labour + intermediate inputs productivity. This approach provides a better indicator of opex productivity as it takes account of the non-labour (e.g., materials and services input changes) element of opex, which addresses Consumer Challenge Panel (CCP) concerns with the AER's adjustment to labour productivity to only cover the labour proportion of opex.[6]
- Reviewing regulatory precedent from Australia and internationally.

We consider that the latter two approaches offer an improvement over the AER's Option 5.

We estimated the unweighted average of labour productivity across five sectors – construction; financial and insurance services; rental, hiring and real estate services; professional, scientific and technical services; and administrative support. We chose these sectors as they carry out similar individual activities to the DNSPs, and our choices are consistent with regulators' decisions in other jurisdictions using the same type of analysis. We estimated the unweighted average over the following periods:

- 2003/04 to 2011/12. The most recently completed multifactor regulatory cycle (as estimated by the ABS).
- 1998/99 to 2011/12. The two complete cycles in the ABS' estimates.
- 1989/90 to 2016/17. The entire time period available from the ABS.

This analysis indicates, after adjusting for the labour proportion of opex, a range for opex productivity of 0.3% to 0.7%. This range covers both an unweighted average across all five sectors and an unweighted average across four sectors excluding 'rental, hiring and real estate services'. We calculated the latter as we have concerns about the influence of the housing market fluctuations on this sector.

Results from the labour productivity estimate are supported by our analysis of labour + intermediate inputs productivity, which indicates an opex productivity range of 0.3% to 0.5% over the same sectors and time periods (although the entire time period available is shorter and covers 1994/95 to 2015/16).[7] It is important to note that these productivity levels were achieved with capital investment, and further opex productivity growth will likely continue to need capital investments. In addition, the lower result for labour + intermediate inputs productivity is evidence that the labour productivity estimate should not be expanded to cover all of opex as increases in intermediate inputs are driving the increases in labour productivity.

[5] This approach is in line with that adopted in overseas jurisdictions, see for example, Ofgem (2012), CEPA (2012). Due to differences in ABS' categorisations and sectors our overall selection differs.

[6] CCP (2018).

[7] While we do not advocate using the utilities sector's labour + intermediate inputs productivity, we note that it is negative across all of the time periods we assessed.

Recent precedent from the Australian water sector indicates a frontier shift only estimate of 0.25%.[8] We have excluded estimates from states where frontier shift and catch-up have not been separated. We also undertook a review of international precedent; however, we think the international evidence can be excluded as a source of information at this stage. This is because the AER has a several Australian sources to rely on and only using Australian data avoids further inconsistencies due to differences across countries in, for example, working conditions, input prices, and wages.[9]

In the table below, we summarise our alternative sources of information/ approaches that could supplement/ replace the AER's individual estimate options.

Table ES.1: Summary of estimates

Approaches	Proposed estimates/ ranges
Status quo – Zero productivity growth	0%
Gas networks' productivity	0%-0.7%
Labour productivity, adjusted for labour proportion of opex (selected sectors)	0.3% - 0.7%
Labour + intermediate inputs productivity (selected sectors)	0.3% - 0.5%
Regulatory (water) precedent (Australia)	0.25%
'Holistic' range	**0% - 0.7%**

Source: AER, CEPA analysis

This suggests a 'holistic' range across the measures of 0% to 0.7%. The inconsistency between these measures and the econometric modelling output coefficients used to forecast opex means the AER needs to apply caution in selecting from this range. In other words, it may be more appropriate to select from the lower end of the range in order to reflect the greater risks associated with setting the measure towards the upper end of the range. It is also important to note that these measures take account of changes in capital (e.g., investment in information communication technology (ICT)) therefore the AER should not make further adjustment for opex improvements from these investments as this would double count the efficiencies from the investment. Additionally, the AER will need to allow for capital expenditure (capex) that drives opex productivity otherwise the DNSPs may not be able to achieve these targets.

In addition, as noted above, the econometric results do not mean that the DNSPs have not been achieving frontier shift, rather it may reflect that the AERs' output measures are insufficient to capture DNSPs' activity drivers and changes in service quality. If the AER does apply an 'external' frontier shift target, in addition to adopting a cautious approach when selecting the frontier shift target, it will also need to allow for step-changes in the DNSPs' opex allowances to deal with changes in service requirements that are not captured by the output measures. For example, dealing with varying and greater penetration of distributed energy resources (DER) can increase DNSP's opex.[10]

[8] We have excluded recent decisions from other state regulators as frontier shift and catch-up were not clearly separated.

[9] The use of international data would be more applicable if there were insufficient sources of Australian based evidence. The international data we reviewed indicated a range between 0% and 1.1% (although the upper end was for total expenditure (totex) and not solely opex).

[10] The current model specifications do not have explicit explanatory factors to capture these changes, instead these increases in opex over time are likely to be captured largely in the time trend coefficient. If this coefficient is replaced by an external estimate, then these increasing costs are not taken into account in the AER's opex forecast allowances.

1. INTRODUCTION

Ausgrid, Evoenergy and Jemena have engaged Cambridge Economic Policy Associates (CEPA) to undertake analysis to support their submission to the Australian Energy Regulator's (AER's) draft decision paper on 'Forecasting productivity growth for electricity distributors' (hereafter referred to as the 'Draft Decision Paper').

Electricity Distribution Network Service Providers (DNSPs) are expected to make ongoing efficiency improvements that reflect achievable frontier shift, for example by adopting new technology and working practices. This is a key premise of incentive regulation.

1.1. HOW IS FRONTIER SHIFT COMMONLY SET FOR REGULATED COMPANIES?

In developing a view of the scope for ongoing efficiency of regulated networks a variety of approaches can be and have been used by regulators in Australia and other jurisdictions. These approaches can generally be categorised into the following:

- **Indirect comparisons.** Where estimates from other sectors are used, for example assessment of historical productivity growth or cost trends for selected sectors of the Australian economy or other regulated industries. Comparator industries can be selected on the basis of undertaking comparable activities (e.g., using similar skilled labour, carrying out administration tasks, etc) to those of regulated companies. Ideally comparator sectors should be chosen with a large share of privatised companies as this ownership type is likely to face greater pressure (e.g., through the threat of bankruptcy) to achieve efficiency gains than state-owned companies.
- **Within sector comparisons**. This relies on using historical productivity growth or cost trends from within the regulated industry. This approach does risk embedding regulated companies' historical productivity, which may reflect poor productivity performance or be misleading due to capturing catch-up efficiency, and as such has been avoided by a number of regulators in other jurisdictions, particularly when historical productivity has been low.
- **International comparisons.** This involves the use of data/ productivity estimates from regulated companies in the same sector, or similar sectors, in other countries. However, because of differences in local conditions across countries, this type of comparison is more applicable when robust local evidence is not available.

There are advantages and disadvantages to each of the approaches listed above, and in our experience, as has been proposed by the AER, looking at a range of measures helps to build a picture of achievable opex productivity. For further discussions on the different measures that could be used please refer to CEPA (2003), ACCC/AER (2012), and AEMC (2013). As noted by the AER in the Draft Decision Paper (page 18), opex productivity is not something that national statistical agencies measure and therefore careful consideration is needed of how estimates from these sources might apply to DNSPs' opex.

1.2. THE STRUCTURE OF THIS PAPER

We agree with the statements made by the AER on in its Draft Decision Paper, on page 10, that:

- Productivity growth is achieved over the medium to long-term.
- Consistency between the output measures (and modelling) and productivity growth is important.

We cover the above points, and present additional information on frontier shift, in the remainder of this report based on the following structure:

- In **Section 2**, we consider the **consistency between the AER's output measures (and modelling) and the use of 'other' productivity estimates**. In this section, we discuss:
    - the issues with introducing an 'external' productivity estimate that has not been captured in the econometric models, which reflects the DNSPs' incentivised opex performance;
    - the risks of setting an 'external' productivity adjustment for all DNSPs based on their relative efficiency;
    - the effect of other 'inputs' on the productivity measures;
    - the use of undergrounding as a 'productivity' driver; and
    - the use of gas networks' productivity estimates.
- In **Section 3**, we consider the choice of **time period** used to determine average annual productivity change and its impact on the different metrics presented in the AER's paper – labour productivity and the MPFP measure. We then consider AER's approach to **separating frontier shift and catch-up** in its MPFP analysis.
- In **Section 4** we present our alternative approach to developing a productivity estimate, based on our experience in other jurisdictions. We also set out a range of regulatory precedents to provide a cross-check.
- In **Appendix A** we provide responses to the AER's questions set out in the Draft Decision Paper.

As our conclusions are summarised at the beginning of each section and in the Executive Summary, we do not have a standalone 'Conclusions' section.

2. CONSISTENCY BETWEEN OUTPUT MEASURES AND PRODUCTIVITY GROWTH

Summary

In this section, we set out some of the risks of introducing an external measure of productivity growth, in particular on frontier versus non-frontier companies. We also discuss the use of the undergrounding coefficient and the gas networks' productivity estimate(s).

Introducing an 'external' productivity challenge

The AER forecasts opex allowances using the same output drivers used in its econometric models. Using a productivity estimate that differs from what was estimated in the econometric models creates inconsistency in the different elements that make up the opex forecasts. The AER needs to consider the impact of this inconsistency given that the econometric models are estimating a positive time trend coefficient.

In addition, the risk created by this inconsistency is increased for those DNSPs that the AER also applies a catch-up efficiency adjustment to. This is because the catch-up efficiency adjustment is also based on econometric modelling results which rely on the specific set of output measures.

We also note that the DNSPs shareholders' benefit from a reduction in opex, and this incentive is intended to lead to a lower base level of opex for future regulatory periods. If the DNSPs' opex is increasing it either reflects the fact that the output measures are inadequate to identify the productivity gains, the DNSPs have not been able to identify productivity gains, or the incentives are too weak to encourage DNSPs to make reductions. Given commentary from the AER and infrastructure investors the first seems the most plausible.

If the AER does apply an 'external' frontier shift target, in addition to applying caution in selecting the target to reflect the inconsistencies, it may also need to allow for 'step-changes' in the DNSPs' opex allowances to deal with changes in service requirements that are not captured by the output drivers, for example dealing with greater penetration of DER.

Undergrounding

While undergrounding may lead to lower opex we do not consider this as opex productivity. As the AER points out this is a 'business condition explanatory variable' and should not be considered as a driver of opex productivity.

In addition, given that undergrounding is done for a variety of reasons across the networks and the historical rate of undergrounding varies materially across the DNSPs, using the average historical rate of undergrounding is not appropriate. Using the historical average across all DNSPs implies that all DNSPs need to achieve at least the historical average rate of underground going forward in order to achieve the proposed 0.5% productivity growth. This does not seem prudent or efficient as the DNSPs will almost certainly face different undergrounding requirements going forward than the historical industry average annual change.

Gas networks productivity estimates

The estimates cited by the AER are from consultants commissioned by gas networks. The AER does not have access to the underlying data, nor has it tested its own specifications. Further consideration should be given to their applicability to the activities undertaken by the DNSPs. For example, we note that the consultants' model specifications contain a capital inputs measure (the networks' regulatory asset base (RAB)) which the AER does not include in its DNSPs econometric modelling.

In addition, we note that a number of the estimates cited by the AER from the consultants' reports are not statistically different from zero. This means that the range of productivity growth in the gas networks sector, as estimated by the consultants, is more accurately represented as 0% to 0.7%, rather than around the 0.5% noted by the AER.

Notwithstanding these points, we consider that the gas networks sector's productivity range of 0% to 0.7% can provide another reference point for the DNSPs achievable productivity.

2.1. INTRODUCING AN 'EXTERNAL' PRODUCTIVITY CHALLENGE

2.1.1. Consistency between opex forecasting and productivity estimates

As the AER mentioned in its 2013 Explanatory Statement:

> *"The econometric cost modelling offers a more coherent approach to forecasting opex escalation as it explicitly models input price changes, output growth and efficiency and productivity gains as cost drivers. By jointly accounting for the change in these factors, it* ***mitigates the risk of double counting*** *or* ***inappropriately accommodating the drivers of the rate of change in opex****."*[11] *[Emphasis added]*

The AER, as stated in its Draft Decision Paper, chose not to implement the 'negative' productivity that was being estimated in the econometric model(s) as it was not satisfied that the estimate reflected 'business as usual' conditions.[12] As discussed above, the AER noted that this was due to new regulatory obligations that the DNSPs had to meet and these obligations increased opex, but without a significant change in outputs. This is an important point; opex increased but the measures that the AER used for outputs (included one for quality based on customer minutes lost) did not change to the same extent.

The fact that the econometric modelling estimates a positive time trend, across the 2006 to 2016 and the 2012-2017 periods, does not mean that the networks are not achieving productivity gains. It only means that based on the unadjusted opex (unadjusted for one-off costs, capitalisation, changes in regulation, etc), outputs and quality adjustment the AER uses in its modelling, opex increased for the DNSPs over time. Within this measure the DNSPs could have faced increased costs from, for example, the aforementioned regulatory obligations cited by the AER, or the changing nature of its services and operations (e.g., increased penetration of solar and batteries in its networks, improved quality of services, etc). A positive time trend is not an unusual result if the model specification and adjustments for input prices do not fully reflect the cost pressures on the regulated companies. For example, we estimated a positive time trend in some of the econometric cost assessment modelling we undertook for Ofwat, and we noted that:

> *"The time trend variable in all the econometric models accounts for the frontier shift, RPEs [Real Price Effects] and changes in quality not captured via the other variables in the model. A positive time trend indicates that the improvement in technology which would lead to savings had been outweighed by RPEs or increases in quality that the industry has paid for. A negative time trend indicates that gains in ongoing efficiency outweigh the other two factors put together."*[13]

There is a limited range of output measures available to the AER to use and we do not wish to dive too far into this debate for the purposes of this report. However, recent changes in consumers' behaviour (e.g., increased energy efficiency, uptake of solar/ batteries) and the need for DNSPs to respond to these, and other changes, affect outputs and opex. These impacts may not be adequately accounted for in the MPFP or econometric modelling, and therefore they would be captured in part as negative productivity by the former and as a positive coefficient on the time trend by the latter.

[11] AER (2013), page 179.

[12] Draft Decision Paper, page 10.

[13] CEPA (2014), page 37.

The use of an external source for the productivity estimate which is inconsistent with the outputs used to forecast opex and the econometric modelling creates the risk of setting an inappropriate productivity target.

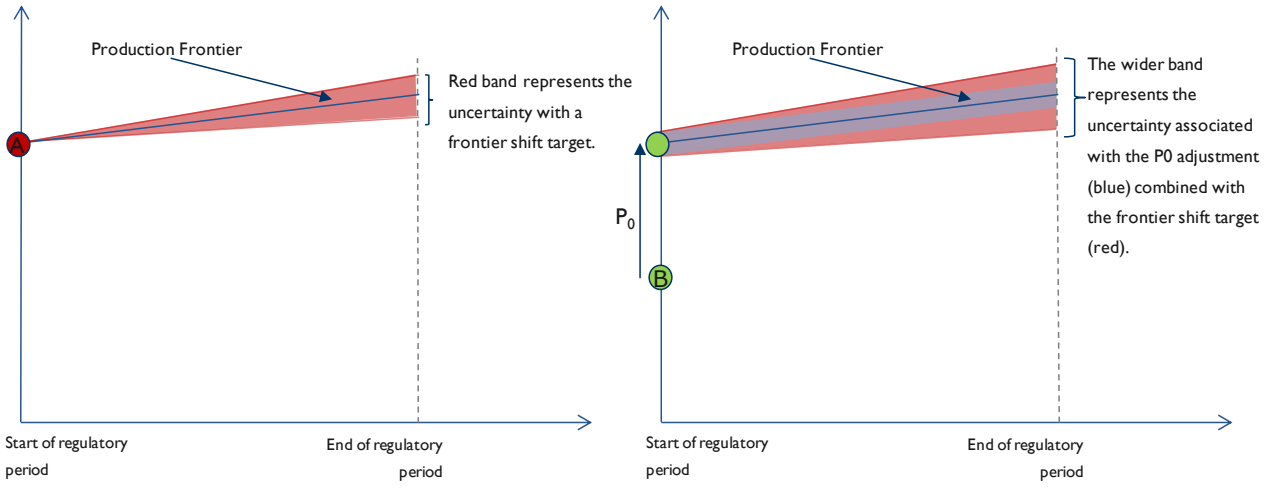
If the AER does apply an 'external' frontier shift target it, in addition to applying caution in selecting the target to reflect the inconsistencies, it may need to allow for 'step-changes' in the DNSPs' opex allowances to deal with changes in service requirements that are not captured by the output drivers, for example dealing with a greater penetration of DER.

2.1.2. Implication of DNSPs' position relative to the frontier

In addition to the risk of setting the frontier shift at an unachievable level, there is also an interaction with the AER's application of catch-up efficiency which the AER should consider.

In the figure below, we illustrate the risk implications of setting a frontier shift target from a frontier DNSP ('A') versus that of a DNSP that is not at the frontier ('B') and for which the AER applies an initial catch-up efficiency (P_0) adjustment.

Figure 2.1: Illustration of risk (uncertainty) with a frontier shift or a frontier shift and catch-up adjustment



Source: CEPA

On the left-hand panel of the figure, we illustrate the uncertainty associated with a frontier shift target. We assume that the risk is symmetrical, i.e., the AER could set the target too high or too low. As the frontier firm does not face a P_0 adjustment the only uncertainty it faces is around the frontier shift (the red band). In contrast (illustrated in right-hand panel of the figure), a DNSP that is set both a catch-up efficiency and a frontier shift challenge faces greater risk that the opex target for the end of the regulatory period is set at an unachievable level (the uncertainty around the P_0 target is represented by the blue band).

This risk increases further if opex productivity targets are set based on outputs that are not used in the econometric modelling. This is particularly a concern as, as we note in Section 3.3.3, the econometric modelling based on a data set covering 2012-2017 has a positive coefficient on the time variable indicating that costs are increasing relative to outputs over this period.

Therefore, DNSPs for which the AER makes an adjustment to opex allowance for catch-up efficiency face a greater risk that is not compensated for elsewhere in the regulatory framework. The AER should consider this increased risk to certain DNSPs as part of its decision process.

2.1.3. The effect of opex incentives

The regulatory framework creates incentives for the DNSPs to reduce their expenditure. As the CCP note, the opex benchmark does not affect the incentives on the DNSPs to make productivity improvements.[14] Therefore, the DNSPs have been incentivised to reduce their opex over time. If the DNSPs have not been reducing opex in relation to the output measures the AER uses for its productivity assessment, then this could mean:

- there are other cost pressures not accounted for by the output measures (which may have been allowed by the AER through step-changes);
- there are minimal efficiency savings to be made; and/or
- the incentives are not strong enough and the DNSPs are not responding.

Commentary from the AER and infrastructure investors indicates that the first seems the most plausible.

The DNSPs' attempts to reduce opex in order to gain from the incentives in the building blocks framework are captured in the econometric model, and the coefficient on the time trend reflects this. Even when the pre-2012 years are removed from the model due to the AER's concerns that they contain significant step-changes due to regulatory obligations, the econometric models indicate that DNSPs costs have risen despite the incentives on them to reduce costs. This supports the premise that the models' specifications are not picking up all the cost pressures on DNSPs.

2.2. UNDERGROUNDING

The AER has suggested that the change in the proportion of the network that is undergrounded could lead to 'opex productivity'. While undergrounding may lead to lower opex we do not consider this as opex productivity. As the AER points out, this is a 'business condition explanatory variable' and should not be considered as a driver of opex productivity.[15]

Leaving aside the consideration of whether undergrounding is a driver of opex productivity, the way the AER has proposed to use this seems incongruous with the application of its modelling, i.e. driving opex forecasts using customer numbers, circuit length, and ratcheted maximum demand.[16] Undergrounding is done for a variety of reasons across the networks and the historical rate of undergrounding varies materially across the DNSPs. Using the historical average across all DNSPs implies that all DNSPs need to achieve at least the historical average rate of underground going forward in order to achieve the proposed 0.5% productivity growth. This does not seem prudent or efficient as the DNSPs will almost certainly face different undergrounding requirements going forward than the historical industry average annual change.

[14] CCP (2018), page 9.

[15] Draft Decision Paper, page16.

[16] The AER could use alternative approaches to incorporate underground changes in their forecasts if they were confident that the coefficients from the econometric model reflect the impact of underground on each DNSP's opex. The modelling is undertaken with international data and this could affect the estimate of the coefficients as the dummy variables used in the modelling do not control for changes over time.

2.3. GAS NETWORKS' PRODUCTIVITY ESTIMATES

As we have noted above, using estimates for other sectors is an acceptable approach if the other sector undertakes similar activities to the DNSPs and there is a sufficiently long time period to observe productivity growth.

Broadly, while there will be a number of similar activities across the networks, such as business support, regulatory compliance, etc, DNSPs undertake different activities to the gas networks, for example vegetation management around overhead lines, electrical engineering, etc.

While acknowledging these differences and encouraging the AER to undertake further work in assessing these, in our experience the gas network sector can provide another point of reference for potential productivity growth. On this basis, we consider the AER's proposed approach in the discussion below.

In its Draft Decision Paper, the AER refers to four different sets of gas networks' productivity estimates, based on different output measures. The AER has not undertaken this analysis itself and we understand that the AER does not have the data sets upon which the analysis is conducted. The four sets of estimates referred to in the Draft Decision Paper come from the following reports:

- A 2016 ACIL Allen report prepared for Australian Gas Networks (ACIL Allen, 2016).[17] This report provides two sets of productivity estimates based on models using a single output – customer numbers – and dual outputs – customer numbers and energy throughput. The authors prefer a single output model to a dual output model. The models also include the RAB as a proxy for capital inputs. The authors use a data set of nine companies covering 10 years.
- A 2015 Economic Insights report prepared for Jemena Gas Networks (Economic Insights, 2015).[18] This report provides productivity estimates based on models using two outputs – energy and customer numbers. The models also include the RAB as a proxy for capital inputs. The authors use a data set covering nine Australian gas networks and two New Zealand gas networks. The length of the data set varies by company, but the longest is 1999 to 2014.
- A 2016 Economic Insights report prepared for Multinet Gas (Economic Insights, 2016).[19] This report provides productivity estimates based on models using two outputs – customer numbers and network length – and three outputs – customer numbers, gas throughput, and network length. The authors use a data set covering 11 Australian gas networks and three New Zealand gas networks. The length of the data set varies by company, but the longest is 1999 to 2015.

In ACIL Allen (2016), only one of the 10 coefficients on the time variable is significant at the 90% level (or higher), therefore the null hypothesis that the coefficient (productivity trend) on the time variable is equal to zero cannot be rejected.[20] In other words, the positive coefficient on the time trend cannot be considered to be statistically different from zero. In Economic Insights (2016), four of the nine coefficients

[17] ACIL Allen Consulting (2016).

[18] Economic Insights (2015).

[19] Economic Insights (2016).

[20] ACIL Allen Consulting (2016), Table 4.1, page 21 and Table 4.3, page 22.

on the time variable are not significant at the 10% level.[21] In Economic Insights (2015), both coefficients on the time trends are statistically significant.[22]

This means that the studies cited by the AER indicate a range of 0% to 0.7% (rounded to one decimal place), with a mid-point of 0.35%, opex productivity growth rather than indicating a productivity average closer to 0.5% percent growth.

Interestingly, in almost all these models a material driver of opex costs appears to be the RAB, which is included as a proxy for capital inputs. In other words, as the gas networks increase their RABs their opex also increases. We note that the AER's DNSP econometric modelling does not include a broad measure of the DNSPs' asset base as a proxy for capital services. Given this additional explanatory variable in the gas distribution modelling, the gas networks productivity estimates may be less applicable to the DNSPs and at a minimum the AER needs to consider these implications.

[21] Economic Insights (2016), Table 3.1, page 19.

[22] Economic Insights (2015), Table 5.3, page 47.

3. TIME PERIOD AND FONTIER SHIFT

Summary

Productivity is highly cyclical and measuring it over a short period, on incomplete economic/ business/ productivity cycles can provide misleading results as they do not take account of temporary effects. Common practice (including by regulators in Australia and internationally) supports productivity being measured over at least one complete productivity cycle. When using data from regulated sectors a long period is required, as analysis of economic cycles based on economy-wide data is unlikely to reflect how output is measured in the regulated sectors. While a longer time series can be used, the start- and end-points need to be assessed to determine that they are not outliers (e.g., contain large one-off costs).

ABS productivity cycles

The ABS' most recent productivity release identified the following complete cycles based on its multifactor productivity for the 'measured economy' as a whole:

- 1998/99 to 2003/04.
- 2003/04 to 2011/12.

The ABS states that the 2011/12 to 2016/17 period is an incomplete cycle. We also note that in last year's release the ABS' second productivity cycle was only from 2003/04 to 2007/08. This had a significant impact on the average annual labour productivity for this most recently completed cycle (0.4% for 2003/04 to 2007/08 versus 1.0% for 2003/04 to 2011/12).

Because of the differences in how productivity is measured by the AER compared to the ABS, we see no compelling reason why the ABS' productivity cycles would apply to the AER's analysis.

AER MPFP averaging period

The AER has indicated that 2012 represents a break point at which higher costs from new regulatory obligations have flowed through to business as usual (BAU). DNSPs' MPFP productivity estimates, on average, are the lowest across the period in 2012. This is almost solely driven by materially higher aggregate opex in this year (there is minimal output changes driving the MPFP estimate).

We have reviewed the AER's 2015 assessment of the DNSPs' opex against their allowance, and while there is some indication that 2012 opex may have been higher due to some regulatory obligations it is clear that there are a number of other factors driving the higher opex level in this year. Economic Insights, in its 2018 report for the AER, notes that the post-2012 period appears more settled than pre-2012 after 'reform initiatives' and the aftermath of the Victorian 2009 bushfires. However, the 'unsettled' performance pre-2012 appears to be largely driven by two Victorian 'upper quartile' DNSPs having significant variation in their performance. If these two DNSPs are excluded the remaining DNSPs performance across the period appears relatively settled. The 2012 opex appears to be an outlier value and should not be used as a break point. In addition, choosing 2011/12 as the breakpoint only leaves a four year period to estimate productivity. In our view this is too short a period for assessing annual productivity (we note that the AEMC, in 2011, considered that at least eight years were required).

The AER's 2018 econometric models were based on a shortened 2012-17 data set, in line with the AER's shortened 'catch-up adjusted' MPFP estimate. The modelling result showed a positive coefficient on the time trend. This indicates that even when using the AER's preferred breakpoint of 2012, based on the outputs used in the AER's econometric models and opex forecasting model, the recent historical information indicates that on average the DNSPs' opex is increasing. As this is over a period in which the AER considers that a degree of catch-up was occurring, which should further add to a negative time trend, the econometric modelling results do not support the AER's MPFP time period.

Separating catch-up and frontier shift

We do not consider the AER's approach to separating catch-up efficiency from frontier shift is robust given the volatile nature of the 'frontier' DNSPs' average annual opex productivity estimates over the 2006-12 period and 2012-16 period. Some of the DNSPs' estimates for the 2012-16 period appear implausibly high (e.g., TasNetworks' is 7.7% per annum) or implausibly low (e.g., AusNet Services' is negative 5.3%). We also do not consider that selecting just the 'upper quartile' performance would correct for this issue, particularly as two of the Victorian upper quartile performers report that recent improvements in opex performance were driven in part by increased capitalisation of overheads.

3.1. MEASURING PRODUCTIVITY OVER TIME

Productivity is a highly cyclical variable, which means that measurements will show marked variation over the economic cycle as well as across economic cycles. Measuring productivity over a short time period can result in misleading estimates, particularly if the estimate is taken over partial economic cycles. Instead of estimating productivity over an undefined or short period, it is standard practice to consider productivity growth over complete economic cycles.[23] As the ABS states:

> *"A common method of examining changes in productivity over an extended period involves identifying and dividing the data into productivity growth cycles. By analysing averages of productivity statistics between growth cycle peaks, the effects of some temporary influences (such as variation in capital utilisation) can be minimised, allowing better analysis of the drivers of productivity growth in different periods."*[24]

We are also of the view that productivity should be measured over full cycles and, particularly if full cycles cannot be identified, over a long-time period. However, because of the variation in productivity over time there is a trade-off between maximising: (i) the duration of data; and (ii) proximity to the period of analysis. We set out this trade-off in a report we prepared for the Dutch Energy regulator in 2012:

> *"if:*
>
> - *the analysis includes a greater number of business cycles, it is more robust to the possibility that an industry has observed atypical TFP growth over a single business cycle due to industry specific reasons; however*
> - *a longer time period is arguably less robust to the possibility that there has been a permanent structural break in the TFP performance of an industry over time, which would mean that productivity performance in business cycles further back in the past is less relevant to current productivity performance. Such a structural break might be a technological innovation in the industry or a secular decline in the industry's level of international competitiveness."*[25]

In our opinion it is good to review a range of periods, for example, the most recent full productivity cycle, at least two productivity cycles, and the full length of the data set available (unless it is clear that the start and end points are outliers).[26]

For regulated sectors it is not clear that productivity cycles identified by the statistical agencies would apply to regulators' estimates. The measured outputs are unlikely to align with the measures used by the statistical agencies. Therefore, looking at a longer timeseries and ensuring that the start- and end-points are not affected by one-off impacts may be more appropriate when using these measures. We note that the need for a long time series to analyse productivity was identified by the AEMC, in its 2011 review into the use of TFP. The AEMC stated that:

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[23] OECD (2003), p 119.

[24] ABS website, 5260.0.55.002 - Estimates of Industry Multifactor Productivity, 2016-17, accessed 22 November 2018.

[25] CEPA (2012), page 41.

[26] Using economic/ business cycles is common practice by regulators and consultants in European jurisdictions. Oxera (2016), Table 5.1, summarises a number of reports that cover productivity in regulated sectors across a number of jurisdictions.

> *"We are of the view that at least 8 years of robust and consistent data will be required to establish a TFP growth rate that could be used in a TFP methodology for price and revenue determinations"*[27]

Other regulatory analysis, such as the gas studies listed by the AER in the Draft Decision Paper, also use the longest time period the data set allows.

3.2. ABS' PRODUCTIVITY CYCLES

For its labour productivity analysis, the AER has relied on the ABS' estimation of labour productivity. In regard to the time period that labour productivity should be measured over, the ABS' most recent productivity release identified the following complete cycles:

- 1998/99 to 2003/04.
- 2003/04 to 2011/12.[28]

While the ABS report average annual growth rates for the 2011/12 to 2016/17 period, the ABS states that this an incomplete cycle. We consider that it is also worth noting that the ABS' identified cycles can change as national accounts and other statistics are revised. For example, in last (2017) year's publication of the productivity statistics the ABS identified 2007/08 as a peak rather than 2011/12 (the average annual labour productivity growth rate between 2003/04 and 2007/08 was 0.4% compared to 1.0% over the new peak-to-peak 2003/04 to 2011/12 period).[29] It is reasonable to assume that there is a risk that the ABS' productivity cycles may change again in the future, which supports consideration of longer time periods.

It is also worth noting that, while the ABS identify 2011/12 as a peak at one end of a multifactor productivity growth cycle for the whole market sector, we do not consider that there is any strong reason why the ABS determined cycles would apply to the AER's analysis. The AER's choice of outputs and the method used to measure productivity is very different to the ABS' approach. There is no reason to expect that the AER's measures of outputs and opex would align with the cyclical profile of value-added output and inputs of labour and capital.

3.3. THE AER'S MPFP ANALYSIS

3.3.1. 2012 'break point'

In the figure below, using the data set collated by the AER and Economic Insights, we have set out indices for outputs, quality, opex, and opex productivity across the industry.[30] These indices clearly show that opex changes across the whole period, and not just limited to the period up to 2012, have largely driven opex productivity. The data also indicates that 2012 appears to be an outlier year in terms of opex. It is

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[27] AEMC (2011), page 23.

[28] ABS website, 5260.0.55.002 - Estimates of Industry Multifactor Productivity, 2016-17, accessed 22 November 2018. The ABS determines productivity growth cycle peaks "*by comparing the annual MFP estimates with their corresponding long-term trend estimates*" (source: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/5260.0.55.002main+features22016-17, accessed 22 November 2018). This is slightly different to the definition we have used in the past, and proposed by the OECD (OECD, 2003), which measures a complete business cycle from a point of zero output gap to another point of zero output gap including both a peak and a trough. (Output gap refers to the difference between the output of a country as measured by its GDP at any given point of time and the long term trend of the output.)

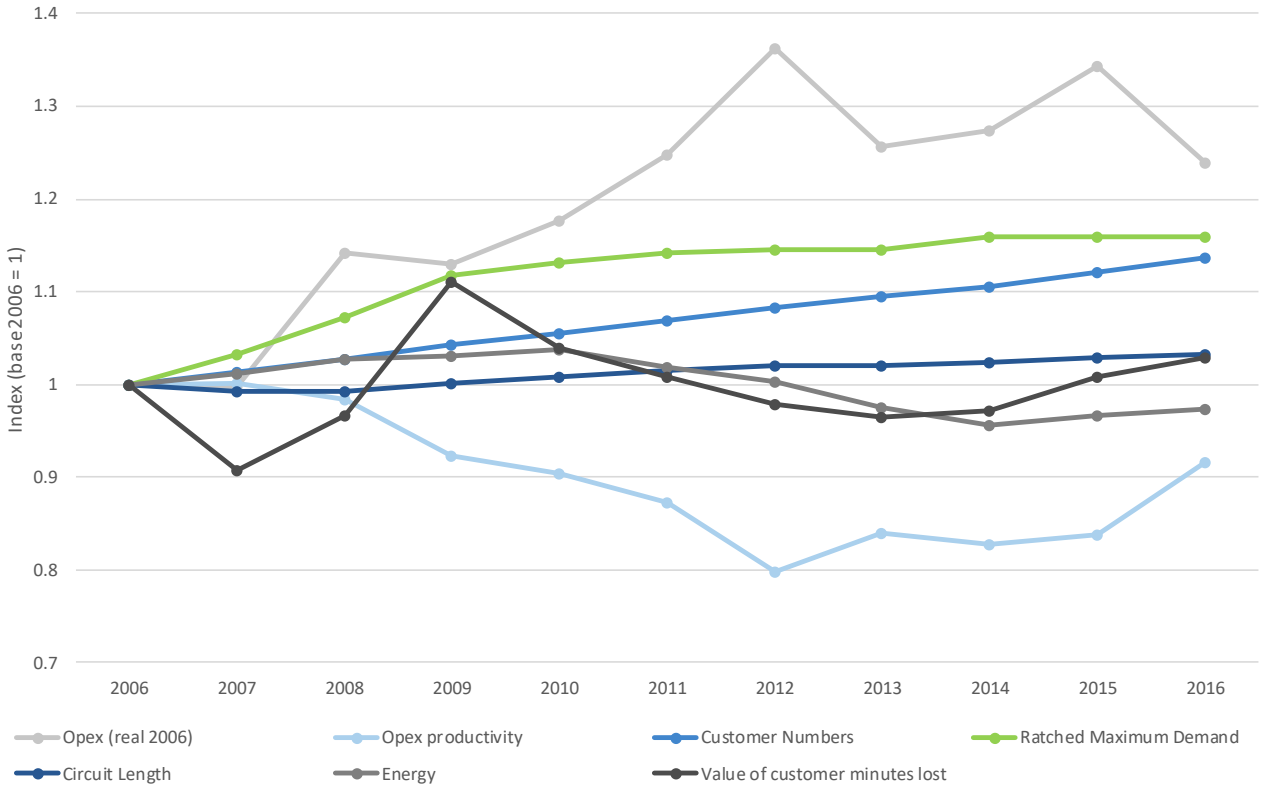
[29] ABS website, 5260.0.55.002 - Estimates of Industry Multifactor Productivity, 2016-17, accessed 22 November 2018.

[30] The aggregate opex productivity is an unweighted average of the DNSPs' MPFP indices.

materially higher than the preceding and following year, and it is out of step with the industry trend during the period.

Choosing 2012 as the starting-point for the MPFP estimates sets the opex productivity index at its lowest point across the whole period. This leads to the highest possible average annual opex productivity estimate out to 2016.

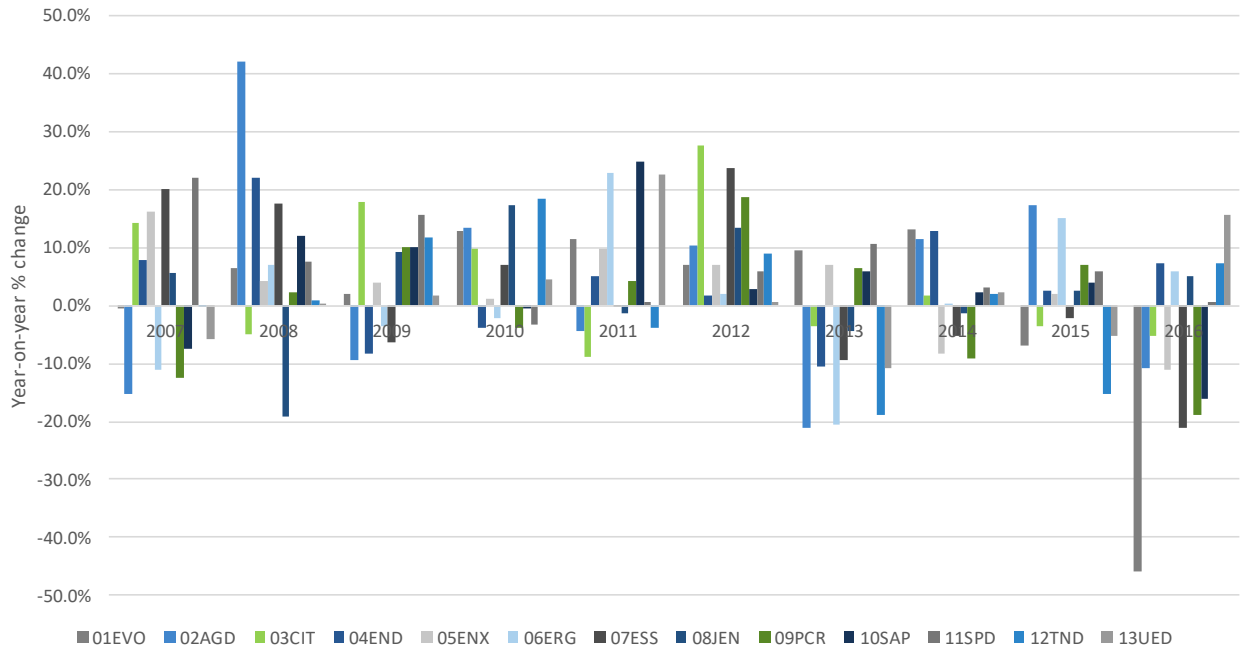
Figure 3.1: Indices of average outputs, opex, and opex productivity (unweighted)



Source: CEPA analysis, AER, Economic Insights

Figure 3.2 below shows the year-on-year movements in opex for each of the DNSPs. In 2012 all DNSPs had an increase in opex, with the three largest percentage increases coming from CitiPower, Essential, and Powercor (two upper quartile DNSPs and one 'inefficient' DNSP). In 2013, there were substantial opex decreases across a number of DNSP, with the three largest decreases coming from Ausgrid, Ergon, and TasNetworks (two 'not materially inefficient' DNSPs and one 'inefficient' DNSP).

Figure 3.2: DNSPs' year-on-year real (2006$) opex change



Source: CEPA analysis, AER, Economic Insights

The AER's report on the DNSPs' performance in 2011 to 2013 (AER, 2015), does not appear consistent with the argument that poor performance was solely driven by new regulatory obligations. For example, the AER noted that TasNetworks had reported that "*TasNetworks' distribution business went through a number of significant restructures and redundancy costs have added to prior years' operating expenditure*."[31] Another example is Jemena, which reported a number of reasons for spending above its regulatory allowance in all three years:

- *"higher maintenance costs related to vegetation control and zone substation maintenance*
- *Broadmeadows depot being damaged by a storm event on 25 December 2012*
- *loss of synergies from large range of services previously provided to United Energy*
- *increased regulatory costs due to a substantial increase in regulatory activity by policy makers, rule makers and regulators*
- *a more onerous regulatory reporting through RINs."*[32]

TasNetworks' higher costs do not seem to have been related to the new regulatory obligations, rather they appear to have been related to one-off factors affecting opex. While a proportion of Jemena's higher costs were due to increased regulatory costs,[33] there were a number of other reasons for higher opex in 2012.

[31] AER (2015), page 116.

[32] AER (2015), pages 146-147.

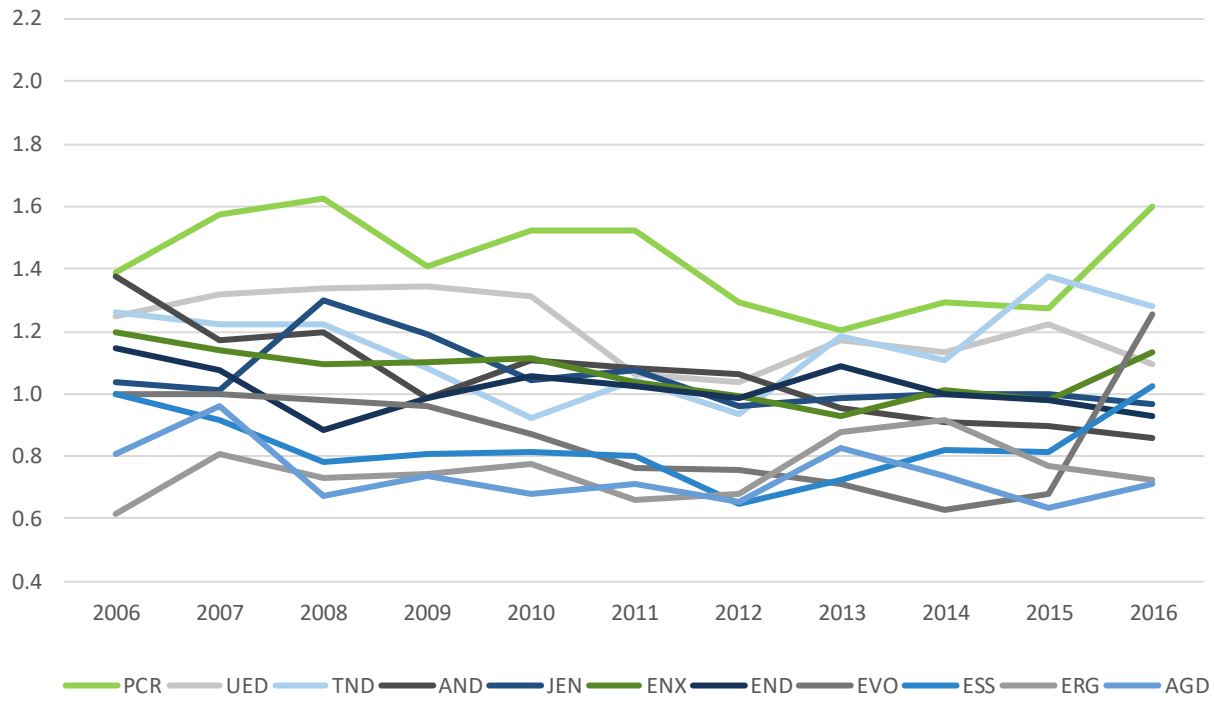
[33] Jemena (2015), Table 2.2, provides further details and specifies that the higher vegetation control costs were linked to new regulations introduced in 2010.

Other support for the AER's break point of 2012 comes from Economic Insights. In its August 2018 benchmarking report prepared for the AER, it stated that:

> *"the period from 2012 onwards represents for Australian DNSPs a period of more settled performance following earlier reform initiatives and unusual events such as the aftermath of the 2009 Victorian bushfires."*[34]

However, we are not convinced that the evidence presented in Economic Insights (2018) supports the 2012 break point either. On the face of it the 'unsettled' performance pre-2012 appears to be largely driven by changes in CitiPower and SA Power Networks relative performance (see Draft Decision Paper Figure 2, and Economic Insights (2018) Figure 4.2). If we exclude these two DNSPs from the Figure 2 of the Draft Decision Paper, then the relative productivity performance of the remaining DNSPs is consistently between 0.6 and 1.6 (see Figure 3.3).[35] This range would be even tighter if Powercor were also excluded.

Figure 3.3: Opex multilateral partial factor productivity, 2006 to 2016, excluding CitiPower and SA Power Networks[36]



Source: CEPA analysis, AER, Economic Insights

3.3.2. Start- and end-points

We note that the AER does not adjust opex for one-off events/ costs or changes in requirements before modelling, therefore one-off costs in the start-/ end-years used to calculate the annual averages do affect

[34] Economic Insights (2018), page 19.

[35] This is not a statistical test, rather a sense check in response to Economic Insights point that "*[i]t can be seen from figure 3.2* [chart of the DNSPs' opex MPFP indices] *above that the period from 2012 onwards represents for Australian DNSPs a period of more settled performance*". Economic Insights (2018), page 19.

[36] We have left the vertical axis range consistent with that presented in the Draft Decision Paper and Economic Insights (2018), page 16.

the average annual productivity estimates. In addition, as the AER's analysis (including the econometric analysis) is undertaken post-capitalisation, the DNSPs' different capitalisation policies may affect the DNSPs' performance. For example, Spark Infrastructure noted in its June 2018 investor presentation that, for the Victorian DNSPs' it has a stake in (CitiPower and Powercor):

> *"Operating Costs (ex Beon) Down by 11.4%...[in part due to] Higher capitalisation of labour costs due to increased number of capital projects."*[37]

Therefore, the DNSPs' opex performance over the first half of 2018 period would have been worse without the capitalisation. There is no reason to believe that the historical data is not affected to the same extent. For example, based on our analysis of its Category Analysis RINs, in 2015 CitiPower capitalised approximately 35% of its overheads, while in 2016 it capitalised 45%.[38] Powercor capitalised 40% of overheads in 2015 and 43% in 2016.[39] We have singled out a selection of upper quartile performers, however variations in capitalisation of overheads occurs across all of the DNSPs.

In summary, we do not believe that there is sufficient evidence to support the use of the MPFP estimates which have 2012 as a start point and the AER would need to carefully consider the effect of one-off, step, or capitalisation changes on the start- and end-points of any period using the MPFP.

3.3.3. The AER's econometric model(s)

In Economic Insights' 2018 DNSPs benchmarking report for the AER, Economic Insights undertook its econometric modelling using a shortened, 2012-2017, data set. For all three models its estimated time trend coefficients were positive; between 1.5 and 1.8.[40] These estimates are similar to the 1.8 to 1.9 values that Economic Insights estimated using the 2006-2016 data set. This indicates that even over the shortened time period the AER is proposing for its MPFP frontier shift estimates, based on the output specification in the econometric modelling the DNSPs' opex is increasing. And this was during a period where the AER considers that a degree of catch-up is occurring for those DNSPs not at the frontier.[41] Material levels of catch-up and significant frontier shift should point to a negative time trend if the modelling specification is appropriate.

In addition, the econometric models do not account for changes in quality, either, for example in terms of interruptions or in services quality or reliability. The exclusion of any quality adjustments will impact on the time trend (we discuss this point further in Section 2.1.1).

These points do not support an additional productivity adjustment, particularly on the basis of the MPFP results over the 2012-16 period, to the DNSPs' allowances given the outputs specification is used to forecast the DNSPs' allowances.

3.3.4. Separating catch-up and frontier shift

The AER has set challenging catch-up targets for the DNSPs that it considered were not at the frontier. These DNSPs appear to have responded to these challenges and reduced their opex. This means that the

[37] Spark Infrastructure (2018), slide 10.

[38] CitiPower (2015), Tab 2.10 and CitiPower (2016). Tab 2.10.

[39] Powercor (2015), Tab 2.10 and Powercor (2016), Tab 2.10.

[40] Economic Insights (2018), pages 20-21.

[41] Draft Decision Paper, page 14.

MPFP analysis is capturing both frontier shift and catch-up efficiency. If the AER's estimate captures any catch-up efficiency, then it risks setting the frontier shift target at a level that is above what is achievable by DNSPs over the next five years.

The AER has proposed that a frontier shift estimate can be constructed by only looking at the opex MPFP growth from 2012 to 2016 for those DNSPs that it considered were not 'materially inefficient' at their last determinations. This is not a statistical method, rather it relies on the assumption that if the AER considered that the DNSPs were not materially inefficient then the only changes in their performance must be from frontier shift.

In the table below, we have reproduced the AER estimates of average annual opex MPFP growth, as set out in Draft Decision Paper Table 2, for the not materially inefficient DNSPs.

Table 3.1: Average annual opex MPFP growth by not materially inefficient DNSP

DNSP	2006-16	2006-12	2012-16
CitiPower	-2.8%	-7.1%	3.6%
Endeavour Energy	-2.1%	-2.5%	-1.4%
Ergon	1.6%	1.5%	1.6%
Jemena	-0.7%	-1.3%	0.1%
Powercor	1.4%	-1.2%	5.4%
SA Power Networks	-2.2%	-4.5%	1.2%
AusNet Services	-4.7%	-4.4%	-5.3%
TasNetworks	0.1%	-4.9%	7.7%
United Energy Distribution	-1.3%	-3.1%	1.4%
Average	-1.2%	-3.1%	1.6%

Source: AER Draft Decision Paper

As the table illustrates, the growth rates for DNSPs vary significantly across the shorter periods. For example, TasNetworks had productivity growth of -4.9% prior to 2012 before achieving productivity growth of 7.7% post-2012. Similar shifts across other DNSPs indicate unsettled performance that is unlikely to purely represent frontier shift. For example, TasNetworks' 'ongoing frontier shift' of 7.7% does not seem plausible as it would imply that TasNetworks is able to 'shift' the frontier in four years to achieve productivity gains of close to 30%; also, AusNet Services' negative frontier shift over the period does not seem plausible. In addition, as noted in Section 3.3.2, two of the 'upper quartile'[42] DNSPs – CitiPower and Powercor – performance may be affected by capitalisation of opex. Therefore, using their performance as an indicator of frontier shift may set an inappropriate target as capitalisation of opex is not frontier shift.

We consider this provides further reasons not to use the 'not materially inefficient' or, as proposed by the CCP,[43] the 'upper quartile' DNSPs' MPFP changes as an indicator of frontier shift. We are of the view that the AER's proposed approach to separate catch-up and frontier shift is not robust, particularly in light of the positive coefficient on the time trend estimated in the AER's most recent econometric models covering the 2012-2017 time period.

[42] See Economic Insights (2018, page 24.

[43] CCP (2018), slide 12.

4. ALTERNATIVE APPROACHES AND ESTIMATES

Summary

In this section, we set out an alternative approach to using the utilities sector labour productivity estimate. We also set out some recent regulatory precedents in the energy sector in other jurisdictions and other sectors in Australia.

Selected sectors composite labour productivity estimates

We do not consider that the ABS' labour productivity estimate for the utilities sector is an appropriate comparator point for DNSP productivity growth. Recent year-on-year changes in the estimates indicate significant volatility in the measure. There is also the risk of embedding historical productivity performance as the DNSPs make up a material part of the sector. In addition, there are a number of state-owned companies in this sector that may not face the same competitive pressures as privately owned companies to achieve productivity gains.

Instead, adopting an approach widely used in other jurisdictions, we selected five sectors that conduct activities that are similar to components of the DNSPs' opex activities. These sectors are:

- Construction.
- Financial and insurance services.
- Rental, hiring, and real estate services.
- Professional, scientific, and technical services.
- Administration and support services.

Our choices were based on Ofgem's application of this approach, and our experience from estimating composite indices for regulators across a number of sectors.

We estimate the unweighted average labour productivity across the five sectors and across four sectors excluding the rental, hiring, and real estate services (due to volatility in the estimates for this sector likely due to real estate fluctuations) over the following periods:

- 2003/04 to 2011/12. The most recently completed multifactor regulatory cycle (as estimated by the ABS).
- 1998/99 to 2011/12. The two complete cycles in the ABS' estimates.
- 1989/90 to 2016/17. The entire time period available from the ABS.

After adjusting for the proportion of labour in opex, these estimates indicate an opex productivity range of 0.3% to 0.7%.

Selected sectors composite labour + intermediate inputs productivity estimates

In addition to the labour productivity estimates, we also estimated labour + intermediate inputs productivity, which may be a better proxy for opex productivity (than labour productivity) as it also includes the effect from changes in materials and services. This measure indicates the selected sectors, across the time periods, achieved productivity growth between 0.3% and 0.5%.

It is important to remember that these are only partial productivity measures and capital is required to help drive these productivity changes. Setting opex productivity adjustments for DNSPs' investments in ICT would double count productivity and therefore set an unrealistic productivity target. The AER will need to allow for the capex that drives opex productivity, otherwise the DNSPs may not be able to achieve these targets.

Regulatory precedent

Recent regulatory decisions in the water sector in Australia for frontier shift is for an annual target of 0.25%. Recent regulatory decisions for electricity networks' frontier shift in other jurisdictions range from 0% (New Zealand) to 1.1% (Great Britain) per annum**.** However, we think the international evidence can be excluded as a source of information at this stage. This is because the AER has a several Australian sources to rely on and only using Australian data avoids further inconsistencies due to differences across countries in, for example, working conditions, input prices, and wages.

Overall

In the table below, we summarise our alternative sources of information/ approaches that could supplement/ replace the AER's individual estimate options. From the AER's options we believe only the 'status quo' and the gas networks' productivity estimates (after adjusting the range to reflect insignificant coefficients) should remain sources of evidence.

Table 4.1: Summary of estimates

Approaches	Proposed estimates/ ranges
Status quo – Zero productivity growth	0%
Gas networks' productivity	0% - 0.7%
Labour productivity, adjusted for labour proportion of opex (selected sectors)	0.3% - 0.7%
Labour + intermediate inputs productivity (selected sectors)	0.3% - 0.5%
Regulatory (water) precedent (Australia)	0.25%
'Holistic' range	**0% - 0.7%**

Source: AER, CEPA analysis

This suggests a 'holistic' range across the measures of 0% to 0.7%. The inconsistency between these measures and the econometric modelling output coefficients used to forecast opex means the AER needs to apply caution in selecting from this range. Therefore, it may be more appropriate for the AER to select from the lower end of the range in order to reflect the greater risks associated with setting the measure towards the upper end of the range.

4.1. SELECTED SECTORS COMPOSITE LABOUR PRODUCTIVITY ESTIMATES

We have undertaken several productivity studies for regulators in other jurisdictions across different sectors. One method that we have applied is to build a composite index of productivity using estimates from other sectors that carry out similar activities to parts of the DNSPs' opex program, to provide an indication of achievable opex productivity gains.

We believe that this approach is better than relying on productivity growth rates for the 'electricity, gas, water and waste services' ('utilities') sector. We do not believe that this is a reliable measure for the AER to use for the following reasons:

- Figure 3 in the AER's Draft Decision Paper shows that the productivity results for this sector are extremely volatile, particularly for recent years with productivity year-on-year changes of 15%. These changes are being driven by changes in the number of hours worked rather than changes in value-added GDP (output measure).
- The DNSPs make up a reasonable proportion of this sector, therefore using this estimate creates a risk of embedding the DNSPs' performance in future reviews.
- This sector contains a large number of state-owned companies that may not face the same shareholder pressure to make productivity gains as privately-owned companies. [44]

With regards to creating a composite index, the labour productivity growth estimates are not available at a detailed level of disaggregation, thus establishing a close match to sectoral growth in the electricity distribution sector, while avoiding using the utilities sector, is not possible.[45]

[44] This argument was also set out in Frontier (2007) and CEPA (2012).

[45] We note that the ABS only publish productivity statistics at the highest sectoral levels, and this is at a more aggregated level than which is available in other jurisdictions. This has led us to choose slightly different sectors than we may have chosen if a greater level of disaggregation was available.

After reviewing the available sectors and their Australian and New Zealand Standard Industrial Classification (ANZSIC) definitions and comparing these to our knowledge of the distribution activities, and taking account of previous work in this area,[46] we identified the following sectors that we consider relate to different individual activities that a DNSP undertakes:

- **Construction**. Similar to the DNSPs' maintenance and repair activities.
- **Financial and insurance services**. Similar to aspects of the DNSPs' financing and financial administration activities.
- **Rental, hiring and real estate services**. The rental and hiring parts cover vehicle ownership, leasing, and contracting costs the DNSPs face. Real estate covers the property management DNSPs carry out. However, we note that the real estate part of this category is subject to housing market fluctuations.
- **Professional, scientific and technical services**. Covers the engineering and other professional areas of the DNSPs' businesses.
- **Administrative and support services**. Similar to the DNSPs' business support services element.

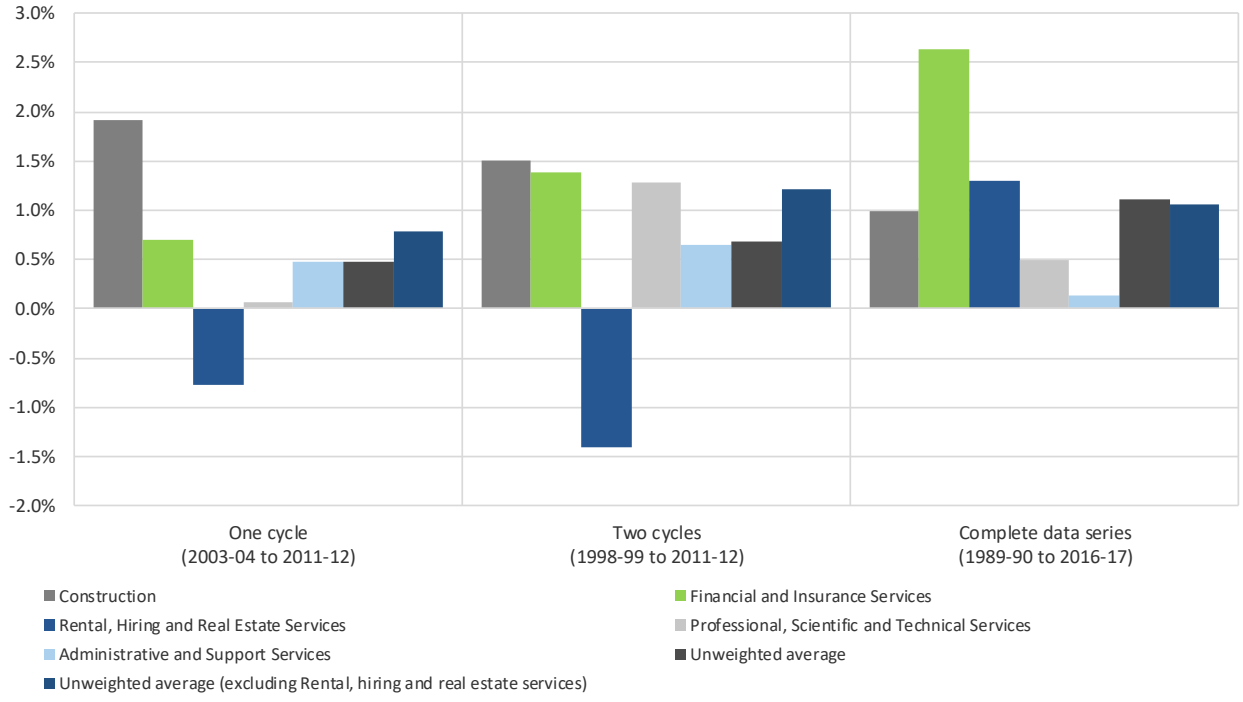
Figure 4.1 below sets out the average annual quality-adjusted labour productivity growth rates across the sectors listed above, an unweighted average including all five sectors and an unweighted average excluding 'Rental, hiring and real estate services'. We have used unweighted averages as we do not have the required information to appropriately weight each sector. We estimated the labour productivity over the following periods:

- 2003/04 to 2011/12. The most recently completed multifactor regulatory cycles (as estimated by the ABS).
- 1998/99 to 2011/12. The two complete cycles in the ABS' estimates.
- 1989/90 to 2016/17. The entire time period available from the ABS. [47]

[46] See for example, Ofgem (2012), Europe Economics (2007), Frontier (2007), and CEPA (2012).

[47] We have not assessed whether the productivity cycles are appropriate for each of the sectors, rather we assume that the ABS' definition of a productivity cycle for the market sector allows for the same period breakdown to apply to the underlying sectors.

Figure 4.1: Average annual value-added labour productivity growth rates, by time period[48]



Source: CEPA analysis, ABS (5260.0.55.002)

Table 4.2: Average annual value-added labour productivity growth rates, by time period

Sector	One cycle (2003/04 to 2011/12)	Two cycles (1998/99 to 2011/12)	Complete data series (1989/90 to 2016/17)
Construction	1.9%	1.5%	1.0%
Financial and Insurance Services	0.7%	1.4%	2.6%
Rental, Hiring and Real Estate Services	-0.8%	-1.4%	1.3%
Professional, Scientific and Technical Services	0.1%	1.3%	0.5%
Administrative and Support Services	0.5%	0.7%	0.1%
Unweighted average	**0.5%**	**0.7%**	**1.1%**
Unweighted average (excluding Rental, hiring and real estate services)	**0.8%**	**1.2%**	**1.1%**

Source: CEPA analysis, ABS (5260.0.55.002)

Based on the unweighted average and the most recent full business cycle and longer time periods, the ABS evidence for selected sectors indicates a 0.5% to 1.2% labour productivity range.[49] As this is based on value-added, rather than gross output, improvements in intermediate inputs are somewhat taken account of as reductions in the level of intermediate inputs increase value-added (all else being equal), therefore we

[48] A positive value indicates productivity improvements.

[49] Additional work could be undertaken to determine the precise sectors and weights that could be used to create a composite index.

consider it appropriate to follow the AER's approach of adjusting this range for the labour proportion of opex. On the basis that labour makes up approximately 60% of opex,[50] the labour productivity from these selected sectors indicates an achievable opex productivity challenge of between 0.3% and 0.7% per annum.

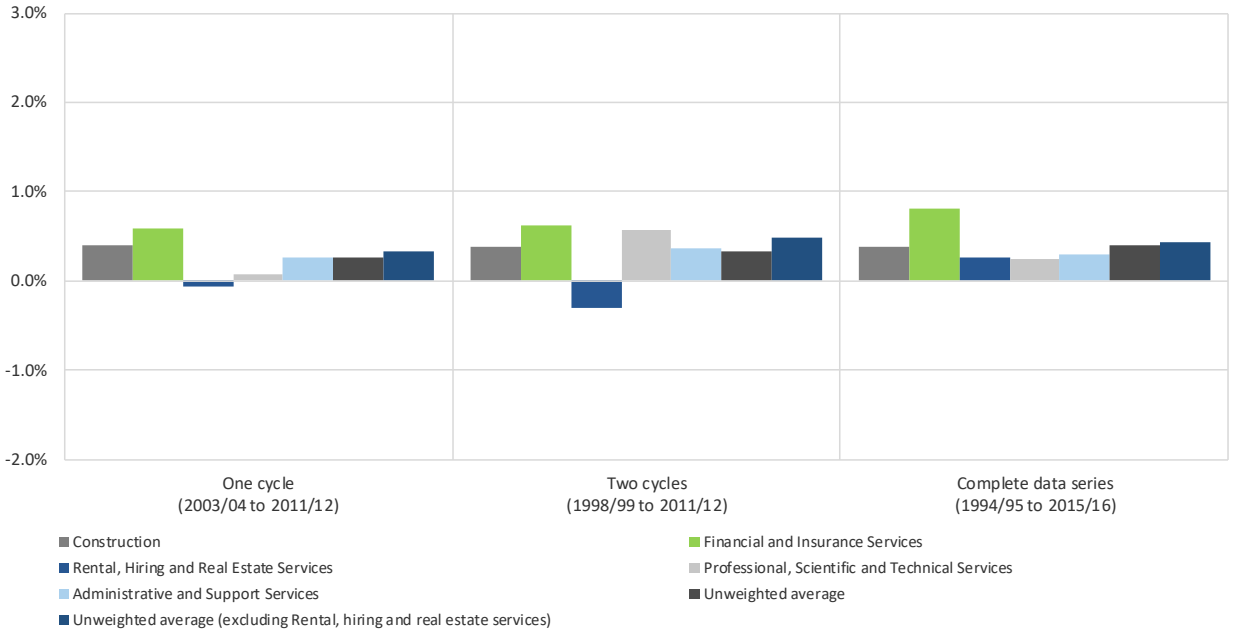
4.2. SELECTED SECTORS COMPOSITE LABOUR + INTERMEDIATE INPUTS PRODUCTIVITY ESTIMATES

An alternative metric to labour productivity that may be a better proxy for opex productivity is the labour + intermediate inputs productivity as it also includes the effect from changes in materials and services.[51] This approach has been previously used by Ofgem (and also by a number of regulators and consultants in other jurisdictions).[52] We have calculated it using ABS data and the following formula:

> Labour and intermediate inputs productivity (GO)
> = growth in volume of GO − (share of labour in labour and intermediate inputs
> × growth in volume of labour) − (share of intermediate inputs in labour and intermediate inputs
> × growth in volume of intermediate inputs)[53]

The average annual labour and intermediate input productivity changes for the sectors, and unweighted averages are shown in Figure 4.2 and Table 4.3 below.

Figure 4.2: Average annual gross output labour + intermediate inputs productivity growth rates, by time period[54]



Source: CEPA analysis, ABS (5260.0.55.002)

[50] The AER Draft Decision Paper states that its labour input weight is 59.7% (Draft Decision Paper, page 25).

[51] This measure uses gross output rather than value-added. Gross output has to be used to allow for the estimation of intermediate input changes on productivity.

[52] See Ofgem (2009a) and Ofgem (2012),

[53] This is the same as the formula used in Ofgem (2012).

[54] Note, the available ABS data for estimating this measure is shorter than for the labour productivity measure.

Table 4.3: Average annual gross output labour + intermediate inputs productivity growth rates, by time period

	One cycle (2003-04 to 2011-12)	Two cycles (1998/99 to 2011/12)	Complete data series (1994/95 to 2015/16)
Construction	0.4%	0.4%	0.4%
Financial and Insurance Services	0.6%	0.6%	0.8%
Rental, Hiring and Real Estate Services	-0.1%	-0.3%	0.3%
Professional, Scientific and Technical Services	0.1%	0.6%	0.2%
Administrative and Support Services	0.3%	0.4%	0.3%
Unweighted average	**0.3%**	**0.3%**	**0.4%**
Unweighted average (excluding Rental, hiring and real estate services)	**0.3%**	**0.5%**	**0.4%**

Source: CEPA analysis, ABS (5260.0.55.002)

Based on the unweighted average and the most recent full business cycle and longer time periods, this evidence supports a 0.3% to 0.5% opex productivity range. As this range is lower than the labour productivity range it indicates that intermediate inputs have been growing at a faster rate than outputs, on average, across these sectors.

It is important to appreciate the limitations of both the labour productivity and labour + intermediate inputs productivity estimates in regard to other inputs. As the ACCC/AER stated in their 2012 report on Benchmarking Opex and Capex in Energy Network:

> *"While PPIs provide some insights, they can give misleading information regarding the overall economic performance of energy utilities producing multiple outputs and multiple inputs. For example, when considered in isolation, a labour productivity measure would tend to overstate the growth of overall productivity in a utility experiencing a substantial degree of capital deepening (i.e., capital substituting for labour in the production). Similarly, inadequately accounting for the multiple outputs produced by a utility would also make performance comparison over time or across utilities less useful for the regulator."*[55]

We provide an illustration of the impact of other inputs (e.g., capital deepening) on labour productivity in the box below.[56]

[55] AER/ACCC (2012), page 17. We note that the AER/ACCC reference our 2003 report for Ofgem (CEPA (2003)) on benchmarking energy networks.

[56] The ABS' definition of Capital deepening is "*Capital deepening refers to changes in the capital to labour ratio. Increased capital deepening means that, on average, each unit of labour has more capital to work with to produce output, so is an indicator of ability to augment labour. Labour saving practices, such as automation of production, will result in increased capital deepening, which is often associated with a decline in capital productivity. Growth in capital deepening is an important driver (alongside MFP) of labour productivity growth." (Source: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/5260.0.55.002Main%20Features22017-18?opendocument&tabname=Summary&prodno=5260.0.55.002&issue=2017-18&num=&view=)*

Box 1: Source of opex productivity growth

A common misconception with the application of productivity in regulation is that productivity gains, over and above those indicated by measures from other sectors, are achievable if allowances are provided for new technology and/or capital investment. However, the productivity estimates from other sectors reflect the other sectors' adoption and use of new technology, such as information communication technology (ICT).

Consider the ABS labour productivity statistics. As labour productivity estimates effectively assume that other inputs – capital services – are constant, the measure by itself does not explain how the productivity gains were achieved e.g., from investment in new capital or new work processes. The ABS use value-added as its output measure, rather than gross output, for labour productivity. Value-added takes account of the substitution between outsourcing and labour for intermediate inputs (e.g., materials).[57] In the table below, we reproduce the ABS' market sector quality adjusted labour productivity estimates by growth cycle.

Table 4.4: ABS estimates of labour productivity growth, by MFP growth cycle[58]

	1998/99 to 2003/04	2003/04 to 2011/12	1998/99 to 2011/12
Quality adjusted labour productivity	1.99%	1.02%	1.39%

Source: ABS (5260.0.55.002)

The ABS helpfully provide an estimate of different inputs' and multifactor productivities' contribution to output growth, and therefore labour productivity growth. We have reproduced these estimates in the table below.

Table 4.5: ABS estimates of contributions to output growth, by MFP growth cycle

	1998/99 to 2003/04	2003/04 to 2011/12	1998/99 to 2011/12
Capital services	1.70%	2.23%	2.03%
Hours worked	0.68%	0.93%	0.83%
Labour composition	0.26%	0.28%	0.27%
Multifactor productivity	0.91%	-0.33%	0.15%

Source: ABS (5260.0.55.002)

The contribution analysis shows that capital services have been, by a large margin, the greatest contributor to output growth over all the periods considered. For example, in the 2003/04 to 2011/12 period output grew by 3.11 percentage points, and capital services accounted for 2.23 percentage points (or 72%) of the growth in outputs. This means that the estimated labour productivity growth is largely due to increases in capital services. In other words, labour productivity growth could not have been achieved without investment in technology such as ICT. Setting further opex productivity adjustments for DNSPs' investments in ICT would double count productivity and therefore set an unrealistic productivity target.

4.3. PRECEDENT FROM OTHER SECTORS AND JURISDICTIONS

In Table 4.6 below, we set out several current ongoing efficiency challenges set by regulators in other jurisdictions for the energy sector and the water sector in Australia. We note that there are other regulated sectors that the AER could consider, such as telecommunications and ports, however water likely has the closest network characteristics to those in electricity and gas. If the AER were to look at other sectors' estimates, it would need to ensure that these do not include catch-up efficiency.

[57] Cobbold (2003), page 25.

[58] We have not included the most recent years (2011/12 onwards) as the cycle is incomplete.

Table 4.6: Summary of ongoing efficiency targets

Regulator	Country/ State	Sector	Price control	Applied to	Efficiency target
Ofgem	Great Britain	Electricity distribution	2015-2023	Totex	0.8-1.1%
Commerce Commission	New Zealand	Electricity distribution	2020-25	Opex	0.0% (draft proposal)
Utility Regulator	Northern Ireland	Electricity distribution	2017-24	Opex	1.0%
Bundesnetzagentur	Germany	Gas distribution*	2019-23	Total revenue	0.49%
IPART	NSW	Water	2016-20	Opex	0.25%
ERA	WA	Water	2018-2023	Opex	0.25%

** BNetZA makes its electricity decision in December 2018, however in the past it has set the same target for gas and electricity which is why we have presented the gas estimate here.*

Source: New Zealand Commerce Commission (2018); Ofgem (2014a); Bundesnetzagentur (2017); Northern Ireland Utility Regulator (2017); Atkins Cardno (2015); ERA (2017)

We have excluded two Australian water sector estimates from the table as we believe they contain a substantial level of catch-up efficiency. These are:

- The **Essential Services Commission** of Victoria's recent (2018) Water Price Review. Companies have proposed annual productivity improvements ranging from 1% to 2.5%. However, it does appear that these proposals include catch-up efficiency and that these proposals were made under a new (PREMO) regulatory regime which has changed the incentives placed on the businesses.
- The **Independent Competition and Regulatory Commission** (ICRC) recent (2018) water review. The ICRC appears to have accepted Icon Water's proposed 1.75% annual efficiency target. However, this efficiency target appears to include Icon Water's catch-up efficiency through a business transformation program.[59]

We note that in Great Britain, Ofgem now sets targets based on totex rather than opex and capex separately, therefore the target applies equally to opex and capex; and the DNSPs proposed the efficiency targets listed and Ofgem accepted them (rather than Ofgem estimating the forecast efficiency itself). This avoids the risk of setting incompatible opex and capex productivity targets. In contrast to the AER's forecasting, Ofgem's approach to benchmarking includes DNSPs' forecast expenditure in its relative efficiency benchmarking and therefore forecast step-changes and one-off adjustments are explicitly taken account of.[60]

While we have presented estimates for international jurisdictions here, we note that international locations, compared to Australia, almost certainly have different:

- working conditions and regulations;
- prices across wages, capital, materials, etc; and

[59] Calibre (2018), page 58.

[60] See Ofgem (2014b), page 32, for a summary of its approach.

- operating environments.

Only using Australian data avoids introducing further inconsistencies in the opex forecasts due to differences across countries noted above. Therefore, at this stage, we think the international evidence can be excluded from the sources of evidence the AER uses as the AER has several Australian sources to rely on.

4.4. SUMMARY

In the table below, we summarise our alternative sources of information/ approaches that could supplement/ replace the AER's individual estimate options. From the AER's options we believe only the 'status quo' and the gas networks' productivity estimates (after adjusting the range to reflect insignificant coefficients) should remain sources of evidence.

Table 4.7: Summary of estimates

Approaches	Proposed estimates/ ranges
Status quo – Zero productivity growth	0%
Gas networks' productivity	0% - 0.7%
Labour productivity, adjusted for labour proportion of opex (selected sectors)	0.3% - 0.7%
Labour + intermediate inputs productivity (selected sectors)	0.3% - 0.5%
Regulatory (water) precedent (Australia)	0.25%
'Holistic' range	**0% - 0.7%**

Source: AER, CEPA analysis

This suggests a 'holistic' range across the measures of 0% to 0.7%. The inconsistency between these measures and the econometric modelling output coefficients used to forecast opex means the AER needs to apply caution in selecting from this range. In other words, it may be more appropriate to select from the lower end of the range in order to reflect the greater risks associated with setting the measure towards the upper end of the range. It is also important to note that these measures take account of changes in capital (e.g., investment in ICT) therefore the AER should not make further adjustment for opex improvements from these investments as this would double count the efficiencies from the investment. Additionally, the AER will need to allow for capex that drives opex productivity otherwise the DNSPs may not be able to achieve these targets.

APPENDIX A RESPONSES TO THE AER'S CONSULTATION QUESTIONS

We have provided brief responses to the AER's questions below. Please refer to the body of our report for the supporting analysis.

Question 1: Are there any other sources of information, for example, any economy wide measures of productivity growth that we should take into account when we forecast opex productivity growth?

We believe that the AER can rely on the ABS' data to a greater extent. As set out in Section 4, the AER could use sectors undertaking similar activities to the DNSPs to build up a profile of achievable productivity growth. In addition, we believe that a labour + intermediate inputs productivity estimate provides a better indicator of opex productivity growth than labour productivity by itself.

We also consider that the AER can refer to other regulators' decisions in regard to achievable opex productivity (see Section 4.3). These can provide a cross-check rather than necessarily being the sole piece of information the AER should rely on. The AER should also make note of any cyclical references, i.e., the water sector using the energy sectors productivity.

We are not aware of robust evidence of frontier shift from other sources, such as survey data. We note that evidence of opex savings from sources such as investor briefings can include catch-up efficiency, one-off effects, and accounting issues such as capitalisation changes (for example, Spark Infrastructure (2018)).

Question 2: Should all information sources be given equal weight or should we give greater or lesser weight to specific sources? If we should give greater or lesser weight to a specific information source, which source and why?

We believe weight can be given to external measures of productivity. As the AER has noted, the DNSP data captured a significant period of catch-up efficiency and we do not believe the approach of only choosing the change in productivity growth for DNSPs that it determined to be not inefficient is sufficiently robust to separate catch-up and frontier shift.

We do not believe any weight should be placed on the MPFP analysis unless the AER can ensure that the start- and end-points of the full time series are free from the effect of factors unrelated to frontier shift (e.g., capitalisation changes, one-off costs, etc).

We believe that information on productivity gains from sectors that are largely privately owned and face genuine market competition provide better indicators of achievable productivity. The AER may be able to broadly match the ABS' sector analysis with the DNSPs' activities.

We believe that the AER can place weight on other Australian regulators' decisions on frontier shift. As there are Australian decisions that the AER can rely on, we consider evidence from international jurisdictions should not be included in the evidence base, as the economic and regulatory conditions are different (see Section 4.3).

Question 3: Do you agree that the time trend achieved by gas distributors is reasonably reflective of the time trend that electricity distributors can achieve? If not, do you think the gas results overstate or understate what can be achieved by electricity distributors? Why?

We consider that the gas distributors' historical performance does provide another data point for the AER to compare its other estimates to. However, we have some concerns with the AER's interpretation of the results, in particular that there are a large number of insignificant time trend coefficients, which indicate that productivity growth may not be significantly different from zero (see Section 2.3).

We also note that the econometric modelling is significantly different to the AER's DNSP modelling in that in most models only one or two outputs are used, and it includes an indicator for capital inputs. We also note that the AER does not have viability of the data set used in the modelling and therefore may not have visibility on any issues, one-off costs, reporting differences, in the underlying data.

Question 4: Should we account for changes in the proportion of undergrounding when we forecast opex productivity growth?

The AER should not account for changes in the proportion of undergrounding when forecasting opex productivity.

Undergrounding is done for a variety of reasons across the networks and the historical rate of undergrounding varies materially across the DNSPs. Using the historical average across all DNSPs implies that all DNSPs need to achieve at least the historical average rate of underground going forward in order to achieve the proposed 0.5% productivity growth. This does not seem prudent or efficient as the DNSPs will almost certainly face different undergrounding requirements going forward than the historical industry average annual change.

Question 5: Should we account for economies of scale when we forecast opex productivity growth? If so, on what basis should we forecast economies of scale?

No. The elasticities on the output measures account for economies of scale (see Economic Insights (2014), page 8).

Question 6: What is the best way to use quality adjusted labour productivity growth (both past and forecast) to inform our opex productivity growth forecast?

Please see our response to question 1.

Question 7: Are there any other forecasting approaches we should consider?

Please see our response to question 1.

Question 8: Which option do you consider to be the best approach to forecast opex productivity growth for a prudent and efficient distributor? Why?

Please see our response to question 1.

Question 9: How much opex productivity growth do you think an efficient distributor can reasonably achieve? Why? What information are you relying on to inform this view?

Please see our response to question 1.

Question 10: Do you agree that we should apply the productivity growth forecast determined by this review process in our next regulatory determination for each electricity distributor? If not, how frequently should we update our forecast? Why?

Yes. However, the AER will need to be cautious in this approach in order to take account of the inconsistency it is introducing between different elements of its approach to opex forecasting. In addition, given the changes in opex that are not captured by the output measures, the AER may also need to make step-change adjustments to account for cost drivers that are captured in the time trend.

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