AEMC

REVIEW

Australian Energy Market Commission

DESIGN DISCUSSION PAPER

Review into the use of total factor productivity for the determination of prices and revenues

28 August 2009

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About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy, established the Australian Energy Market Commission (AEMC) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market. It is a statutory authority. Our key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council as requested, or on AEMC initiative.

Summary

As part of its total factor productivity (TFP) Review, the Australian Energy Market Commission has published this discussion paper which presents a design of a TFP methodology for the determination of revenues and prices.

The purpose of this TFP design is to provide a basis for all parties to consider and discuss in detail the feasibility and possible operation of a TFP methodology for revenue and pricing decisions as an alternative to the current building block approach. It responds to stakeholders' comments that further information on the design of a TFP methodology is required to enable them to reach a view on the relative merits and disadvantages of applying TFP. Stakeholders' views and comments in this regard will be a critical input into the draft report for this Review.

The TFP design example presented here is one possible approach to a TFP methodology. The paper steps through each of the various elements of a TFP methodology, and sets out an example of how each element could be designed. In some areas a range of options for discussion is presented. The paper also recognises that for certain elements further analysis would be needed before a TFP methodology could be applied.

There are two parts to the example methodology presented. The first part comprises the core elements of a TFP methodology that would need to be prescribed in the Rules. This includes the option for service providers to choose between either the TFP methodology or the existing building block approach at the start of each regulatory period. It would also include the formulae and processes for calculating the TFP growth rate and determining the X factor.

The second part considers the elements of the methodology that the service provider should be able to seek to adapt to its own circumstances with the regulator's approval. These elements include the length of the regulatory period and the use of off ramps and capital modules.

This discussion paper does not represent a preferred design, nor does it suggest that the example presented should be adopted as an alternative methodology for economic regulation of the Australian electricity and gas sectors. These are matters for the draft and final reports of the Review.

Also, the design has been developed under the assumption that the necessary data would be available. The TFP methodology should determine the required data rather than the existing data-set dictating the design of the TFP methodology.

Submissions are to be lodged by 30 October 2009. In September and October 2009, two workshops will be held to discuss the key issues raised in this discussion paper. One workshop will focus on gas distribution and the other electricity distribution. We look forward to engaging with stakeholders on the matters raised in this paper. The feedback on this TFP design will assist in the development of the draft report for this Review.

Contents

Abbreviations

AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
Commission	see AEMC
CPI	Consumer Price Index
ESC	Essential Services Commission of Victoria
FCM	Financial Capital Maintenance
MCE	Ministerial Council on Energy
MTFP	Multilateral Total Factor Productivity
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NGL	National Gas Law
NGO	National Gas Objective
NGR	National Gas Rules
OEB	Ontario Energy Board
PEG	Pacific Economics Group
PFP	Partial Factor Productivity
Rules	National Electricity Rules and National Gas Rules
TFP	Total Factor Productivity

Glossary of terms

Brattle Incentives Report	The Brattle Group, *Incentives under total factor productivity based and building-blocks type price controls*, June 2009.
Brattle International Review Report	The Brattle Group, *Use of total factor productivity analysis in network regulation: case studies of regulatory practice*, October 2008.
Building block approach	The approach specified by NER and NGR to determine the total revenue of a service provider. Total revenue is the sum of a return on the capital base, depreciation, corporate income tax, increments and decrements resulting from an incentive mechanism and forecast operating expenditure.
Capital module	A mechanism to manage extraordinary capital expenditure during a regulatory period.
Cost pass through mechanism	A mechanism to manage, and pass through to users, specific costs or savings that are incurred by a service provider during a regulatory period.
Depreciation	The amount representing the return to a service provider to cover its investment costs. This is calculated based upon the profile that reflects the nature of the assets over the economic life of the asset.
Economic Insights Data Availability Report	Economic Insights, *Assessment of data currently available to support TFP-based network regulation*, 9 June 2009.
Economic Insights Sensitivity Report	Economic Insights, *Energy network total factor productivity sensitivity analysis*, 9 June 2009.
External benchmarking	The comparison of a service providers actual or forecast costs to an exogenous reference level (for example, the most efficient business in the sector). A benchmark is deemed to be external if a business cannot influence the benchmark against which it is assessed through its own actions.
Expert Panel	Expert Panel on Energy Access Pricing
Fixed X	Where X is determined from an estimate of TFP growth and that estimate is fixed for the entire regulatory period.
Inputs	Those components which the service providers employs to provide its services.
Issues Paper	AEMC 2008, *Review into the use of total factor productivity for the determination of prices and revenues: framework and issues paper*, 12 December 2008, Sydney.
NAS Expenditure Profiles Report	Network Advisory Services, *Issues in relation to the availability and use of asset, expenditure and related information for Australian electricity and gas distribution businesses*, August 2009.
Normalisation	Adjusting data to account for differences in operating environment conditions.
Off ramp	A mechanism to manage service provider specific exogenous events during a regulatory period.
Outputs	The dimensions of services provided valued by customers.

P_0	Initial price or revenue cap set for the start of the regulatory period.
Perspectives on the building block approach	AEMC 2008, *Review into the use of total factor productivity for the determination of prices and revenues: perspectives on the building block approach, 30 July 2009*, Sydney.
Regulatory period	The period for which the terms of the regulatory determinations on allowed prices/revenue are set. Under the framework established under the NEL, this is referred to as the regulatory control period. Under the framework established under the NGL, it is called the access arrangement period.
Review	AEMC Review into the use of total factor productivity for the determination of prices and revenues.
Revised statement of approach	AEMC 2009, *Review into the use of total factor productivity for the determination of prices and revenues: revised statement of approach*, 28 April 2009, Sydney.
Rolling X	Where X is determined from an estimate of TFP growth that is annually updated using a rolling average approach.
TFP methodology	TFP based revenue and pricing methodology.
Victorian Proposal	Victorian Minister for Energy and Resources, *Rule change proposal to allow the use of total factor productivity methodology in distribution*, 18 June 2008.

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1 Introduction

The Australian Energy Market Commission (AEMC) is undertaking a review on the possible use of total factor productivity (TFP) for the determination of prices and revenues in regulatory decisions (Review).

This discussion paper responds to stakeholders' comments that further information on the design of a TFP based revenue and pricing methodology (TFP methodology) is required to enable them to reach a view on the relative merits of applying a TFP methodology.[1] This discussion paper presents a design as an example of a possible TFP methodology for consultation and discussion.

The background and purpose of this discussion paper, together with further information on proposed consultation is set out in the remainder of this chapter. This paper does not make any assessment on whether this or any other example of a TFP methodology would be consistent with the National Electricity Objective (NEO) or the National Gas Objective (NGO).

More details on the background and progress to date of the Review can be found in Appendix A.

1.1 Background to design

Stakeholders have commented that given the importance of the Review, more extensive consultation and stakeholder involvement is needed. A number of parties suggested that they would like a greater understanding of the details of a possible TFP methodology and its operation to be able to evaluate TFP, its associated issues and suitability for Australian energy regulation.[2]

The revised statement of approach acknowledged these points and noted that there are numerous choices or options that can be made when designing a TFP methodology. Accordingly, we undertook to:

- release consultant reports as they are concluded;
- prepare and release for consultation a example of a TFP design; and
- conduct more, and focused, discussions with parties on TFP design issues.

This discussion paper addresses the second of these points.

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1 AEMC 2009, *Review into the use of total factor productivity for the determination of prices and revenues: revised statement of approach*, 28 April 2009, p. 7. (Revised statement of approach) The revised statement of approach for the Review stated the need for a more co-operative approach with stakeholders on analysing the relevant issues before the release of the Review's draft recommendations.

2 Revised statement of approach, p. 7.

1.2 Purpose of the design

The particular TFP design in this paper has been prepared to encourage and enhance discussion on the possible application of a TFP methodology. This paper raises specific questions for comment and presents options on certain aspects to the design. The information obtained through this consultation will assist in the development of the draft report for this Review.

This discussion paper does not:

- represent a preferred design of a TFP methodology;
- imply that the design presented is consistent with the NEO and NGO;[3] or
- indicate that the AEMC has decided that this example, or any other example of a TFP methodology, should be adopted as an alternative methodology for economic regulation of the Australian electricity and/or gas sectors.

These are matters for the draft report of the Review.

The discussion paper focuses on the essential elements of a possible TFP methodology for the setting of revenue or prices for regulated service providers. Not all the details required for a functioning TFP methodology are covered in this example. Further work would be required on a number of elements before the design would be complete.

Of the essential elements, certain features have been selected in preference to others to form an example of a total TFP methodology suitable for consultation. In making these selections, regard has been had to the NEO and NGO and the revenue and pricing principles, as well as submissions and consultant reports, the previous analysis undertaken by the Essential Service Commission of Victoria (ESC) and the information contained in the Rule change proposal lodged by the Victorian Minister for Energy and Resources.[4]

The TFP design example set out in this discussion paper has been guided by the following criteria:

- consistency with the economic theory supporting the use of a TFP methodology;
- providing an incentive to minimise costs to the level of efficient costs and share those with users;
- supporting the efficient investment in assets and providing the opportunity to recover the capital and non-capital costs consistent with those incurred by an efficient service provider;

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3 NEL, ss. 7-7A and NGL, ss. 23-24.

4 Victorian Minister for Energy and Resources, *Rule change proposal to allow the use of total factor productivity methodology in distribution*, 18 June 2008. (Victorian Proposal)

- having regard to the possibility of variations in expenditure profiles of service providers in the future;
- good regulatory practice through clarity, certainty and transparency of the regulatory framework; and
- minimising the cost and impact of regulation.

Consideration has not been given to the adequacy of any existing data-set. Rather, the design has been developed under the assumption that the necessary data would be available. The TFP methodology should determine the required data rather than the existing data-set dictating the design of the TFP methodology.

Another focus has been the application of any TFP methodology in a broadly consistent manner to the electricity and gas distribution sectors.[5] There would necessarily be some differences in detail due to the current differences between the National Electricity Rules (NER) and National Gas Rules (NGR), and the particular needs of the sectors. However, where feasible the approach in this paper has been to form a TFP methodology that may be applicable to both sectors.

This discussion paper draws on, but does not discuss in detail, information on the theory of TFP and its use in economic regulation as well as information about the building block approach. Background material on these matters has been provided in the following chapter, the Issues Paper and various consultant reports prepared during the course of the Review.[6]

1.3 Consultation process

1.3.1 Consultant and AEMC reports

A number of consultant reports have been published as part of this Review which have aided the preparation of this discussion paper. The AEMC released its report *Perspectives on the building block approach* on 30 July 2009. Most recently, a report by Network Advisory Services (NAS) was released on 21 August 2009.[7] More details on these reports can be found in Appendix A.[8]

Stakeholders wishing to comment on any of the matters raised in any of these reports are invited to lodge their submission online through the home page of the AEMC's website by Friday 30 October 2009, quoting project reference number 'EMO0006'.

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5 The Revised statement of approach stated that the Review will now focus on the possible application of TFP to the electricity and distribution sectors and that the possible application to the transmission sectors will be assessed at a later stage. See Revised statement of approach, p. 9.

6 AEMC, *Review into the use of total factor productivity for the determination of prices and revenues: framework and issues paper*, 12 December 2008. (Issues Paper)

7 Network Advisory Services, *Issues in relation to the availability of use of asset, expenditure and related information for Australian electricity and gas distribution businesses*, August 2009. (NAS Expenditure Profiles Report)

8 All documents relating to this Review are available from the AEMC's website.

1.3.2 Workshops and submissions

As stated previously, the purpose of this discussion paper is to facilitate consultation through written submissions and discussion at planned workshops.

Consultation on matters contained in this discussion paper will take two forms. First, two workshops will be held to discuss key issues raised in this discussion paper. These workshops will be held during September 2009. One workshop will focus on gas distribution and the other on electricity distribution. All stakeholders will be invited to attend the workshops. Further details and invitations to attend will be provided shortly.

Second, written submissions are invited on any aspect of the possible TFP design as outlined in this discussion paper. Parties wishing to provide written submissions are invited to lodge their submission online through the home page of the AEMC's website by Friday 30 October 2009, quoting project reference number 'EMO0006'.

1.4 Way forward

As outlined above, the focus of this discussion paper is to obtain further information from stakeholders on TFP. This will be a valuable input into the development of the draft report for the Review.

In addition to the TFP design in this discussion paper and submissions and comments on it, the following will be taken into account in developing the draft report:

- submissions made by stakeholders throughout this Review process;
- reports from consultants commissioned by the AEMC;
- other information on TFP and the regulation of electricity and gas service providers in Australia and other jurisdictions;
- work carried out by ESC on the application and use of TFP in Victoria; and
- the Expert Panel's report.[9]

In taking into account this information, the draft report will address the question set out in the terms of reference for the Review.[10]

The stage 1 draft report of the Review will be released in December 2009. The remainder of the Review process will then follow the timetable set out below.

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9 Expert Panel on Energy Access Pricing, *Report to the Ministerial Council on Energy*, April 2006.

10 AEMC 2008, *Review into the use of total factor productivity for the determination of prices and revenues: terms of reference*, 21 November 2008, Sydney.

Date	Milestone
Public forum on the stage 1 draft report	late January 2010
Submissions on the stage 1 draft report due	late February 2010
Provide the stage 1 final report to the MCE	April 2010
Consultation on the stage 2 draft Rules (if required)	May 2010
Provide stage 2 final report on draft Rules to the MCE (if required)	June 2010

1.5 Structure of paper

The next chapter provides a brief explanation of TFP and the rationale for using TFP in incentive regulation. Chapter 3 provides a summary of the features of the TFP design presented in this discussion paper. Chapters 4-8 discuss more in detail the elements of that TFP design. Appendix A outlines the progress of the Review. Appendices B-D provide greater detail on TFP design issues.

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2 Rationale for a TFP methodology in incentive regulation

This Review is assessing whether a TFP methodology for regulatory determinations should be permitted as an alternative to the building blocks approach in the national energy markets. This chapter briefly sets out some of the theoretical context and concepts for the Review. It contains a brief description on what TFP is, how TFP can be useful in incentive regulation and the use of TFP growth estimates in setting regulatory paths. Other background information is also available in the Issues Paper.

2.1 What is TFP?

TFP measures how businesses, industries or regions use all the inputs in their production processes to produce outputs that are valued by customers and can identify the component of the change in outputs that is not explained by changes in inputs. TFP indices provide a way of comparing how productive businesses or industries use their resources. For example, an industry TFP growth index measures the rate at which the productivity of a group of businesses changes over time. However, such measures do not identify whether the average business or any particular business is 'technically efficient' as they do not attempt to measure whether the business is producing as much as possible with the given inputs.

2.2 Using TFP in incentive regulation

2.2.1 Aims of incentive regulation

The aim of incentive regulation is to provide strong incentives for regulated businesses to reduce costs, improve service quality, and undertake efficient investment. The incentive to reduce costs is provided by setting the prices or revenue to apply during the regulatory period at the start of the regulatory period, regardless of what actual costs during the regulatory period turn out to be. In doing so, incentive regulation attempts to replicate the discipline competitive market forces would impose on the regulated business if they were present. These forces compel businesses that realise productivity gains to pass these gains on to their customers in the form of lower prices (after accounting for changes in input prices).

There are two distinct aspects to incentive regulation: the initial level of the cap (on allowed revenue or prices) and the rate of change to the cap over time:

- The initial cap is estimated by the regulator to reflect the efficient level of costs for the business. Hence, the business is incentivised to out-perform that cap.
- The rate of change sets the allowed path at which the business's inflation adjusted prices or revenues may change over time. The rate of change is typically represented by a 'CPI-X' term.

The X factor consists of two aspects: the estimation of the expected efficiency gains of the industry net of the general economy wide efficiency growth and an allowance for

the difference between the growth of input prices for the business and the economy wide input price growth rate.

The initial level of the (price or revenue) cap and the rate of change to the cap – the X factor – can be set either according to business-specific analysis of costs, or on the basis of external benchmarks.

2.2.2 Building block approach

The building block approach determines the initial price or revenue cap and the rate of change (or price or revenue path) through the use of business specific information. The approach requires summing the indexation of the regulatory asset base and forecasts of the return on capital, depreciation, cost of corporate income tax, revenue increments or decrements resulting from the operation of an incentive scheme and the operating expenditure of a specific business.

The X factor under a building block approach is a business specific adjustment factor set to reflect the efficient level of expenditure that the business would need to incur over time to meet the required levels of service reliability and quality, expected demand growth and cost of capital financing. In doing so, the regulator is required to make assumptions about the future productivity of the business.

2.2.3 TFP methodology

TFP indices do not measure profitability or efficiency and therefore cannot help regulators to set the initial price or revenue cap at a level that gives the business a reasonable return. The initial price or revenue level must be determined by another method; for example, using a building block approach.

However, TFP indices can be used to determine the price or revenue path, providing an alternative to the building block approach of carrying out an analysis of business specific cost forecasts. Under a TFP methodology, the X factor is set according to an external benchmark. That is, the productivity performance (or rate of change in productivity) of a relevant 'industry group' (that is, group of comparable businesses) over time.

Under a TFP methodology, if the initial cap is set to recover the efficient level of costs (including capital funding costs), and the historical TFP growth rate reflects productivity growth that can be expected going forward, then the business should be able to earn a reasonable rate of return and recover efficient costs when TFP growth measures are used to determine the X factor.

A simple TFP methodology is where the X factor is set equal to the estimated TFP growth rate. However, overseas applications of a TFP methodology sometimes only use the TFP growth rate as a starting point for setting X and have taken into account other considerations. Therefore, additional components can be included in the determination of X. The term – sometimes referred to as a stretch factor – that incorporates these other considerations could be justified for a number of reasons. For example, to adjust the rate of change to allow for circumstances specific to the

regulated business or to better reflect the incentive performance in moving to a TFP based methodology. This is discussed further in chapter 8.

A TFP methodology could also be designed to incorporate other factors such as a capital module and off ramps. A capital module would create a provision for recovery of future increases in capital expenditure which would not be reflected in the TFP formula. An off ramp is a mechanism which provides the opportunity to intervene into a regulatory period prematurely and reset costs and prices by setting a new price cap level. Both concepts are discussed further in chapter 7.

2.2.4 Advantages and disadvantages of the methodologies

The current building block approach for revenue regulation provides a degree of certainty for investors as it is considered to be a well understood, relatively straight forward and stable process which yields sufficient incentives for service providers to seek cost efficiencies. Also, the building block approach has the potential advantage of being able to focus on the specific circumstances facing each service provider and to be forward–looking.

However, as reported in *Perspectives on the building block approach*, the building block approach has been criticized for:[11]

- failing to cater for innovation;
- being too resource and cost intensive;[12]
- requiring subjective judgments by the regulator resulting in a level of efficient prices being too low to allow for sufficient returns;[13]
- information asymmetry between the regulator and the service provider;
- leading to disputes; and
- being open to gaming by service providers.[14]

In addition, the building block approach:

- tends to focus on benchmarking a service provider against its own past performance rather than against an average or best industry performance; and

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11 AEMC, *Review into the use of total factor productivity for the determination of prices and revenues: perspectives on the building block approach*, 30 July 2009. (Perspectives on the building block approach)

12 A building block methodology is an information intensive exercise. Also, the preparation of and participation in this regulatory process is costly.

13 The analysis of what the service provider's efficient costs might be subjective and non– reproducible as it depends on professional opinion rather than an explicit model.

14 When applying a building block approach, the regulator invariably faces information asymmetry relative to the service provider and there is a risk the regulator can be 'gamed' by being misled about the true level of efficient costs and how quickly efficiency gaps can be bridged.

- may result in prices that are too high, permitting inefficiencies or excess returns to persist.

As a TFP methodology reduces the use of business-specific cost data, its proponents consider that it has high powered incentive properties by benchmarking service providers against industry wide productivity performance. Other potential benefits from a TFP methodology, compared with the building block approach, are:

- overcoming, or avoiding, the current information asymmetry problem;

- less likelihood of disputes (provided there is a generally accepted TFP methodology) since the allowed price path would be based upon historical industry wide data which would be known and measurable instead of relying on firm specific forecasts; and

- lower regulatory costs.

A potential disadvantage of TFP is that it is fundamentally dependent on the availability of high quality data to accurately calculate industry wide productivity trends. Collecting the required data through a transparent process that ensures the data to be clearly defined, consistent, comparable and reliable could increase the regulatory costs for businesses. Also, there may be disagreements upon the specification of the methodology used to calculate TFP growth (for example, defining the appropriate range of inputs and outputs).

The objective of this Review, is to determine under what circumstances the adoption of a TFP methodology, as an alternative to the existing building block approach, can be expected to deliver economic benefits.[15] This will involve assessing and balancing the advantages and disadvantages of the two methodologies in the light of the NEO and NGO and revenue and pricing principles. A key part of this assessment will be analyzing and specifying how a TFP methodology could be applied in the national energy markets. The TFP example presented in this discussion paper represents the development of a workable methodology to provide a more detailed basis for assessment and comment on the merits of the two regulatory approaches. The discussion and submissions on this paper will be of assistance to this assessment.

15 This includes the question to propose to the MCE to introduce or not TFP as an alternative methodology for revenue regulation.

3 Overview of TFP design

This chapter sets out the various elements of the TFP design example presented in this paper. The supporting reasoning and explanation behind the design elements are provided in the subsequent chapters. As a general principle, the same design would be used for the electricity revenue determinations and gas access arrangements.

Applying a TFP methodology

- A high level of prescription on the TFP methodology would be included in the NER and NGR. All the TFP principles, key mechanics (such as formulas, calculations and definitions), key rights and obligations and procedural requirements would be clearly and comprehensively established in the NER and NGR.

- In addition, the regulator would produce a set of non-binding TFP guidelines covering two aspects of the methodology:

    - technical matters on which the regulator would have discretion as a complement to the Rules; and

    - those aspects of the methodology that could be adapted by the service provider to its circumstances, subject to the regulator's approval..

- The initial selection of a TFP methodology and its continued application beyond the first regulatory control period would be a decision for the service provider. No approval of the regulator would be required.

- Once the service provider selects the TFP methodology for its regulatory determination, the same timetable and processes currently applicable for the building block approach would apply. The only change would be that for electricity, the regulator would have to prepare a framework and approach paper covering the possibility of a service provider using either a TFP methodology or a building block approach.

- The decision to revert back to using the building block approach after a regulatory period using the TFP methodology would lie with the service provider. No approval by the regulator would be required. The timetable and processes currently set out in the NER or NGR would apply.

- The principles and mechanisms of the TFP methodology would be locked in for a particular service provider and would remain unchanged for the entire regulatory period.

Calculating the TFP growth rate

- Only an index number approach would be permitted for calculating TFP. The regulator would choose the index number method it considers appropriate, provided the method chosen satisfies the important technical requirement of being 'superlative' (that is, it can provide a close approximation to an arbitrary smooth function).

- The specification for calculating the TFP growth rate (that is, inputs, outputs and weightings) would be prescribed in the NER and NGR. However, at this stage further analysis and consultation is needed to determine the correct specification.

- For defining the industry group, two options for further discussion are presented:

    (a) there would be one single TFP growth rate factor that would be applied to any service provider within the respective sector. This would be based on the average TFP growth rate for all regulated service providers in that sector; or

    (b) the industry would be divided into subsets according to operating conditions. There would be four sub-groups:

        (i) urban, high density

        (ii) urban, low density

        (iii) rural, high density

        (iv) rural, low density

- In both options, all service providers operating in the sector would be required to provide TFP data, even if they have not elected to use the TFP methodology themselves. For gas, all covered pipelines would be included (even if the covered pipeline is subject to light regulation).

- The regulator would only be permitted to remove a service provider from the calculation under exceptional circumstances such as if there are serious gaps or problems with the data provided by that service provider.

- Inclusion of data on any businesses which are outside the jurisdiction of the NEL or NGL (for example, overseas businesses) would not be permitted.

- The regulator would be required to use audited historical data as provided by the service providers. It would only be permitted to make adjustments to the data to:

        - adjust for structural differences to improve the consistency of the data (for example, for different classifications of services); or

        - to adjust certain years data for certain service providers because of exceptional circumstances.

- Any adjustments would be made transparent and done in accordance with the guidelines. The data-set used would be available to all service providers to allow them to undertake their own modelling (subject to any confidentiality issues). Normalising the data for operating environment differences would not be permitted.

- The regulator would have the option to decide whether to use an average annual growth rate approach or a regression–based trend method in calculating the TFP growth rate.

- The regulator would be required to use the longest time period that is possible provided that the available data is robust. It would also need to be consistent with a minimum time series of eight years of data being required before a TFP methodology could be applied to revenue determinations.

- If the service provider is subject to a rolling X under the TFP methodology then the inputs and output weights would be updated on an annual basis as well.

Setting the initial cap

- The method to set the initial price or revenue cap at the start of the regulatory period would be a partial building block approach where the regulator:

        - determines the level of operational and capital expenditure for that year based upon an reasonable assessment of actual costs incurred in the current period;

        - calculates the regulatory asset base in accordance with the existing roll forward methodology;

        - estimates the efficient rate of return for the duration of the new regulatory period in accordance with the existing methodology; and

        - estimates the efficient tax for the initial year in accordance with the existing methodology.

- This method would be used regardless of whether under the current regulatory period the service provider is using the building block approach or a TFP methodology. It would be applied both to electricity and gas distribution service providers.

Additional design terms

- Longer regulatory periods are consistent with a TFP methodology and would be available to service providers. This is consistent with the current provisions of the NER and NGR which provide service providers with the ability to propose an extended regulatory period under the building block approach. That is, for electricity service providers, a regulatory control period would be at least five years. For gas service providers, an access arrangement period could be of any length. Service providers and regulators would have the same level of discretion as currently exists.

- A cost pass through mechanism would be available for service providers to include in their revenue or access arrangement proposals at their discretion. The regulator would then respond to the proposed mechanism within the decision making process.

- A service provider could include a capital module in its proposed revenue or access arrangement to recover actual efficient, extraordinary significant increases in capital expenditure during a regulatory period. The regulator would need to be satisfied that the expenditure is outside the scope of the cost drivers that are taken into account in setting the X. Discussions with stakeholders would be needed to determine the most appropriate design of this module.

- Off ramps would be available under a TFP methodology. An off ramp mechanism would:

    - be proposed by the service provider or required by the regulator;

    - clearly specify the 'off ramp event' at the start of the regulatory period. This could be an specified event or a rate of return or revenue band (for example, that the actual rate of return varies by more than 20 per cent of allowed rate of return);

    - require an 'off ramp event' to be significant; and

    - require that the need and specification of an off ramp mechanism be assessed for each forthcoming regulatory period

- Service providers would propose the form of X (that is, either a fixed or rolling X) for the duration of the forthcoming regulatory period. In making its proposal, a service provider should take into account the length of the forthcoming regulatory period, and the use of off-ramps and cost pass through mechanisms.

- The service provider can propose any combination of the all design elements for the regulator's approval (similar to the current arrangements). The regulator's assessment on the proposed package would have regard to the NEO or NGO and the revenue and pricing principles.

- An efficiency carryover mechanism should be excluded from operating in conjunction with a TFP based methodology as it is not consistent with that methodology.

- Any efficiency carryover mechanism existing at the commencement of a TFP regulatory period should continue to run its course as initially planned.

- The existing demand management and service incentive schemes would continue to be available to service providers under a TFP methodology. There should be no difference in their operation that reflects a service provider's use of either a building block approach or a TFP methodology to the determination of revenues and prices.

Price path under a TFP methodology

- The allowed rate of change of the price cap under the TFP methodology would be calculated in accordance with the following formula:

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ consumer prices} - \{[\Delta \text{ industry TFP} - \Delta \text{economy TFP}] - [\Delta \text{ industry input prices} - \Delta \text{ economy input prices}]\}$$

- A separate measure for industry input prices growth would be included into the determination of the X factor, and prescribed in the Rules. Further work and consultation with the industry would be required to determine the most appropriate measure. The producer price index would be used for the economy input price growth term.

- An additional term would be included in the formula for determining the X factor to permit the regulator to make business specific adjustments. Such adjustments would only be justified if the regulator considers that the industry TFP growth rate should be adapted to reflect a significant difference in the productivity growth potential of that specified service provider. The regulator's decision would need to be consistent with the relevant national objective and the revenue and pricing principles. The adjustment could be positive or negative.

  Further analysis would be needed to develop the appropriate framework, including the potential use of benchmarking techniques, governing this decision.

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4 Applying a TFP methodology

Before discussing the elements of the TFP design, this chapter sets out some high level principles on how a TFP methodology could be included in the existing regulatory framework and applied.

4.1 Prescription in the Rules

Issue

An important consideration when designing a framework for TFP is the balance between setting out the principles and obligations for the service provider and regulator in the Rules and providing for flexibility and discretion through the use of guidelines. Hence, the relevant questions in respect of this issue are:

- what should be the level of specification of a TFP methodology included in the Rules? and
- is there a role for supporting guidelines, and if so, what form should those guidelines take?

There are areas of regulatory decision making that should involve the exercise of judgement and discretion by the regulator. This is because good economic regulation should be sufficiently flexible to adapt to the individual circumstances of regulated businesses across different periods of time. Importantly however, where the Rules confer discretions upon regulators, the Rules should also specify the criteria and scope for exercising those discretions.[16]

Design element

A high level of prescription on the TFP methodology would be included in the NER and NGR. All the TFP principles, key mechanics (such as formulas, calculations and definitions), key rights and obligations and procedural requirements would be clearly and comprehensively established in the NER and NGR.

In addition, the regulator would produce a set of non-binding TFP guidelines covering two aspects of the methodology:

- technical matters on which the regulator would have discretion as a complement to the Rules; and
- those aspects of the methodology that could be adapted by the service provider to its circumstances, subject to the regulator's approval.

16 AEMC, *Draft National Electricity Amendment (Economic Regulation of Transmission Services) Rule 2006*, Rule Determination, 16 November 2006, pp. 33-34.

Considerations

A sufficient level of prescription in the Rules for the application of a TFP methodology would be an essential precondition to ensure an acceptable level of regulatory predictability, transparency, clarity, certainty and investor confidence. It would also be required to maintain consistency with the existing regulatory regime.

In general, the AEMC's approach has been to include in the Rules those elements of a regulatory methodology and process which are comparatively uncontroversial, unlikely to need to vary in application across different service providers in different circumstances or which are necessary to be determined on an ex ante basis for the efficient administration of the regulatory process. The Rules should also contain the rights and obligations of service providers and the regulator.

Consistent with this, the Expert Panel made the point that the Rules should address matters that are likely to change relatively infrequently over time and that do not rely on an assessment of individual market conditions or circumstances.[17] A TFP methodology should be applied consistently across all service providers and should be stable over time. This is consistent with the Expert Panel's view.

One argument made against placing material aspects of a TFP methodology in guidelines is that stakeholders cannot seek a change to guidelines as guidelines can only be amended by the regulator at its instigation.[18] The NEL and NGL both provide a transparent, consultative Rule change process which allows any person to propose a Rule change. This supports the design example described in this paper which specifies the TFP methodology in the NER and NGR rather than in guidelines.

However, there would be aspects of the TFP methodology and process which would not be fundamental; these would include elements that could be at the regulator's discretion.[19] There would also be areas of the methodology that could be adapted by the service provider to suit its own circumstances (for example, the length of the regulatory period). For these elements, guidelines could provide assistance to service providers in the formation of their revenue or access arrangement proposals while still allowing flexibility.

The design example in this discussion paper provides a balance between prescription in the Rules and detail in guidelines. This is consistent with the current design of the building block approach for electricity revenue determinations.[20]

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17 Expert Panel on Energy Access Pricing, *Report to the Ministerial Council on Energy*, April 2006, p. 26.

18 This point was made in various submissions on the Victorian Proposal.

19 Regulatory discretion would be bound by criteria in the Rules. It would also be bound by legislation and good and consistent regulatory practice.

20 Under the current building block approach for electricity revenue determinations, Chapter 6 of the NER contains all high level building block principles, mechanisms and processes. It also provides limited discretion to the AER through non-binding guidelines.

4.2 Process for selecting a revenue methodology

4.2.1 Initial selection of TFP

Issue

Under this Review, a TFP methodology is being considered as an optional alternative to the current building block approach. Hence, a TFP methodology would only be applied on the initiation of the service provider.

In this context, the issue is whether the use of a TFP methodology by a particular service provider must be approved by the regulator.

Design element

The initial selection of a TFP methodology and its continued application beyond the first regulatory period would be a decision for the service provider. No approval of the regulator would be required.

Once the service provider selects the TFP methodology, the same timetable and processes currently applicable for the building block approach would apply. The only change would be that for electricity, the regulator would have to prepare a framework and approach paper covering the possibility of a service provider using either a TFP methodology or a building block approach.

Considerations

The possible benefit of the regulator having the ability to grant or refuse a service provider proposal to be regulated under a TFP methodology is that it would allow an assessment of whether the necessary conditions for a TFP methodology exist for that particular service provider.

The Issues Paper discussed two possible pre-conditions: having an adequate data-set; and that the industry has reached a steady state.[21] This design example includes a threshold test (regarding the length and quality of necessary data-set) before a TFP methodology would be permitted (see section 5.2.5). This test would be in the Rules as an objective threshold which would not involve any discretion by the regulator.

For the reasons set out in the NAS Expenditure Profiles Report, it is unlikely that the sectors will ever be in a 'steady state'. Any TFP methodology would need to be able to cope with future variations in the profile of expenditures. Accordingly, the need for such a pre-condition or threshold test decreases.

Importantly, if a TFP methodology were to be included into the NER or NGR then a decision would have been made that a TFP methodology is suitable for revenue and

[21] Issues Paper, pp. 17-22.

pricing determinations. To give the regulator an additional discretion over a service provider's choice of using a TFP methodology for its revenue or access arrangement proposal would create ambiguity.

Similarly, at the end of any regulatory period, the service provider would have the option to continue being regulated under a TFP methodology.

The existing regulatory frameworks in the NER and NGR are based upon the premise that a service provider develops and submits a proposal for its future revenue requirements to the regulator. Through a public consultation process the regulator then assesses the proposal against the relevant principles and criteria set out in the Rules and any relevant guidelines, and responds to the proposal. This should also be the underlying framework for a TFP methodology.

4.2.2 Selection of the building block approach after TFP

Issue

A service provider may decide to revert back to using the building block approach after having used a TFP methodology. In this case, similar questions arise with respect to the role of the regulator and the process to be implemented. Again, the issue is whether the regulator should have the ability to override the service provider's selection of a revenue methodology.

Design element

The decision to revert back to using the building block approach after a regulatory period using the TFP methodology would lie with the service provider. No approval by the regulator would be required. Once the service provider selects the building block approach for its revenue methodology, the timetable and processes currently set out in the NER or NGR for the building block approach would apply.

Reverting back to the building block approach after using a TFP methodology should only be possible after at least one regulatory period. It would not be feasible to change within a regulatory period.

Considerations

The Victorian Proposal raised a concern about giving the service provider the ability to move between a TFP methodology and the building block approach. It considered that giving service providers the ability to select methodologies may encourage them to seek to change their methodology when it would deliver a short term financial benefit. This would provide scope for windfall gains to service providers as well as increasing the administrative cost of the whole regulatory regime.

An example of this behaviour is where the service provider does not spend any capital expenditure while under a TFP methodology and then, in the subsequent period, seeks a higher expenditure allowance under the building block approach. To

address this, the Victorian Proposal suggested that the agreement of the regulator would be needed before a service provider could return to using the building block approach.[22] However, giving the regulator the ability to override the service provider's choice of methodology would not be required. Any expenditure gaming could be prevented:

- by the fact that the service provider would be required to maintain a safe, reliable network in accordance with its licence conditions; and
- when the regulator is determining the efficient level of expenditure under the building block approach it can have regard to previous levels of expenditure, irrespective of what revenue methodology was applied in the previous regulatory period.[23]

Also, it could be difficult to provide an objective framework for the regulator to make such a decision. Providing such discretion would create significant regulatory uncertainty. This could decrease the likelihood that service providers would seek to use a TFP methodology in the first instance.

The design example in this paper proposes that the regulator should be given the option to include off ramps in a TFP methodology where it considers it appropriate. This would give the regulator a mechanism to prevent the service provider from capturing excess profit under a TFP methodology.

4.2.3 Amending a methodology during a regulatory period

Issue

Once a TFP methodology is applied for a regulatory period, modifications to the calculation formula may improve the accuracy of the growth estimate. For example, the set of inputs or the scope of the service providers included in the industry group could be changed if better data becomes available.

The issue in this regard is whether the possibility of modifications to a TFP methodology (as they apply to a particular service provider) could be permitted during a regulatory period.

Design element

The principles and mechanisms of a TFP methodology would be locked in for a particular service provider and would remain unchanged for the entire regulatory period.

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22 Victorian Proposal, p. 21.

23 It should be noted that under the current building block approach there already exists some potential for regulatory gaming due to information asymmetries between the regulator and the service provider.

Considerations

No modifications should be allowed to amend any aspects of a TFP methodology as applied to a service provider during a regulatory period. Such changes would undermine investor confidence and regulatory certainty. Also, a TFP methodology would include mechanisms and procedural requirements embedded in the NER and NGR. Changes to these terms during a regulatory period may be inconsistent with the provisions of NEL and NGL.[24]

Hence, any change made to these Rules (or the relevant guidelines) would only be relevant to service providers lodging proposals after the date when the Rules or guidelines have changed. This means that, among other things, the calculation methodology of the growth rate would not alter for the duration of a regulatory period for a service provider.

This does not preclude the possibility of use of a rolling X. While the value of X would be updated annually, the methodology used to calculate the X would remain constant.

24 See NEL, schedule 2, clause 33 and NGL, schedule 2, clause 41.

5 Calculating the TFP growth rate

This chapter discusses the elements to the methodology relating to how to calculate the TFP growth rate for determining the X factor. It supports the use of an index number based methodology and discusses each aspect of the calculation needed to compute a TFP index.

Measuring the productivity of network and pipeline businesses presents a number of challenges. Each aspect involves making choices to establish a clear approach to calculating the index. Substantial work has been done by ESC (with Dr Kaufmann of Pacific Economic Group (PEG)) and by Dr Lawrence of Economic Insights on developing an index–based methodology suitable for Australia. This chapter draws heavily on those streams of work. The chapter also has regard to the Economic Insights Sensitivity Report, which shows that the calculation of TFP growth rates can be very sensitive to specification and calculation choices.[25] It is acknowledged that there is no agreed settled approach and this chapter highlights the different perspectives and identifies where further work is needed.

5.1 Appropriate methodology

Issue

To estimate TFP growth a method is needed to combine changes in the quantities of a diverse range of outputs and inputs into measures of the respective change in total output quantity and total input quantity. There are two broad approaches to this - the index number approach and the econometric approach.

There are a number of alternative methodologies that can be used under the index number approach. The differences between these methodologies mainly relate to the method of aggregating changes in individual components into the change in the overall output or input measure.

Design element

Only an index number approach would be permitted for calculating TFP. The regulator would choose the index number method it considers appropriate, provided the method chosen satisfies the important technical requirement of being 'superlative' (that is, it can provide a close approximation to an arbitrary smooth function). The regulator would specify the index number form in guidelines.

25 Economic Insights, *Energy network total factor productivity sensitivity analysis*, 9 June 2009. (Economic Insights Sensitivity Report)

Considerations

There are a number of reasons why an index method, rather than an econometric method, would be preferred. The index number method is relatively transparent and the results are readily reproducible. There is no practical limitation on the number of outputs and inputs that can be considered in the index number analysis. This is important since the TFP growth index ideally needs to include as many of the business's inputs and outputs as possible. Also, in practice index number approaches are predominantly used, particularly where there are a limited number of observations available.

There are a number of alternative index number forms that could be used. In practice, the Fisher and the Törnqvist index number forms are the most common. Under most scenarios and given the characteristics of energy distribution, these two methods should produce similar results.[26]

This design would provide the regulator with the flexibility to decide which index method would produce the most accurate result (which could be the Fisher index, the Törnqvist index or another 'superlative' method). In making this decision, the regulator should have regard to the extent and characteristics of the available data-set. The relevant Rules would require that the regulator specify, in detail, its chosen method in guidelines.

5.2 Design of an index methodology

Whichever particular index number form method is used, the following items would be needed to calculate the industry TFP growth rate:

- specification of the service providers' outputs and how to measure each of them;
- specification of the service providers' inputs and how to measure each of them;
- the methodology for determining the weights for each output and each input;
- a selection of the group of comparable service providers (defining the industry) over which to calculate the measure;
- form of the growth rate calculation; and
- the time period over which TFP growth is to be calculated.

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26 PEG has used the Törnqvist index method but has noted that in practice Törnqvist index results are little different to those of the Fisher index. Economic Insights has noted that the Fisher index technique is increasingly favoured by statistical agencies because it satisfies all the desirable axiomatic properties for price and productivity indexes. Economic Insights noted that the Fisher and Törnqvist index methods produce very similar results where the shares of the items being aggregated are relatively stable over time. Where shares tend to increase rapidly from very low values (eg. where the uptake of a new technology suddenly increases), the Törnqvist index method can produce inaccurate results where the Fisher index will continue to produce accurate results in this situation. Economic Insights Sensitivity Report, pp. 22-23.

5.2.1 Outputs, inputs and appropriate weights

Issue

TFP is defined as the change in total output quantity divided by the change in total input quantity between two periods. To calculate this, both sets of outputs and inputs attributed to the industry need to be specified. In addition, a weighting must be allocated to each output quantity to calculate the output index. Likewise, in order to produce the input index another set of weightings is needed for each input quantity. The weightings must be reflective of the relative contributions of the inputs and outputs. The issue is: what is the correct specification to calculate the TFP growth rate.

Design element

The specification for calculating the TFP growth rate (that is, inputs, outputs and weightings) would be prescribed in the NER and NGR. However, at this stage further analysis and consultation is needed to determine the correct specification.

Questions for comment and discussion

- What should be the correct specification of inputs and outputs to be used to calculate the TFP growth estimate?
- Is the proposed set of criteria to identify the correct specification appropriate?

Considerations

The specification of the output and input components included in the TFP calculation needs to reflect accurately the industry characteristics. The output measures used should represent the basket of services provided by the industry. Customer numbers, system capacity, peak demand and volumes would be the main output dimensions included. Similarly, the range of inputs used in the TFP growth rate calculation should reflect as many of the factors of production and purchased inputs used by network service providers as possible.

The specification of network outputs and inputs and the approach to weighting has varied across those jurisdictions that have adopted a TFP methodology.[27] There has been debate within Australia on the most appropriate methodology. Two possible specifications have been debated: the PEG/Kaufman specification developed for the ESC; and an alternative specification developed by Lawrence which has formed the basis of New Zealand's electricity distribution regulatory regime as well as having been applied in Australia. The key differences between these two approaches are:

[27] The Brattle Group, *Use of total factor productivity analysis in network regulation: case studies of regulatory practice*, October 2008, pp. 4-6. (Brattle International Review Report)

- measuring the capital input quantity: Lawrence argues that physical measures of capital (for example, line capacity times length and transformer capacity) provide the best proxy to the quantity of annual capital input given the physical deterioration characteristics of network assets. PEG/Kaufman advocates deflated asset value based quantity proxies;

- outputs to be included: Lawrence advocates using a functional output coverage including a network capacity measure as an output. PEG/Kaufman argues that the output measures should be only those billed items which regulated tariffs are based upon.

- output weights: PEG/Kaufman recommends using revenue share weights while Lawrence argues for using output cost share weights on the basis that revenue shares may not accurately reflect underlying costs given the non–competitive nature of the industry (that is, price will not equal marginal cost in these industries).

Further explanation on the reasoning behind the two specifications and the differences is contained in Appendix B. There are some common issues with both specifications relating to how to include quality of service measures and treat system security expenditure. These are also discussed in Appendix B.

Criteria to determine calculation methodology

It is suggested that a physical capital input measure should be used to realistically reflect the actual depreciation profile of the assets employed. Also, this should not affect the ability of the service provider to recover its regulatory asset base and would be consistent with the revenue and pricing principles. In relation to the outputs debate, the rationale put forward by ESC – that actual revenue shares must be used to be consistent with allocative efficiency – seems theoretically correct. However from a practical perspective, given the processes and considerations that go into establishing tariff structures, the current revenue shares may not appropriately reflect the value placed on each output by the consumer.

Economic Insights has recently shown that this proposition is based on the assumption that the energy distribution industry exhibits the characteristics of a competitive industry. When the increasing returns to scale nature of the industry and the role of sunk cost assets is taken into account allocative efficiency requires that all functional outputs (of which billable outputs will be a subset) be included and the deviation of market prices from marginal costs be allowed for (see Appendix D).

To assist any further analysis in this area, the following set of criteria to determine the appropriate specification is proposed:

- results in a stable index over time;

- creates no systematic bias in the TFP growth estimate;

- is consistent with promoting economic efficiency and does not result in any perverse incentives;

- is consistent with the service provider's regulatory asset base; and

- results in reporting requirements which are proportionate and not onerous.

Importantly, the views of stakeholders need to be incorporated into this, as a TFP methodology will only be used if the service providers themselves have confidence in the specification used for the TFP calculation. Therefore, comments on both the debate between Lawrence and PEG/Kaufman and also the proposed criteria to determine the correct specification are sought.

5.2.2 Defining the industry

Issue

Definition of the group of service providers that would be used to calculate the industry TFP growth rate is required. The options for defining the industry are:

- any selection of businesses, including overseas businesses, as considered appropriate by the regulator;
- all regulated businesses in the relevant sector; or
- a subset of regulated businesses selected in accordance with defined criteria.

Design element

Two options for further discussion are:

(c) there would be one single TFP growth rate factor that would be applied to any service provider within the respective sector. This would be based on the average TFP growth rate for all regulated service providers in that sector; or

(d) the industry would be divided into subsets according to operating conditions. There would be four sub-groups:

(v) urban, high density;

(vi) urban, low density;

(vii) rural, high density; and

(viii) rural, low density.

In both options, all service providers operating in the sector would be required to provide TFP data, even if they have not elected to use the TFP methodology themselves. For gas, all covered pipelines would be included (even if the covered pipeline is subject to light regulation).

The regulator would only be permitted to remove a service provider from the calculation under exceptional circumstances, such as if there are serious gaps or problems with the data provided by that service provider. Inclusion of data on any

businesses which are outside the jurisdiction of the NEL or NGL (for example, overseas businesses) would not be permitted.

Questions for comment and discussion

- Is a single X factor for all regulated service providers in the sector appropriate? Or, would it be necessary to divide the sector into four subsets according to operating environment conditions or customer density?

Considerations

The selection of the industry group for the TFP growth rate calculation is a key element of a TFP methodology. Service providers would need to have a clear understanding of how the group would be determined. Thus clear prescription in the Rules on this would be needed.

Setting the industry as all the regulated service providers in that sector (for example, all electricity distribution service providers operating in the NEM) would ensure that the TFP growth rate is more comprehensive and representative of conditions for the entire regulated industry. In addition, a single X factor is easier to implement and administer and would promote the stability of a TFP methodology.

Alternatively, the sectors could be sub-divided, forming a number of TFP industry groups. However, given the small number of businesses within both distribution sectors, any attempt to sub-divide is likely to result in TFP estimates that are able to be readily influenced by the behaviour of one service provider within the sub-sector. This would undermine the incentive properties of a TFP methodology.

Importantly, any division of the regulated service providers into sub-groups could be to be relatively contentious. Also, having multiple industry groups within a sector could give businesses ongoing incentives to redefine industry definitions to their own advantage.[28]

Parties may argue against having a single TFP factor on the grounds that there are substantial differences in the operating conditions and current productivity levels within the sector. This would suggest that the sector as a whole is not a comparable industry group and the resulting TFP rate is not suitable. In response to this, it is noted that the TFP growth rate is used to set the allowed rate of change and not the initial price level. The initial price or revenue would be set to reflect each service provider's operating conditions and practices. Also, TFP results for Victoria supports the view that while different operating conditions would impact on the level of productivity, such differences do not have a substantial impact on the rate of change of TFP.[29]

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28 For example, to define the industry aggregates so that their business is placed within a group that has the lowest observed historical TFP growth rates and hence, the lowest X factor.

29 ESC submission, March 2009, p. 13.

However, it is noted that there has been no opportunity to objectively test this result using different specifications or a broader range of service providers. It may be the case that rural service providers, for example have fewer opportunities to utilise recent developments in technology. Rural service providers may have slower growth rates or more challenging topography and hence have fewer productivity growth opportunities.

In chapter 8, it is suggested that there could be merit in permitting the regulator to make business specific adjustments to the TFP growth rate in determining the appropriate X factor. Such adjustments could recognise any significant differences in the operating environments and the commercial structures of the various service providers.

Given this option, it appears appropriate for a single TFP growth rate to be calculated for all the regulated service providers in the sector. However given the importance of this, an alternative approach, of dividing the sectors into sub-groups by operating conditions, should be considered. This could be a simple division between urban and rural based service providers or, for further disaggregation, also split on the grounds of whether the service provider has a low or high density customer base. This may increase the likelihood of service providers seeking to be regulated under a TFP methodology but, as noted above, there appear to be difficulties in using sub-groups.

Use of overseas data not permitted
Electricity service providers strongly disagreed with the Victorian Proposal to allow the AER the option of including overseas distribution data for the calculation of the industry TFP estimate. Service providers considered that it would be highly problematic to include data from overseas jurisdictions due to differences in accounting policies, tax laws and corporate structures. These concerns are accepted. Accordingly, under this example inclusion of data from businesses that operate outside the jurisdiction of the NEL and NGL would not be permitted. It is noted that there may still be a role for reference to overseas results as a means of 'sanity checking' results obtained from NEL and NGL jurisdiction data.

5.2.3 Adjustment to the data-set

Issue

This TFP design assumes that a robust, consistent and long term data-set covering all the necessary data variables is available for the TFP calculation. Even under this assumption, there may still be a need for the regulator to make adjustments to the data for calculating the TFP growth rate. The reasons for this could be to:

- make explicit adjustments for differences in operating environment conditions (normalisation);
- permit the regulator to clean up the data;
- adjust for exceptional circumstances; or

- adjust the data for scale effects.

The issue to consider is whether such adjustments should be permitted under a TFP methodology.

Design element

The regulator would be required to use audited historical data as provided by the service providers. It would only be permitted to make adjustments to the data to:

- adjust for structural differences to improve the consistency of the data (for example, for different classifications of services); or

- adjust certain years' data for certain service providers because of exceptional circumstances.

Any adjustments would be made transparent and done in accordance with the guidelines. The data-set used would be available to all service providers to allow them to undertake their own modelling (subject to any confidentiality issues). Normalising the data for operating environment differences would not be permitted.

Considerations

Normalising the data for operating environment differences
The regulator should not be given the ability to adjust the data-set to normalise for operating environment differences. There is the possibility that such adjustments would be subjective and would introduce a degree of contention into the TFP methodology.[30] Differences in operating conditions would be allowed for in the starting price (and possibly, business specific adjustments to the X factor) under a TFP methodology.

Cleaning up the data
There are a number of structural issues which may affect the comparability of the data across service providers within the same sector. These could be due to differences in the classification of services or in the service providers' capitalisation policies. In such cases, it would be appropriate to permit the regulator to adjust the data in order to improve the consistency and comparability of the data-set. A better long term solution to this problem, however, would be to ensure all service providers supply TFP data on the same basis and subject to the same rigorous and detailed definitions.

Any adjustments in the short term must be made transparent and be done in accordance with the guidelines published by the regulator. Stakeholders have criticised the ESC calculations on the grounds that it has made periodical adjustments to audited historical information at its discretion and in a non-

30 The Victorian Proposal included the assumption that normalisation should be excluded because all service providers have the same opportunities with respect to technical change and economies of scale and scope. This proposition is largely untested.

transparent manner. It is claimed that this has made it impossible for the service providers to understand and replicate the TFP estimate.

Exceptional events
It would also be necessary to permit the regulator to make data adjustments for certain service providers because of exceptional circumstances. For example, the impact of severe storms may result in data for a particular year that is unlikely to be representative of the future.

The ability to adjust data in such cases is more appropriate than simply excluding the data for these years as the latter would lead to non like-with-like comparisons over time and potentially large distortions in the TFP growth rate. These exceptional events could be dealt with on a case by case basis and would often be straightforward to identify.

Economies of scale effects
Economies of scale effects could potentially be present in a TFP analysis because strong scale economies will mean that when output is increasing over time, unit costs would tend to decrease even in the absence of any change in underlying productivity. Therefore, if there are economies of scale, unadjusted estimates of TFP growth could overstate the underlying trend during a period of increasing volumes. In the UK, including a scale effect in the estimation methodology reduced the calculated TFP growth by 0.2% to 0.3%.[31]

Although it is recognised that there could be economies of scale effects present in the network and pipeline sectors, no adjustment for these would be allowed for the same reasons that no adjustments for operating environment conditions would be allowed. Such adjustments would be subjective and would introduce a degree of contention into the TFP methodology. Differences in scale economies would be allowed for in the initial price cap (and possibly, business specific adjustments to the X factor) under a TFP methodology.

5.2.4 Approach to calculating the TFP growth rate

Issue

Another issue with calculating the TFP growth rate is the method to apply. TFP studies have differed in their approaches to the method used to calculate the TFP growth rate. PEG/Kaufman has used the average annual growth rate between the first and last observations calculated using the logarithm of the ratio of the index values divided by the difference between the first and last years. Lawrence, on the other hand, has used a regression–based trend method which regresses the logarithm of the relevant variable against a constant and a linear time trend. The time trend regression coefficient is then the relevant growth rate.

[31] Brattle International Review Report, p. 27.

Design element

The regulator would have the flexibility to decide whether to use an average annual growth rate approach or a regression–based trend method in calculating the TFP growth rate.

Considerations

Whether the difference between the two methods is material depends on whether the relevant series is stable or volatile and whether the first and last observations are relative outliers from the trend of the intervening years. The example provided in the Economic Insights Sensitivity Report showed that there could be a substantial difference in the TFP growth rate between using either the average growth rate or the trend growth rate.[32]

Accepting that the choice could have a material impact on the level of X, it is appropriate for the regulator to make the relevant choice. For transparency and certainty, the regulator would be required to specify its method in the TFP guidelines and commit to that method for the duration of a service provider's regulatory period.

5.2.5 Time period for measurement

Issue

A defined time period over which to calculate the TFP growth rate is needed.

Design element

The regulator would be required to use the longest time period that is possible provided that the available data is robust. It would also need to be consistent with a minimum time series of eight years of data being required before a TFP methodology could be applied to revenue determinations.

Considerations

The rationale for using historical TFP growth rates to determine the allowed rate of change in prices is that the historical rate is representative of the long term productivity growth of the industry. Therefore, since TFP growth rates tend to fluctuate yearly, it is preferable to use the longest historical time period possible to conduct the TFP growth rate calculation. In particular, TFP growth rates calculated over a longer term will mitigate the impact of short run cyclical variations (including that of the business cycle), temporary and one-time events. Given this, a threshold period of eight years would be needed. In addition, it is most appropriate to use the most recent data unless the recent past exhibits anomalous events.

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32 Economic Insights Sensitivity Report, p. 22.

5.2.6 Fixed or annually varying weights

Issue

An issue for the TFP growth rate calculation is whether to vary the allocated weights over the sample period or to leave them fixed for the whole sample period. The rationale for varying the weights is that it would reflect the relative contributions of the input and output components as they change over time.

Design element

If the service provider is subject to a rolling X under the methodology then the inputs and output weights would be updated on an annual basis as well.

Considerations

PEG/Kaufmann has modified its methodology for calculating the Victorian TFP growth rate from using fixed average weights to adopting an annually varying weights approach for determining the output index, where the revenue weights were updated annually in all years for which revenue share data were available.

This option should only be applicable if the service provider is subject to a rolling X under a TFP methodology. If a service provider elects to use a fixed X for the duration of the regulatory period then it would not be appropriate for the regulator to amend that level to account for changes in the weights.

In principle, where sufficient information exists to produce year–specific weights these should be used as it improves the accuracy of the TFP growth estimate.[33] Therefore, if the regulator agrees to a service provider's request to have a rolling X, then weights would be adjusted as well.

[33] But in some cases (such as where econometric output cost shares have to be used) an overall average share may have to be used across all observations.

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6 Setting the initial cap

This chapter discusses setting the initial price or revenue cap for a regulatory period under a TFP methodology. The TFP design in this paper makes use of a form of the building block approach. This is appropriate because it would set the efficient costs in the end-year of the concluding regulatory period by an assessment of actual expenditure plus applying the current arrangements for rolling forward the asset base and determining the rate of return for the forthcoming regulatory period.

6.1 Issue

Under a TFP methodology it is assumed that if the initial price represents a level of efficient costs, and prices in subsequent years change according to an industry wide productivity growth measure, then the service provider would earn a reasonable rate of return and recover efficient costs. However, TFP growth estimates do not by themselves provide information on the efficient cost recovery price (or revenue) level for the service provider. Accordingly, a method is needed to determine the efficient initial price for the start of the new regulatory period (which is the efficient price for the last year of the current regulatory period).

There are a number of possible approaches to determining the initial cap under a TFP methodology. These range from accepting the previous year's price as allowed under the price cap to applying a one-year building block approach. Further, in using a building block approach the issues are whether actual expenditure amounts or forecasts are used and the discretion given to the regulator to determine the starting cap.

Another issue to consider is whether the same method can be applied both to where a service provider is applying TFP for the first time as well as where the service provider is continuing with TFP from a previous period.

6.2 Design element

The method to set the initial price or revenue cap at the start of the regulatory period would be a building block approach under which the regulator would:

- determine the level of operational and capital expenditure for that year based upon a reasonable assessment of actual costs incurred in the current period;
- calculate the regulatory asset base in accordance with the existing roll forward methodology;
- estimate the efficient rate of return for the duration of the new regulatory period in accordance with the existing methodology; and
- estimate the efficient tax for the initial year in accordance with the existing methodology.

This method would be used regardless of whether under the current regulatory period the service provider is using the building block approach or a TFP methodology. It would be applied both to electricity and gas distribution service providers.

Questions for comment and discussion

- What would be the impact on service providers' incentives to improve performance under this design example?
- What would be the impact on service providers' ability to recover efficient costs under this design example?
- Should the regulator have the discretion to refer to other information, such as forecast costs, when setting the initial price or revenue cap?

6.3 Considerations

The periodic alignment of prices to costs does detract from the incentive properties that are gained from breaking the link between prices and costs within a period under a CPI-X framework. However, if the gap between prices and costs becomes significant and/or exists for some time, then the service provider would earn either more or less than a reasonable rate of return. This would impact on the ability of investors to earn a reasonable rate of return. For these reasons, a periodic resetting of prices to costs is a desirable feature of a regulatory regime.

Therefore, accepting the existing price cap as the initial price cap for the new regulatory period is not the appropriate approach. A method to determine the level of prices which reflects the costs of the service provider is needed at the start of each regulatory period under a TFP methodology.

A building block approach in accordance with the existing framework would require forecasts of costs and demand over a defined period.[34] However, such a method is counter to the key aspect of TFP – to avoid reliance on business specific forecasts. Also, if this approach were adopted it would result in a TFP methodology requiring the same resources and processes as the building block approach. It would also suffer from the disadvantage of information asymmetry that is difficult to overcome.[35]

An alternative method would be to use actual operating and capital expenditure data for the current period. For example, if a five year regulatory period were operating, the most recent actual data available for inclusion in a revenue or access arrangement proposal is from year three. Year three data could be adopted as a proxy for year five without adjustment.

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34 It is unlikely that forecasts for a single year would be sufficient as the regulator would want to understand the profile of expenditure in order to assess the efficiency of costs in that year.

35 For further discussion, see Perspectives on the building block approach.

However, it would be more appropriate to permit the regulator to make an assessment of whether the actual year three data is the best estimate of costs for year five and to make any adjustments accordingly. For example, the regulator may adjust for expected volume growth between year three and year five. In making this decision, the regulator would have regard to actual cost data in other years in order to mitigate the risk of the service provider loading up on costs in year three and the existing expenditure criteria set out in the NER or NGR.[36]

Using actual operating and capital expenditure data is consistent with the overall objectives of TFP. With this data it is proposed that the regulator use:

- the current roll forward approach for the regulatory asset base (and depreciation); and
- the current approach to the rate of return and tax.

It would also allow the asset base roll forward process to continue without any alteration or adjustment according to revenue methodology. Similarly, the current approach to calculating the rate of return for the duration of the forthcoming regulatory period and the resulting tax allowance would continue.[37] This is preferable to the use of actual return and taxation information.

However, this approach does rest on the assumption that the historical data is a reasonable indicator of future costs. While this is consistent with TFP, it does raise the issue of how to manage expected increased forecast costs. The design example in this paper provides mechanisms to manage such a situation. The capital module, cost pass through and off ramp mechanisms are all discussed in chapter 7.

The information required for determining the initial price or revenue cap under this approach is available to service providers and regulators when the service provider is moving from a building block approach period to a TFP period and in moving between TFP periods. Accordingly, the same method would apply in both situations.

36 NER, clauses 6.5.6-6.5.7 and NGR, rules 79 and 91.

37 This does not preclude the regulator from calculating a different return under TFP compared to the building block approach.

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7 Additional design terms

This chapter discusses a number of design features of a TFP methodology. First, a number of elements whose use and details of application can be proposed by the service provider and assessed by the regulator are considered. Secondly, the existing incentive mechanisms and their application under a TFP methodology are discussed.

7.1 Flexible design features

Certain aspects of a regulatory regime that are centred on the use of TFP to determine a revenue or price path would be most appropriately specified in the NER and NGR. These elements of a regime are the more critical features, such as the methodology to calculate the TFP growth index.

However, there are a number of other elements to a TFP methodology where it is appropriate, with the regulator's approval, to give the service provider the flexibility to adapt the methodology to its own circumstances. The processes and framework for determining these individual elements and the overall assessment would be set out in the Rules and, where appropriate, would be similar to the current arrangements under the building block approach.

Service providers and the regulator would need to strike a balance between the various objectives of the NEO or NGO and the revenue and pricing principles.

The following flexible, or discretionary, elements of the design are discussed in turn below. These are:

- the length of the regulatory period;
- the use of cost pass through mechanisms;
- the use of a capital module;
- the use and operation of off ramps; and
- the form of X.

7.1.1 Length of the regulatory period

Issue

In using a building block approach, a five year term has emerged as the most frequently used regulatory period for service providers and regulators. It is the minimum term specified by the NER for electricity determinations.[38] The issue for

[38] See NER, Chapter 10 and clause 6.12.3.

consideration is what would be the appropriate term for a regulatory period where a TFP methodology has been used.

Design element

Longer regulatory periods are consistent with a TFP methodology and would be available to service providers. This is consistent with the current provisions of the NER and NGR which provide service providers with the ability to propose an extended regulatory period under the building block approach.

For electricity service providers, a regulatory period would be at least five years. For gas service providers, a regulatory period could be of any length. Service providers and regulators would have the same level of discretion as currently exists.

Questions for comment and discussion

- Should a regulatory period longer than five years should be set in the NER and NGR for a service provider using a TFP methodology?

Considerations

A claimed benefit of TFP is that longer regulatory periods can be used without requiring long term forecasting of costs or demand. A longer period generates some cost savings in that the periodic realignment of prices and costs is less frequent. It also provides a longer time horizon for a service provider to retain any cost savings that it is able to generate. This gives a service provider a greater incentive to seek out those efficiencies.[39]

The current relevant provisions of the NER and NGR allow regulatory periods beyond the commonly used five years to be adopted with the approval of the regulator, although the details differ slightly between gas and electricity.[40]

At present all service providers have some discretion in proposing the term of the regulatory period for their revenue or access arrangement proposal to the regulator for its assessment and response. If a service provider is particularly concerned with the opportunity to recover efficient costs it may propose frequent realignments of

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39 The counter to this is that users will wait longer for their share of the efficiency gains.

40 Chapter 10 of the NER currently states that a regulatory control period (for both transmission and distribution service providers) must be at least five years. This is also specified in clauses 6.3.2 and 6A.4.2 of the NER. In addition, clauses 6.12.3 and 6A.14.3 of the NER state that if a service provider includes a regulatory control period of five years in its revenue proposal then this must be approved by the regulator.
The current provisions of the NGR for full access arrangements that are not lodged voluntarily require a service provider to propose a term for the forthcoming access arrangement period by specifying the review submission date and revision commencement date. However, rule 50 of the NGR also states that under certain conditions, the regulator must approve a proposed access arrangement period of five years. Nevertheless, subject to that provision, any period can be proposed and approved provided that it is consistent with the NGO and revenue and pricing principles. Unlike under the NER, there is no specified minimum term.

prices and costs (that is, shorter regulatory periods). However, this may limit the incentives for the service provider to seek productivity improvements. Conversely, a service provider may elect for a longer period to capture the gains from efficiency improvements.

It is clear and well understood that a longer regulatory period does increase the incentives for service providers to improve their performance.[41] This is true under a building block approach as well as under a TFP methodology.[42] It is appropriate for service providers to have the ability to propose a term for their forthcoming regulatory period and for the regulator to respond to the proposal. For both parties, regard should be had to other aspects of the revenue or access arrangement proposal.

7.1.2 Cost pass through mechanisms

Issue

Cost pass through mechanisms are currently available to both electricity and gas distribution service providers. These mechanisms aim to allow certain costs or savings incurred by a service provider during a regulatory period to be passed through to users. In principle, the events leading to the cost or savings should outside the service provider's control (for example, changes to the corporate tax rate). To include controllable costs would detract from the incentive to reduce costs that exists under a CPI-X mechanism. The issue is whether a cost pass through mechanism is compatible with a TFP methodology.

Design element

A cost pass through mechanism would be available for service providers to include in their revenue or access arrangement proposals at their discretion. The regulator would then respond to the proposed mechanism within the decision making process.

Questions for comment and discussion

- Are any amendments to the current provisions required to ensure compatibility with a TFP based framework?
- How can the possibility of double counting cost pass through events under a price path with a rolling X be addressed?

Considerations

The benefit of a cost pass through mechanism is that it manages changes in costs that are uncertain in timing and/or quantum and are not under the control of the service

41 Although it has a consequent effect of limiting the benefits that may flow to users.

42 The Brattle Group, *Incentives under total factor productivity based and building-blocks type price controls,* June 2009, p. 41. (Brattle Incentives Report)

provider. There is no need to wait for the conclusion of a regulatory period and the full reassessment of costs and prices for a change in certain costs to flow through to prices. Nor does the mechanism require an assessment of any other elements of the revenue determination or access arrangement.[43]

Without a cost pass through mechanism service providers would, at best, face a lag in their recovery of legitimate cost increases as an assessment of costs would only occur at the conclusion of a regulatory period. Similarly, without a mechanism savings would not be passed onto users until the end of a regulatory period.[44]

The mechanism operates within a regulatory period in regard to pre-specified 'cost pass through events'. In effect, the mechanism becomes an addition to the CPI-X formula that is applied annually to update a service provider's prices.

The calculation of X in a TFP methodology requires the specification and measurement of a service provider's actual inputs and outputs. Similarly, the calculation of the initial price or revenue cap for a regulatory period requires the actual cost information relevant to the provision of the regulated service.

When a cost pass through event occurs it would impact on actual costs and would be taken into account when setting the initial prices for the subsequent regulatory period.[45] However, for the remaining duration of the current period, a service provider's operating costs would have altered. If the service provider is operating with a fixed X in its price or revenue cap, a cost pass through mechanism provides the benefit of adjusting regulated prices during the period. For a service provider that is operating with a rolling X, some cost pass through events may, with some lag, impact on the X (if the cost past through event affects the industry). However, the operation of a cost pass through mechanism would ensure a timely adjustment to prices and the recovery of efficient costs.

This suggests that a cost pass through mechanism would be particularly beneficial to service providers that use a fixed X in the price path formula. To the extent that cost pass through events are included in the mechanism and in a rolling X, there may be some double counting of the event. This would have to be taken into account by the service provider and the regulator when determining the cost pass through amount.

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43 Under the NGR a cost pass through mechanism can be proposed by a service provider as part of its proposed reference tariff variation mechanism (rule 97). An electricity distribution service provider is able to seek approval for cost pass through amounts in accordance with clause 6.6.1 of the NER.

44 That is, a cost pass through mechanism should operate symmetrically.

45 For example, a new tax may at first be managed as a cost pass through event. However, on assessing costs for the next regulatory period, the tax can be included in the assessment of the service provider's efficient costs.

7.1.3 Capital module

Issue

The issue raised by a number of service providers is how a TFP methodology would ensure the recovery of efficient, lumpy capital expenditure.

Design element

A service provider could include a capital module in its proposed revenue or access arrangement to recover actual efficient, extraordinary significant increases in capital expenditure during a regulatory period. The regulator would need to be satisfied that the expenditure is outside the scope of the cost drivers that are taken into account in setting the X. Discussions with stakeholders would be needed to determine the most appropriate design of this module.

Questions for comment and discussion

- Is a capital module required and, if so, how should such a module be designed for Australia? In particular, should the module use agreed (and prudently assessed) forecast or actual expenditure amounts?

Considerations

A number of service providers have queried whether a TFP methodology can provide for the recovery of step changes in capital expenditure. The ESC's response to this has been to suggest that an Australian TFP methodology include a capital module similar to that recently adopted by the Ontario Energy Board (OEB).[46]

The OEB capital module allows for forecast additional capital expenditure to be recovered through changes to the price cap if it meets certain criteria not otherwise recovered through the rate base process.[47] The criteria are: that a threshold on expenditure (which is distributor specific) is exceeded; that the expenditure driver is clearly non-discretionary and not included in the calculation of prices; and that the capital expenditure is prudent.[48] Such expenditure would not usually be captured by the TFP growth index (and, accordingly, X). However, in allowing the recovery of forecast expenditure, the module incorporates a prudency assessment and an ex-post adjustment between actual and forecast expenditure.

The OEB approach can be varied. The price adjustment could be based upon forecast or actual costs and could consider whether the service provider or users are exposed

46 ESC supplemental submission, May 2009, p. 6.

47 OEB, *Supplemental report of the Board on 3rd generation incentive regulation for Ontario's electricity distributors*, 17 September 2008, p. 31. For further explanation see Appendix C.

48 If the use of a capital module is approved then the distributor must report actual expenditure to the OEB annually. The treatment of the difference between forecast and capital expenditure is then resolved in the next scheduled review of the rate base.

to the difference between actual and forecast expenditure. The ESC has suggested that a capital module could be used for prudent actual expenditure that is in addition to the expenditure covered by the growth rate.[49] The service provider would be able to recover actual costs at any time during the regulatory period subject to the regulator's approval. This approach would be more consistent with the underlying objectives of a TFP methodology in that it does not require forecast costs.

An alternative would be to adapt the current contingency project mechanism which is applied in electricity transmission determinations. Under this option, the regulator agrees to the trigger event at the start of the regulatory period. If and when the need for a contingent project is triggered, the transmission network service provider proposes the forecast expenditure. The regulator would accept the proposed expenditure if it determines that the expenditure is reasonable, having assessed it against specified criteria.[50]

The principal of including a capital module in the TFP methodology is sound. However, as there are a number of possible variations on this concept, there is a need for further work and discussions in designing the most appropriate form of the module for Australia.

7.1.4 Off ramps

Issue

An off ramp is a mechanism which provides the opportunity to intervene into a regulatory period prematurely and reset costs and prices by setting a new price or revenue cap level. The issue for consideration is whether off ramps are a desirable feature of a TFP methodology. If so, should they be required or optional and what are the events or circumstances that could initiate the use of an off ramp?

Design element

Off ramps would be available under a TFP methodology. An off ramp mechanism would:

- be proposed by the service provider or required by the regulator;
- clearly specify the 'off ramp event' at the start of the regulatory period. This could be a specified event or a rate of return or revenue band (for example, that the actual rate of return varies by more than 20 per cent of allowed rate of return);
- require an 'off ramp event' to be significant; and

49 This could be used to recover expenditure related to 'smart meters'. ESC submission, March 2009, p. 9.

50 See NER, clause 6A.8.

- require that the need and specification of an off ramp mechanism be assessed for each forthcoming regulatory period.

Questions for comment and discussion

- Is there a need for an off ramp mechanism to be included in a TFP methodology? Does its use inappropriately reduce incentives?

Considerations

The inclusion of one or more off ramps in a regulatory package provides a 'safety net' or insurance for service providers. An off ramp mechanism could protect against firm specific circumstances not already covered by other mechanisms such as a cost pass through mechanism or capital module.

The insurance provided by an off ramp mechanism would be for situations that may be anticipated and known to some degree but uncertain as to quantum or timing. An off ramp mechanism could also be used for situations of a more general nature such as a significant and permanent change in revenues, a significant interconnection to other assets, or a shift in volume growth. It may also be used to limit the volatility in a service provider's actual revenues or returns by specifying a band in which the service provider can operate.[51] In any event, the off ramp mechanism should clearly specify one or more 'off ramp events'. An off ramp mechanism would be a positive feature of a TFP methodology. Such a mechanism would provide an additional tool to manage firm specific events that are outside the scope of an industry wide growth rate calculation.

However, in some circumstances, an off ramp mechanism may dampen a service provider's incentives to achieve higher returns. Accordingly, an off ramp mechanism may be most appropriate if the service provider proposes a regulatory period longer than five years.

In general, it is appropriate for a service provider to decide whether to include an off ramp mechanism in its revenue or access arrangement proposal. The regulator should not be able to reject that decision. However, the regulator's approval would be needed on the specific terms of the off ramp mechanism.

It would be also be prudent to allow the regulator to request the inclusion of such a mechanism in a proposal. This could be particularly relevant if the term of the new regulatory period is considerably longer than five years. Any decision by the regulator relating to the design of an off ramp mechanism would have regard to the NEO or NGO and the revenue and pricing principles.

[51] For example, the band may be described as actual returns being more than 20 per cent different to the benchmark return set by the regulator. If the service provider falls outside this band then the off ramp mechanism is initiated. It should be noted that such a trigger band could be symmetrical or asymmetric.

The questions of whether an off ramp mechanism is desirable and what the specified events would be reconsidered prior to the commencement of each new regulatory period. This would give service providers and the regulator an opportunity to consider what the most relevant events would be for that particular service provider for the forthcoming period.

It is acknowledged that service providers and the regulator may find further guidance on the formation and operation of an off ramp mechanism beneficial. This could be provided by guidelines as well as past experience.

7.1.5 Form of X

Issue

There are two forms of X that can be used in a TFP methodology. These are:

- a fixed X factor – the X is fixed for the duration of the regulatory period; or
- a rolling X factor – the X is updated annually.

The issue is whether one form of the X factor is superior or preferable to the other and should be required under any TFP rules that are incorporated into the NGR and NER.

Design element

Service providers would propose the form of X (that is, either a fixed or rolling X) for the duration of the forthcoming regulatory period. In making its proposal, a service provider should take into account the length of the forthcoming regulatory period, and the use of off-ramps and cost pass through mechanisms.

Questions for comment and discussion

- Should a service provider be able to select the form of the X factor? Or, does this provide a level of uncertainty that is undesirable in the operation of a TFP methodology?

Considerations

A fixed X factor would provide certainty during the regulatory period just as under the current building block approach where a single X is set for a regulatory period. Changes in industry wide costs would be able to flow through to users when setting the initial price or revenue level for the next period. Where applicable, off ramps, the capital module and the cost pass through mechanism would provide the ability to manage certain cost events during the regulatory period. In this respect, the TFP methodology CPI-X mechanism would operate in the same manner as under the building block approach.

In contrast, adopting a rolling X would allow changes in the industry wide costs to flow through (with some lag) to users automatically. This provides a mechanism to share some changes in costs without using a cost pass through or an off ramp mechanism. However, at the start of a regulatory period service providers would be uncertain as to the value of X for each subsequent year and users would be uncertain as to the changes in prices from year to year.

The use of a rolling X would require the annual recalculation of a value for X. However, the calculation process should be a relatively minor task once the TFP variables are determined and the annual information gathering process is established.

The choice between a fixed or rolling X factor may be influenced by the length of the regulatory period. Where a service provider elects to have a longer regulatory period a fixed X would provide certain and strong incentives to find cost efficiencies and improve the operation of the business. However, the use of a rolling X with a longer regulatory period would allow the ongoing sharing of changes in industry costs and could provide some comfort to the service provider in its ability to recover efficient costs.

Some submissions to the Victorian Proposal argued against the proposal to permit a rolling X factor. It was suggested that it would introduce a degree of randomness and uncertainty into the price determination, and would undermine investment decisions as certainty of future prices is diminished.

Noting these concerns, it maybe appropriate to give service providers the option of either a rolling X factor or a fixed X factor. This would give each service provider the flexibility to adapt the TFP methodology to its own circumstances (including its risk appetite). There may be significant implementation issues with this approach when the TFP methodology is first introduced into the NER and NGR. It might be preferable to only permit fixed X factors to be used in the first TFP regulatory period for a service provider. From the second regulatory period, a service provider would be able to select a rolling X. This two step approach could provide a service provider with the opportunity to have 'paper trials' of how a rolling X would affect them.

7.2 Incentive schemes

This section discusses whether the existing side incentive schemes can and should be available to service providers that elect to use a TFP methodology to determine revenues and prices under the NER or NGR. Efficiency carryover mechanisms are discussed first followed by demand and service incentive schemes.

7.2.1 Efficiency carryover mechanisms

Issue

The current provisions of the NER provide for the use of an efficiency benefit sharing scheme (generally referred to as an efficiency carryover mechanism) to operate in conjunction with the building block approach to setting revenues and prices for an

electricity service provider.[52] The NGR also provides for this type of mechanism to be included in an access arrangement.[53]

The issue is whether an efficiency carryover mechanism can be successfully used in combination with a TFP methodology. In forming a proposal on this issue the practical operation of an efficiency carryover mechanism and its degree of consistency with TFP has been considered.

In addition, the issue on the treatment of an existing carryover mechanism in circumstances where the mechanism is not continued in the subsequent period has also been considered.

Design element

An efficiency carryover mechanism should be excluded from operating in conjunction with a TFP based methodology as it is not consistent with that methodology.

Any efficiency carryover mechanism existing at the commencement of a TFP regulatory period should continue to run its course as initially planned.

Considerations

An efficiency carryover mechanism aims to maintain the strength of the incentive to seek cost efficiencies over an entire regulatory period by allowing revenue gains, or losses, earned to be carried forward over a set number of years regardless of when the gain or loss occurred.

To operate this mechanism the amount of any carryover is calculated each year as the difference between forecast expenditure and actual expenditure.[54] That is, to operate the mechanism, annual cost information (both forecast and actual) is required. The forecast information is subject to the regulator's assessment.

In considering whether a TFP methodology should include an efficiency carryover mechanism there are a number of issues:

- whether the use of an efficiency carryover mechanism provides incentives for the service provider to seek cost efficiencies in addition to any incentives arising from the use of TFP in a price or revenue cap;
- whether the operation of an efficiency carryover mechanism is consistent with the operation and intention of a TFP methodology; and

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52 The AER has published schemes for distribution service providers and certain transmission service providers (namely, ElectraNet, SP AusNet and VENCorp).

53 Rule 98 provides that service providers may elect, and the AER may require, one or more incentive mechanisms to be included in a full access arrangement.

54 An efficiency carryover mechanism is more likely to be implemented for operating expenditure but can also apply to capital expenditure.

- how to accommodate the operation of an efficiency carryover mechanism that commenced in the current period.

On the first issue – whether incentives are increased – the Brattle Group has suggested that an efficiency carryover mechanism would operate in the same manner under a TFP methodology as under the current building block approach. It would fine tune a service provider's incentives to find cost savings through setting a carryover period for gains and losses.[55] As stated in the Victorian Proposal, the fundamental issue that an efficiency carryover mechanism addresses – the diminishing incentive to seek cost efficiencies as a price-cost resetting process draws nearer – is relevant under the building block approach and a TFP methodology, given that both approaches include a periodic resetting of prices.[56]

This suggests that the operation of an efficiency carryover mechanism would be beneficial for service providers using a TFP methodology. However, consideration should be given to the operation of the mechanism. In particular, annual forecast cost information would be required even though a TFP methodology does not require it for setting the price path. That annual forecast information is not required for regulatory assessment is claimed to be one of the benefits of using a TFP methodology. Requiring such information (which would be subject to the regulator's approval) could undermine a benefit of using TFP. It may also introduce an element of information asymmetry that would not otherwise exist within the TFP framework.

Given these issues, it would be appropriate for an efficiency carryover mechanism to be excluded from operating in conjunction with a TFP methodology.

The third issue noted above was how to accommodate the operation of an efficiency carryover mechanism that commenced in the current period. For example, where the current period is five years, the efficiency gains or losses arising in the current period will be carried through (either added or subtracted from the actual expenditure) into the new period (effectively years six to 10). Some service providers may have an efficiency carryover mechanism operating when they elect to use TFP in the next regulatory period. In these circumstances the efficiency carryover mechanism initiated in the current period should continue to operate as initially planned and be taken into account when setting prices in each year of the next regulatory period. It would not be appropriate to cut short or alter the operation of a mechanism from what was established at the commencement of the current period.

7.2.2 Demand and service incentive schemes

Issue

The NER provides for two other incentive schemes for distribution service providers: the service target performance incentive scheme, and the demand management incentive scheme. The issue is whether either of these schemes can be successfully

55 Brattle Incentives Report, p. 27.

56 Victorian Proposal, p. 35.

used during a regulatory period where the service provider has had revenues and prices determined by a TFP methodology.

Design element

The existing demand management and service incentive schemes would continue to be available to service providers under a TFP methodology. There should be no difference in their operation that reflects a service provider's use of either a building block approach or a TFP methodology to the determination of revenues and prices.

Considerations

The service target scheme seeks to reward a service provider for improvements in its service performance above a defined target. It provides for financial penalties for reductions in performance. Without this type of scheme, a CPI-X regulatory framework may encourage service providers to reduce costs by reducing (or allowing a reduction in) the quality of service. A 'service target performance incentive scheme' for electricity distribution service providers has been developed by the AER.

A demand management scheme aims to encourage a service provider to make operational choices that reduce growth in demand, or peak demand, to defer or even remove the need for network augmentation. A 'demand management incentive scheme' has been developed by the AER for Energex, Ergon Energy and ETSA Utilities.[57]

Where established, both of these schemes operate outside the building block approach to setting revenues and prices. This suggests that both schemes could be considered as an 'add-on module' to any revenue and pricing determinations. That is the approach taken in the Victorian Proposal.[58] Submissions to date have also expressed the view that these schemes can and should continue to operate.[59] It is also noted that the calculation of X in a TFP methodology does not take into account service quality or demand management. That is, the operation of these schemes appears viable and relevant under a TFP methodology as under a building block approach.

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57 AER, *Demand management incentive scheme: Energex, Ergon Energy and ETSA Utilities 2010-15*, October 2008. A transitional scheme has been put in place for the NSW and ACT electricity distribution service providers.

58 Victorian Proposal, pp. 33-34 and attachment A, p. 15.

59 See submissions from Energex, ETSA-Cititpower-Powercor and ESC.

8 Setting the price path under TFP

This chapter presents a design example for using TFP growth estimates in determining the allowed rate of change – the X factor - to the revenue or price cap. For the application of a TFP methodology, historical measures of TFP growth are used as a proxy for future productivity growth.[60] The key issues to consider are the appropriate specification of the formula and how to account for industry input price growth.

Some applications of a TFP methodology include an additional component in the determination of X.[61] This additional term – sometimes referred to as a stretch factor – could be justified for a number of reasons, for example to adjust the rate of change to allow for circumstances specific to the service provider, to allow for differences in productivity levels or to reflect the expected better incentive performance achieved from the introduction of a TFP methodology (consumer dividend). This chapter explores whether there is a role for business specific adjustments in this case.

8.1 Appropriate formula for determining X

Issue

The issue is what should be the appropriate formula to be set out in the Rules for determining the X factor under a TFP methodology. The formula could be expressed in a number of different ways depending upon whether it is assumed that the change in input prices for the industry is the same as for the economy as a whole or not.

Design element

The allowed rate of change of the price cap under the TFP methodology would be calculated in accordance with the following formula:

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ consumer prices} - \{[\Delta \text{ industry TFP} - \Delta \text{ economy TFP}] - [\Delta \text{ industry input prices} - \Delta \text{ economy input prices}]\}$$

The derivation of this formula is set out in Appendix D.

The industry TFP growth term of the formula would be calculated in accordance with the discussion in chapter 5.

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60 The alternative to using observed past productivity performance is to undertake engineering studies of the scope for future improvements. However, these studies face asymmetric information problems, may be relatively subjective between different assessors and are not as readily replicable or transparent as studies based on past performance.

61 For example, Ontario in Canada.

Considerations

The Victorian Proposal proposed a simplified version of the X factor formula based on the assumption that industry and economy-wide input price growth was the same. However, it is not reasonable to prescribe the rate of change formula based upon an assumption that the change in input prices for the industry is the same as for the economy as a whole. The recent evidence from Australian regulatory reviews and price forecasts prepared for the AER indicate that gas and electricity service providers' input prices are increasing faster than those for the economy as a whole. Therefore, it is not appropriate to make and 'lock in' this assumption.

The Victorian Proposal claimed that one of the benefits for the proposed simplification was that it avoided the need to include economy-wide TFP growth. However, the simplified formula proposed involved substituting the difference between industry input price growth and CPI growth in place of economy-wide TFP growth. This would have involved substituting two price indexes – one of which would be measured with a higher degree of error – for economy-wide TFP growth which is relatively robustly measured.[62] This would increase the scope for measurement error in the variables included.

8.2 Terms to the allowed rate of change

8.2.1 Input price index

Issue

The design formula contains a term for the difference between the growth in the industry input prices minus the growth in economy input prices. The issue is determining the correct measures for these terms.

Design element

The consumer price index would not adequately reflect the input price inflation for the regulated industries. Hence, a separate measure for industry input prices growth would be included into the determination of the X factor, and prescribed in the Rules. Further work and consultation with the industry would be required to determine the most appropriate measure. The producer price index would be used for the economy input price growth term.

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62 We note that the Victorian Proposal advocated the following different formula:

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ consumer prices} - [\Delta \text{ historical industry TFP growth} - (\Delta \text{ industry input prices} - \Delta \text{ consumer prices})]$$

However, the simplifying assumptions used to produce this formula are not considered appropriate or necessary.

Considerations

Regarding the measure for industry input price growth, the question is whether input prices would be expected to grow at a faster rate to outputs generally. Research undertaken by PEG for the ESC has indicated that input prices for Victorian electricity distribution businesses changed at a rate approximately equal to the CPI.[63] Therefore it could argued that the CPI should be used as a proxy for industry input price growth.

However, it would not be appropriate to make this assumption. The goods and services included in the basket used to measure the CPI would be very different to the inputs used by electricity and gas service providers in the provision of their services. Therefore, it cannot be said with confidence that the industry input price growth would not diverge from consumer prices growth at some point in the future. Furthermore, recent evidence indicates that input prices for the electricity and gas businesses have far outstripped general inflation as the service providers have had to compete with the mining sector, among others, for skilled labour and materials.[64]

Accordingly, the TFP methodology formula in the Rules would need to specify the term for the difference between the growth in the industry input prices minus the growth in economy input prices. The question then becomes what index would be the most appropriate measure of input prices for either the electricity and gas distribution sectors. On this matter further analysis and consultation with the industry would be needed. Regarding the economy input prices, the Producer Price Index is recognised as being the appropriate measure.

8.2.2 Business specific adjustments

Issue

In applications of a TFP methodology, an additional business specific factor is sometimes added to the formula to determine X. This could be due to a number of reasons, including:

- to reflect business specific circumstances which may affect the ability of the industry productivity growth rate to reflect the productivity potential of the business;
- to recognise that the industry TFP rate is an average across all businesses and therefore higher performing businesses may be unnecessarily penalised (the converging effect);

63 Victorian Proposal, p. 16.

64 See, for example, Econtech, *Labour Costs Growth Forecasts: Report prepared for Australian Energy Regulator*, 13 August 2007.

- to reflect additional efficiencies which will be generated with the move to a TFP methodology (in North America, this type of adjustment is referred to as consumer dividend);[65] and

- where the starting prices may not reflect efficient unit costs.

The issue for this design example is whether to permit such business specific adjustments.

Design element

An additional term would be included in the formula for determining the X factor to permit the regulator to make business specific adjustments. Such adjustments would only be justified if the regulator considers that the industry TFP growth rate should be adapted to reflect a significant difference in the productivity growth potential of that specified service provider. The regulator's decision would need to be consistent with the relevant national objective and the revenue and pricing principles. The adjustment could be positive or negative.

Further analysis would be needed to develop the appropriate framework, including the potential use of benchmarking techniques, governing the regulator's decision.

Questions for comment and discussion

- Is the rationale for allowing business specific adjustments to the X factor correct?

Considerations

The application of any business specific adjustment to the X factor must be strongly justified both on regulatory and empirical grounds, as including a business specific adjustment factor would lead to different targets set for different service providers. Also, the design of any adjustment would need to maintain the incentive properties of the methodology and to prevent any windfall gains or expropriation of deserved benefits. Such adjustments would be based partly on judgment having regard to available benchmarking data.

This paper's design example proposes that the regulator should be permitted to include business specific adjustments to the X factor. However, any adjustment should only be made because of business specific circumstances or the converging effect. In these situations, there may be a risk that the industry TFP growth estimate does not fairly reflect the expected productivity growth to be captured by the service

65 Rate indexing is designed to create stronger performance incentives than traditional rate of return regulation applied in North America. Hence, superior incentives under a TFP based methodology should lead, in turn, to more rapid TFP growth relative to historical norms. Regulators recognize this, and rate indexing plans typically incorporate what are called either 'consumer dividends' or 'stretch factors' to reflect the expectation that TFP growth will increase under indexing plans, and consumer prices should reflect some of the benefits of this expected growth.

provider. There may be a justified need to tailor the X factor to the circumstances of each particular service provider.

This issue is dependent upon the classification of the industry used for the TFP estimation. If the gas and electricity sectors were to be segmented according to ownership structure and/or operating conditions (for example, rural and urban), then there would be less need to make business specific adjustments. Any business specific adjustment should be limited to exceptional circumstances where it can be justified that there is likely to be a difference between the industry TFP growth rate and the productivity growth potential of the service provider.

Adjustments would not be justified on the basis of the other two reasons presented above. As the regulated service providers would be moving from a building block methodology to a TFP methodology upfront 'consumer dividends' adjustments would be neither necessary nor appropriate. Any additional efficiencies delivered under a TFP methodology would ultimately be passed through to consumers through either a rolling X factor or the periodic assessment of the revenue or access arrangement proposals. Likewise, the design example's approach to determining the initial price or revenue cap (chapter 6) should ensure that the initial price adequately reflects the efficient costs of the service provider.

One difficulty in implementing business specific factors is that there is often little conceptual and empirical basis for choosing appropriate adjustment levels. A mixture of benchmarking techniques and judgement tend to be used in overseas jurisdictions. For example, the TFP based methodology in New Zealand has used multilateral TFP (MTFP) analysis that benchmarked TFP levels across all New Zealand distributors.[66]

The disadvantage of permitting business specific adjustments is that it would introduce a level of complexity and subjectivity into the TFP methodology. It could therefore be an area of potential dispute between the service provider and the regulator. Therefore, although the initial position in this discussion paper is to permit business specific adjustments, further work would be needed to develop the appropriate framework governing how the regulator would determine the exact amount of any adjustment.

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66 MTFP indexes were calculated for each distributor in each year from 1999 through 2003. The MTFP indexes provided information on productivity levels as well as growth rates. They were translated into business adjustment factors by first ranking the distributors from top to bottom in terms of their measured efficiency. Next, distributors were divided into three groups of roughly one-third each. There were 10 distributors in the high efficiency group, 12 in the medium efficiency group, and 7 in the low efficiency group. The dividing lines between these groups were ultimately based on judgment. Businesses in the high efficiency group were given an X factor adjustment of -1%, the medium efficiency group had an X factor adjustment of 0, and the low efficiency group, 1%. These adjustments were made relative to the overall industry average productivity growth rate of around 2%.

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A Background and progress of the Review

A.1 Background

A Rule change proposal from the Victorian Minister for Energy and Resources was submitted to the AEMC on 18 June 2008. This proposal sought to amend the NER to allow the use of a TFP methodology as an alternative approach for the determination of prices for electricity distribution determinations (Victorian Proposal).

The AEMC decided to conduct a review following consideration of preliminary submissions to the Victorian Proposal (Review). The purpose of the Review is:

- to advise the Ministerial Council on Energy (MCE) on whether there are circumstances in which a permitted application of a TFP based methodology would contribute to either the NEO or the NGO; and

- where appropriate, recommend for consideration by the MCE draft Rules to allow a TFP based methodology for any individual or group of service providers.

The Review is not considering whether a TFP based methodology should replace the existing framework. Instead, the Review is focused on whether providing a TFP based revenue determination methodology as an alternative to the existing building block approach would provide benefits to users, service providers and the regulator in the relevant decision making processes. The Review is considering both the electricity and gas transmission and distribution sectors.

The AEMC has adopted a staged approach to addressing the question of whether TFP should be used in pricing and revenue decisions. These are:

- Stage 1 – The AEMC will make an assessment of whether it considers that a TFP methodology would promote either the NEO and/or NGO and therefore, should have a role in the relevant decision making processes. In doing so, the AEMC will look at the possible range of models for applying TFP and will assess the issues relevant to the Victorian Proposal. At the end of this stage, the AEMC will provide its findings to the MCE for its consideration (Stage 1 Final Report); and

- Stage 2 - If the AEMC considers that Rules should be made to facilitate the use of a TFP based methodology for either, or both, gas decisions or electricity determinations it will then proceed to develop its recommended draft Rules to be submitted to the MCE (Stage 2 Final Report). In doing so, the AEMC will have regard to considerations from the MCE on the Stage 1 Final Report.

A.2 Progress to date

On 12 December 2008, the AEMC released a Framework and Issues Paper (Issues Paper) to commence the Review.[67] In addition, the AEMC released a report by The Brattle Group.[68] This report provided information on the use of TFP by energy regulators in a selection of overseas jurisdictions.

The AEMC also conducted a public forum on 11 February 2009 to discuss the Issues Paper. Following the public forum and receipt of submissions, AEMC staff also met with a variety of stakeholders.

After considering the issues raised by interested parties in their submissions to the Issues Paper, the AEMC decided to amend its approach to the Review. A revised statement of approach was released on 28 April 2009. This informed parties on the amended approach that the AEMC would take for the remainder of the Review process.

On 12 June 2009, the AEMC released three reports that it had commissioned. The first, a report on the current availability of data suitable to support the calculation of a TFP index, was prepared by Economic Insights.[69] The second report, also from Economic Insights, reported on a sensitivity analysis of TFP estimates to variations in the methodology used in their construction.[70] A report was also prepared by The Brattle Group. This report discussed the extent and role of incentives under a TFP methodology.[71]

On 23 July 2009, the AEMC revised its timeline for the TFP Review to allow sufficient time to take into consideration a number of consultant reports and other new material on TFP in the formation of a TFP design for this discussion paper.

The AEMC released its report *Perspectives on the building block approach* on 30 July 2009.[72] A report by NAS was released on 21 August 2009.[73]

All reports and submissions related to this review are available from the AEMC's website.

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67 Seventeen submissions were received from Energy Networks Association, Energex, Energy Australia, Ergon Energy, ETSA Utilities/Citipower/Powercor, Grid Australia, Integral Energy, Jemena Limited, SP AusNet, Total Environment Centre, Watt Utilities, AER, Victorian Department of Primary Industries, Envestra Limited, Victorian Essential Services Commission and Energy Users Association.

68 Brattle International Review Report. Presentation slides from London Economics were also released. London Economics, *Experience with TFP methods in regulation of North American electric utilities*, 18 November 2008.

69 Economic Insights, *Assessment of data currently available to support TFP-based network regulation*, 9 June 2009. (Economic Insights Data Availability Report)

70 Economic Insights Sensitivity Report.

71 Brattle Incentives Report.

72 Perspectives on the building block approach.

73 NAS Expenditure Profiles Report.

B Specification of the TFP growth rate calculation

B.1 Debate on the appropriate specification

The specification of network outputs and inputs and the approach to weighting has varied across those jurisdictions that have adopted a TFP based methodology.[74] The ESC has worked on developing TFP estimates for the energy businesses in Australia. However, there has been considerable debate within Australia on the most appropriate methodology. Two possible specifications have been debated: the PEG/Kaufman specification developed for the ESC; and an alternative specification developed by Lawrence which has formed the basis of New Zealand's electricity distribution regulatory regime as well as having been applied in Australia. The key differences between these two approaches are:

- approach to measuring the capital input quantity: Lawrence argues that physical measures of capital (for example, line capacity times length and transformer capacity) provide the best proxy to the quantity of annual capital input given the physical deterioration characteristics of network assets. PEG/Kaufman advocates deflated asset value based quantity proxies.

- outputs to be included: Lawrence advocates using a functional output coverage including a network capacity measure as an output. PEG/Kaufman argues that the output measures should be only those billed items which regulated tariffs are based upon.

- output weights: PEG/Kaufman recommends using revenue share weights while Lawrence argues for using output cost share weights on the basis that revenue shares may not accurately reflect underlying costs given the non–competitive nature of the industry (that is, price will not equal marginal cost in these industries).

Capital input quantity

To estimate TFP growth a quantity and price for each individual input, including capital inputs is required. Given the long–lived nature of capital inputs a measure of the annual 'service potential' quantity for capital inputs is also required. This represents the quantity of service the capital input could potentially provide each year. This will in turn be influenced by the pattern of physical deterioration in the asset.

Two commonly used physical deterioration profiles are 'one hoss shay' depreciation where the service potential quantity remains relatively constant over the asset's life and declining balance or 'geometric' depreciation where the service potential quantity declines by a given percentage each year. In the latter case the decline in service potential quantity is rapid in the early years of the asset's life. A simple proxy

74 Brattle International Review Report.

for a pattern of one hoss shay service potential quantity is the physical quantity of the capital input available while a simple proxy for a pattern of geometric deterioration of service potential is the constant price depreciated asset value formed using the declining balance method.

Lawrence argues that network assets produce a relatively constant flow of services over their entire life and thus their pattern of physical deterioration is close to one hoss shay. In this case, the capital input quantity is best estimated by physical measures such as MVA–kilometres for lines (separately identified for overhead and underground given the different costs associated with each) and total MVA for transformers.

PEG/Kaufmann argues that 'monetary' based measures of capital input quantity (such as the constant–price depreciated asset value) should be used to maintain the link between capital input quantity and total cost. However, this approach implies that the service potential of network assets deteriorates rapidly and approaches zero at the end of its life.

The issue of appropriate capital measures was the subject of considerable debate in 2007-2008 for a power distribution incentive regulation plan in the Canadian Province of Ontario. In its September 2008 final decision, the Ontario Energy Board accepted the PEG's approach of using monetary values, and noted that is the physical measurement of capital, which is inconsistent with the prior Ontario TFP studies and does not appear to have been adopted in any jurisdiction other than New Zealand.[75]

New analysis produced by Economic Insights (which is discussed in Appendix D) has recently demonstrated how an annual capital input cost that is consistent with financial capital maintenance can be used in TFP studies, including with physical measures of annual capital input quantity.

Outputs and output weights

PEG/Kaufmann argues that the outputs included in a TFP study should be those that the business actually bills for (typically throughput, customer numbers and peak demand) and that the appropriate weights are correspondingly revenue weights. They argue this is necessary to ensure that changes in total revenue track changes in total costs over time.

Lawrence, on the other hand, argues that it is inappropriate to base the analysis on competitive industry assumptions as PEG/Kaufmann do. Rather, it is necessary to recognise the increasing returns characteristics of the industry and that prices are unlikely to reflect marginal costs. Indeed, prices are more likely to reflect historical practices, attitudes to risk and convenience rather than marginal costs. In these circumstances it is necessary to move to a functional output coverage (typically throughput, customer numbers and system capacity) and output cost share weights.

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75 Ontario Energy Board, *Supplemental report of the Board on 3rd generation incentive regulation for Ontario's electricity distributors*, 17 September 2008, p. 12.

This approach is more likely to see greater weight placed on system capacity and fixed outputs rather than variable outputs such as throughput which has a low marginal cost.

Lawrence also argues the latter approach will ensure even–handed treatment of all businesses where the X factor is based on productivity growth of a range of businesses with differing characteristics and charging practices.

ESC disagrees with the Lawrence view and considers that nothing could be less arbitrary in terms of its importance for customer welfare than the prices that customers actually pay for different utility services and indeed should pay from an allocative efficiency perspective. It argues that its specifications is consistent with the principle of allocative efficiency.[76]

B.2 Common issues with specification

Quality of service outputs

Incorporating quality measures as an output in TFP growth has proven problematic. Improvements in reliability (usually viewed as being the most important dimension of quality) are typically measured as decreases in the key quality indexes such as SAIFI and SAIDI. However, productivity indexing methods cannot readily incorporate outputs where more of the output is represented by a decrease in the measured outcome rather than an increase (for example, a decrease in SAIFI represents more quality). Inverting the standard quality measures so that an improvement in quality represents an increase in the included measure leads to distortions as the transformation is non-linear. Furthermore, placing an objective value on quality output components has also proven to be problematic.

Due to these difficulties, quality is generally omitted in TFP calculations and overseas regulators have sought to regulate quality through side constraints and separate service quality incentive mechanisms. There could also be perverse incentives created if service quality is included as an output in the TFP calculation when it is also the subject of separate incentive schemes. The design example in this paper is based on the approach of separating service quality incentives and TFP output measures.

System security expenditure

Another issue is how to treat distribution service providers that have invested in providing a higher level of system security in their systems or have incurred expenditure in order to maintain meeting their jurisdictional standards. The problem arises if there no output recognition for this expenditure which is included as an input.

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76 ESC submission, March 2009, pp. 19-21.

For instance, if an electricity service provider improves its system to achieve an 'n–2' rather than 'n–1' standard or invests heavily in undergrounding, it will receive no output recognition for this under the currently used specifications. Instead, it would be 'penalised' on the input side. But this higher level of 'insurance' may be valued highly by customers in which case it should ideally be recognised as increased output. This issue may be separate from the reliability issue identified above as the 'insurance' provided by these actions may not end up being reflected in differential reliability performance if the potential risks being covered do not come to pass. Or, there may be significant timing issues involved in that investment today may not affect reliability performance until several years into the future given the time lags involved. A way of recognising the 'output' associated with this extra input use in these circumstances needs to be developed. And there will, of course, be difficulties in separating these situations from ones of service provider inefficiency.

It is not apparent that the current approaches adequately address this disconnect between inputs and outputs. One option could be to separate out such expenditure from the TFP estimation. However, the amount of expenditure could be relatively substantial and exclusion would create a range of contentious issues.

Nevertheless, such expenditure is expected to represent a significant proportion of total expenditure for some electricity service providers in the near future. A way of recognising the 'output' associated with this extra input use in these circumstances needs to be developed. Further discussion and analysis is needed on this issue.

C The Ontario capital module

C.1 Introduction

A number of submissions from service providers to this Review have questioned whether a TFP methodology is able to ensure the recovery of efficient, lumpy capital expenditure.

In response, the ESC noted that the Ontario Energy Board (OEB) had recently included a 'capital module' in the TFP framework applied to electricity distributors.[77] This appendix aims to provide an overview of the Ontario capital module.

C.2 Development of a capital module

The OEB conducted a review into the development of the third generation of incentive regulation for the electricity distributors. This commenced in August 2007 with the intention of implementing the resulting prices in 2009. The decision is relevant to approximately 85 distributors for a three year regulatory period.

It was noted in the scoping paper that a number of participants to the OEB's second generation process had sought for the regulatory framework 'to provide for the expeditious review and approval of capital expenditure programs'. The OEB noted:

> It was suggested that the regime could include some form of approval of a multi-year capital plan and not just capital items that may arise in the following year.[78]

During the decision making process the OEB noted that the productivity based price cap regime that was to be implemented provided for capital expenditure that was consistent with productivity growth and based on past actual expenditure. However, it acknowledged that future capital expenditure that was substantially greater than past patterns would not be captured by the growth rate.

As a result, a capital module was developed to specifically manage additional capital expenditure. This module, the OEB stated, was not to allow distributors 'to adjust rates on an on-going, as needed basis to accommodate increases in rate base'.[79] This is not consistent with the form of incentive regulation adopted by the OEB:

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77 ESC supplemental submission, May 2009, p. 6.

78 OEB, *Third generation incentive regulation for electricity distributors: staff scoping paper*, EB-2007-0673, 2 August 2007, p. 5. Information on a single forecast year is used as a base year which is then adjusted by an index over the remaining years of the regulatory period.

79 OEB, *Supplemental report of the Board on 3rd generation incentive regulation for Ontario's electricity distributors*, EB-2007-0673, 17 September 2008, p. 30.

> Rather, the capital module is intended to be reserved for unusual circumstances that are not captured as a Z-factor and where the distributor has no other options for meeting its capital requirements within the context of its financial capacities underpinned by existing rates.[80]

Where the price cap regime can be described as P(GDP) – X + K + Z, where:

P(GDP) is the GDP implicit price deflator for final demand

X is productivity growth (based on US electricity distribution productivity growth plus a stretch factor);

K is the capital module; and

Z is a pass through factor for certain unforeseen actual costs incurred that were not within management's control (for example, natural disasters, changes in taxes).[81]

A distributor would be required to apply to the OEB to use the capital module. It could do so if its incremental capital expenditure exceeded a materiality threshold.

This threshold is distributor specific and determined through the use of a formula set by the OEB. The formula is based on a ratio of forecast capital expenditure to depreciation. It also includes an arbitrary additional adjustment of 20 per cent. The aim of the threshold is to ensure that amounts that are put to the OEB for assessment have a significant impact on the operation of the distributor's business. If the amount does not pass the threshold then it will be considered at the next scheduled review of the rate base (that is, assessed for the next regulatory period).

If the incremental capital amount exceeds the threshold then the OEB will consider the application from the distributor. The assessment will take into account:

- the driver of the expenditure. That is, the amount claimed should clearly relate to an expenditure driver that is non-discretionary for the distributor and not included in the base that the productivity growth rates are calculated on.

- the prudency of the expenditure. That is, whether the distributor's decision to undertake the expenditure is the most cost-effective option for users of the distribution system.

If the distributor's application is approved by the OEB then an adjustment to the prices can be made to recover the approved additional capital expenditure. As a result of this decision a distributor will be required to report annually on actual expenditure. The treatment of the difference between forecast and actual capital expenditure is then included in the next scheduled review of the rate base.

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80 OEB, *Supplemental report of the Board on 3rd generation incentive regulation for Ontario's electricity distributors*, EB-2007-0673, 17 September 2008, p. 31.

81 OEB, R*eport of the Board on 3rd generation incentive regulation for Ontario's electricity distributors*, EB-2007-0673, 14 July 2008, pp. 34-37.

D Use of TFP growth estimates in setting regulatory paths

D.1 Formula for setting the regulatory path using TFP

The principal objective of CPI-X regulation is to mimic the outcomes that would be achieved in a competitive market. The process of competition leads to industry output prices reflecting industry unit costs (including a rate of return reflective of the risks involved). Because no individual firm can influence industry unit costs, each firm has a strong incentive to maximise its productivity performance to achieve lower unit costs than the rest of the industry. The firm keeps the efficiency savings until all the industry improves its performance.

The use of CPI-X regulation in infrastructure industries attempts to strengthen the incentive to operate efficiently by imposing similar competitive pressures. It does this by constraining the business's output prices to track the level of estimated efficient unit costs for the industry. If initial prices are set at the unit cost of providing the regulated services, then revenue would be expected to continue to align with costs over time if prices are permitted to rise by the expected growth in unit costs. As the efficient growth in unit costs is equal to the change in input prices net of productivity growth, the formula that underlies the CPI-X approach is:

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ input prices for industry} - \Delta \text{ industry productivity}$$

where Δ represents the proportional change in a variable.

To use this formula regulators must choose a price index to reflect changes in the industry's input prices. The most common choice for this index is the Consumer Price Index (CPI) which is actually an index of output prices for the economy rather than input prices. Normally the economy's input price growth to would be expected to exceed its output price growth by the extent of economy–wide productivity growth (since labour and capital ultimately benefit from productivity growth). Therefore:

$$\Delta \text{ consumer prices} = \Delta \text{ economy input prices} - \Delta \text{ economy productivity}$$

Including this relationship in the formula for allowed price changes for the regulated business leads to:

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ consumer prices} - \{[\Delta \text{ industry productivity} - \Delta \text{ economy productivity}] - [\Delta \text{ input prices for the industry} - \Delta \text{ economy input prices}]\}$$

Using TFP as the measure of productivity, the formula becomes:[82]

$$\Delta \text{ allowed prices for regulated business} = \Delta \text{ consumer prices} - \{[\Delta \text{ industry TFP} - \Delta \text{ economy TFP}] - [\Delta \text{ industry input prices} - \Delta \text{ economy input prices}]\}$$

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82 Which is sometimes referred to as differential of differential formula. See Bernstein and Sappington, 'Setting the X factor in price cap regulation plans', *Journal of Regulatory Economics*, vol. 16, 1999, pp. 5-25.

Therefore, because allowed prices are indexed against changes in CPI,[83] the X factor should reflect the difference between expectations of TFP growth in the industry concerned and the economy as a whole less the difference between input price growth faced by the business and the economy as a whole. If the regulated industry has the same TFP growth as the general economy and the same input prices as the economy then the X factor would be set to zero. Therefore, X is only likely to be positive where industry productivity exceeds economy productivity and where input price inflation for the industry is less than economy input inflation.

For the application of a TFP based methodology, historical measures of TFP growth are used as a proxy for future productivity growth. The alternative to using observed past productivity performance is to undertake engineering studies of the scope for future improvements. However, these studies face asymmetric information problems, may be relatively subjective between different assessors, and are not as readily replicable or transparent as studies based on past performance.

There have been recent developments by Economic Insights regarding the TFP formula. Economic Insights has argued that the traditional formula suffers from two major limitations: that the theory has not recognised the sunk cost nature of network assets; nor adequately allow for the principle of real financial capital maintenance (FCM).[84] Economic Insights considers that the formula needs to be changed.

D.2 Sunk costs, asset valuation and productivity based regulation

Traditional productivity–based regulation has typically been implemented using CPI–X price caps where the formula for the X factor as been specified in accordance with the theory described above. As noted above, recent papers published by Economic Insights argue that the traditional formula suffers from two major limitations. The following discussion provides a summary of this work.[85]

The sunk cost characteristic of network assets and the desirability of ensuring real FCM both have important implications for how productivity analysis is used in network regulation. Introducing sunk costs means that the standard user cost approach to measuring the annual cost of using capital can no longer be used. This is because sunk assets, by definition, cannot be freely traded in a second–hand market which is a key assumption of the standard user cost approach. Rather, it is necessary to change to using operating expenditure cost functions for the regulated business.

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83 CPI is equal to the change in input prices less the change in productivity in the economy as a whole.

84 Real FCM means that a controlled business is compensated for efficient expenditure and efficient investments such that, on an ex–ante basis, its financial capital is at least maintained in present value terms. A general measure of inflation (such as the CPI) is used as it maintains the purchasing power of investors' funds.

85 The papers prepared by Economic Insights which outline its new theory are: *Asset valuation methods and productivity–based regulation: report for Commerce Commission,* 11 June 2009 and *The theory of network regulation in the presence of sunk costs: report for Commerce Commission*, 8 June 2009. See the Commerce Commission of New Zealand website: http://www.comcom.govt.nz/IndustryRegulation/Electricity/PriceQualityPaths/20102015defaultpricepath.aspx

An operating expenditure cost function minimises the variable input costs associated with producing an output target, conditional on the availability of a fixed quantity of capital stock components. In other words, it recognises that the business' relevant decision making options each period are to alter its level of operating expenditure given the quantity of sunk investments it has that period. It can opt to change the level of sunk investments gradually over time by undertaking additional investment or allowing the existing stock to run down, but it cannot treat capital stocks as freely variable from period to period as has been the implication of past theory developed in this area.

As explained in chapter 2, the X factor under a TFP methodology is calculated in accordance with the traditional 'differential of a differential' formula:

(1) $X = \{[\Delta \text{ industry TFP} - \Delta \text{ economy TFP}] - [\Delta \text{ industry input prices} - \Delta \text{ economy input prices}]\}$

To reflect sunk costs, Economic Insights proposes the formula below. The sunk costs counterpart to the traditional 'differential of a differential' X factor formula in equation (1) becomes:

(2) X = [(TFP differential growth rate term) + (input price differential growth rate term) + (nonzero profit adjustment term) – (rate of change of regulated profits term.)]

Which can be expressed as the following:

$$X = \{[C/R]\,\Delta TFP - \Delta TFP_E\} - \{[C/R](s_X \Delta w_X + s_K \Delta P_{kD}) - \Delta W_E\} + [\Pi/R]\,\Delta Y - \Delta\Pi/R$$

The first term is the differential rate of TFP growth between the regulated business (ΔTFP) and the rest of the economy (ΔTFP_E). However, the TFP growth rate of the regulated business must now be weighted by the ratio of the regulated business' costs (including its allowed capital amortisation charges) (C) to its revenues (R). This recognises the non–competitive nature of the industry and that the constant returns to scale assumption is not appropriate in this case.

The second term is the differential rate of growth of C/R times a share weighted sum of the rate of the growth of operating expenditure input prices for the regulated business (Δw_X) and the rate of growth of allowable amortisation charges for sunk cost capital inputs (ΔP_{kD}) less input prices in the rest of the economy (ΔW_E). Total cost for the regulated business (C) is defined as the sum of variable or operating input costs plus allowable amortisation costs for sunk cost capital inputs. The regulated business input cost shares which appear in the input price differential term (s_X and s_K) are defined as the ratio of variable or operating cost to total cost and the ratio of allowable amortisation costs to total cost, respectively.

The last two terms on the right hand side of the formula involve the level of excess profits of the regulated firm (Π) the rate of change of excess profits ($\Delta\Pi$) and output (Y). If the excess profits of the regulated firm are not close to zero, then if excess profits were markedly positive, the regulator could set $\Delta\Pi$ equal to a negative number to reduce these excess profits over time. On the other hand, if excess profits were substantially negative, then the regulator could set $\Delta\Pi$ equal to a positive

number to maintain the financial viability of the regulated firm. However if P_0 adjustments are used to address business profitability issues (that is, R is set equal to C and excess profits (Π) are set to zero) then formula (2) above can be considerably simplified to:

(3) X = TFP differential growth rate term + input price differential growth rate term

or

$$X = \{\Delta TFP - \Delta TFP_E\} + \{\Delta W_E - (s_X \Delta w_X + s_K \Delta P_{kD})\}$$

The main difference compared to the traditional X factor formula (equation (1) above) is that approved capital amortisation charges (which will typically be set to achieve ex ante FCM) are used in forming the industry TFP growth rate and in calculating the industry capital input price index. Economic Insights considers that this approach corrects some of the key inconsistencies which previously existed between productivity–based regulation and building blocks regulation.

Economic Insights also commented on the specification of the TFP growth rate. Its papers show that when regulation involves several businesses and past average rates of TFP growth are used in setting a common rate of change going forward, then the measurement of output in the TFP calculation becomes critical. In particular, it is necessary for the output measure to capture as fully as possible what regulated services are being provided by the businesses in the group, independently of the institutional and historical factors that determine how the businesses happen to charge consumers. When the increasing returns to scale nature of the industry and the role of sunk cost assets is taken into account allocative efficiency requires that all functional outputs (of which billable outputs will be a subset) be included and the deviation of market prices from marginal costs be allowed for.