

**INCENTIVES UNDER
TOTAL FACTOR PRODUCTIVITY BASED
AND BUILDING-BLOCKS TYPE PRICE CONTROLS**

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Executive Summary

The Australian Energy Market Commission has asked us to compare the strength of incentives facing regulated firms under two different approaches to setting price controls: the current “building-blocks” approach, and the alternative Total Factor Productivity¹ approach put forward by the Victorian Government in its recent electricity rule change proposal (“VTFP”). We have concentrated on comparing the specific TFP proposal put forward by the Victorian Government with the building-blocks approach as currently set out in the National Electricity Rules and applied by the Australian Energy Regulator, but we also discuss related ideas that have been raised during recent debate over the merits of TFP in the context of Australian energy regulation. Where relevant, we also make observations about TFP-based and building-blocks type price controls more generally, including designs which focus on strengthening incentives.

We compare the current building-blocks approach with the proposed VTFP alternative according to the incentives they give to the regulated firms to behave in ways that help achieve the objectives of the overall framework for regulating the gas and electricity networks in Australia. Broadly, we characterise these objectives as to:

- control costs and pass cost savings back to consumers;
- invest where necessary; and
- deliver a high quality service.

Our report concentrates on the current framework applied by the Australian Energy Regulator to electricity distribution businesses, but we believe that the substance of our analysis and conclusions apply more generally to the regulation of electricity transmission and gas pipelines.

In this report we do not address the availability of data necessary to implement a TFP approach, nor the detail of index specification. For the purposes of the report we assume that robust data is available and that any technical issues of TFP index specification can be satisfactorily resolved. We therefore do not address any incentive effects that might arise through the detailed specification of the TFP index.

Building-blocks and TFP approaches

Under a building-blocks price control, prices for the forthcoming period are set on the basis of a forecast of each firm’s efficient costs for the forthcoming period. Under TFP approaches, prices for the forthcoming period are set in relation to a historic productivity trend, usually obtained from a statistical study of a group of comparator firms. Both building-blocks and TFP approaches result in a cap on the prices² that regulated firms can charge their customers, and in

¹ In an earlier report for the AEMC we reviewed case studies of the use of TFP in other jurisdictions (*Use of Total Factor Productivity Analyses in Network Regulation – Case Studies of Regulatory Practice*, report for the Australian Energy Market Commission prepared by *The Brattle Group*, October 2008).

² We discuss the two approaches in terms of caps on prices, but the analysis applies equally to situations in which revenue is capped.

both cases the price cap takes the familiar $CPI - X$ form (see Box 1). $CPI - X$ is also known as “incentive” regulation, and is so called because the fact that prices are fixed gives the firm an incentive to control costs. Any difference between prices and out-turn costs can be retained by the firm as increased profits, and thus the firm will invest effort in controlling costs because by doing so it increases its profits.³

Under both VTFP and building-blocks approaches prices at the start of each price control period are set to reflect an estimate of the firm’s current costs.⁴ In both cases, differences between actual out-turn costs and the price cap result in additional or reduced profits for the regulated firm. The difference between the two approaches lies in how the regulator sets the X factor.

Box 1: $CPI - X$ price controls

Under $CPI - X$ price controls the prices that the regulated firm can charge are fixed in advance for a certain period, often around five years. During the price control period prices may increase by no more than CPI inflation, less the X factor.

If, over time, the firm is able to reduce its costs faster than $CPI - X$, the firm will earn extra profits for the duration of the price control period. Thus the price cap gives the firm an incentive to control costs.

At the end of the price control period, the regulator may re-align the firm’s prices with its costs (this price change at the start of the new price control period is often referred to as a “ P_0 change”). As a result, part of the benefits of the firm’s cost control is passed back to consumers as lower prices. The more of the benefits that the firm keeps, the stronger is its incentive to control costs—but the lower is the benefit that is passed on to customers.

The regulator can adjust this trade-off in a number of ways. For example, the longer the price control period, the greater is the incentive to control costs, because the firm is allowed to keep the benefits of reduced costs for longer before they feed through into lower prices.

³ The operation of incentive regulation thus depends on the interests of the firm’s owners (who benefit from increased profits) being well aligned with the interests of the firm’s managers (who have to invest the effort in controlling costs). We think it reasonable to suppose that the behaviour of government-owned firms might be less strongly influenced by profit-based incentive regulation than the equivalent privately-owned or publicly-quoted firm.

⁴ In practice, under either method the regulator could adjust initial prices away from costs in order to smooth the profile of prices over time during the price control period, and between the end of the preceding control period and the start of the next one. We ignore the possibility of price smoothing because it does not change total allowed revenues over the course of the price control period, and therefore does not affect our comparison between building-blocks and TFP approaches.

Under both building-blocks and VTFP approaches, the regulator's price control decision consists of a set of prices for the following (say) five years, which can be characterised by a starting price (P_0) and an X-factor (the rate at which real prices will fall over time). Under building-blocks the regulator chooses P_0 to be equal to out-turn costs in the last year of the preceding price control period, and chooses X such that the net present value of revenues over the forthcoming price control period is equal to the net present value of the regulator's forecast of the firm's efficient costs.⁵ Under VTFP, the regulator chooses P_0 such that initial prices are equal to initial costs, and sets X equal to historic industry-wide TFP growth. Historic industry-wide TFP growth would be obtained from a study of the inputs and outputs of a group of comparator firms, from which the historic rate of TFP growth is measured. Under VTFP the net present value of revenues over the price control period is equal to the net present value of forecast costs if the firm is expected to achieve industry-wide TFP growth.

Assessment

We compare building-blocks and VTFP approaches according to the strength of the incentives they give to the regulated firms.

Controlling costs

The main incentive to control costs comes from the fact that prices are fixed for the duration of the price control period. This element of the incentive is thus common to TFP and building-blocks approaches, as is the fact that the incentive is limited by cost reductions being passed back to customers at the start of the following price control period, when prices are reset to costs via a P_0 change.

Under the building-blocks approach, the incentive to control costs may be weakened by the fact that the regulator can also use out-turn costs in one price control period as inputs to its determination of the scope for cost reductions in the subsequent period (ie, in forecasting efficient costs and from this setting X). As a result, the firm's incentive to control costs is lower than if the regulator could not take this information into account: if the firm reduces costs rapidly in period 1, the regulator may decide that it can continue to do so in period 2, and therefore set forecast costs lower, and the X factor correspondingly higher, in the second period than if the firm had not invested the effort required to cut costs so rapidly in period 1.

Although the VTFP proposal would not use information on out-turn costs to set X, it would use out-turn costs to set prices at the start of the price control period, because, in common with the building-blocks approach, prices at the start of the price control would be set equal to costs at the end of the preceding period. Thus, under the VTFP proposal there is only a partial disconnection between cost control efforts in one period and prices in the next. Furthermore, under the VTFP proposal TFP is optional, so there is no guarantee that the regulated firm will continue with a TFP approach at the subsequent period—it might instead revert to building-

⁵ By "efficient costs" we mean the costs that the firm would incur if it operated as efficiently as possible given the constraints of its operating environment. Thus, for example, a firm with a very sparse rural network might have higher costs (per customer) than one operating in an urban environment.

blocks. As a result, our assessment is that the VTFP proposal would only marginally improve cost control incentives.

Finally, we note that under both building-blocks and TFP approaches the strength of the cost-control incentive can in any case be varied, either by changing the length of the price control period, or by adjusting the efficiency benefit sharing scheme. Either of these could be altered to change the proportion of total savings resulting from a reduction in costs that is retained by the firm. This reinforces our conclusion that building-blocks and VTFP approaches do not significantly differ in terms of the strength of the incentive to control costs.

Passing savings back to customers

Under the VTFP proposal a switch to TFP could only occur if the firm proposes it. The switch is therefore likely to benefit the firm. For it to benefit consumers as well would involve a “win-win” scenario that is possible in theory but which we find to be unlikely in practice. In theory firms might switch to TFP even if it involved lower prices than building-blocks. If VTFP allowed them to keep a higher proportion of their cost savings, then they might undertake greater efforts to reduce costs, so much so that the increase in profits from greater cost savings (relative to building-blocks) outweighed the reduction in profits from lower prices (relative to building-blocks). To put this another way, under VTFP the cost savings might be so much greater than under building-blocks, that even though a smaller *proportion* of the savings are passed back to customers, the *amount* of savings might be greater. However, as explained above, we do not believe that there is a significant difference in cost control incentives between VTFP and building-blocks, so realising higher savings under VTFP than under building-blocks is unlikely.⁶ A “win-win” scenario with lower prices and higher profits under VTFP therefore seems implausible.

Consequently, we expect that only those firms that expected higher prices under TFP than under building-blocks would request the switch. The firms that expected a lower X factor (and thus higher total revenue) under building-blocks than under TFP would elect to stick with building-blocks. As a result, prices will be higher if firms have the option to choose TFP than if all the firms remained subject to building-blocks, because those firms that switch would get higher prices than would have been the case before the VTFP option was introduced.

Under the building-blocks approach, the regulator would like to set prices equal to efficient costs for each firm.⁷ This holds even if one firm has higher costs than others.⁸ Given the

⁶ Furthermore, the firm will only choose the TFP option if it *expects* to be able to earn higher profits by doing so. Thus, in deciding, it will only take into account extra cost reductions it expects to make under TFP that it would not expect to make under building-blocks. Unexpected cost savings, such as might follow from a process of innovation encouraged by a stronger incentive under “compulsory” TFP could not influence the decision.

⁷ Including a return on capital at the firm’s cost of capital.

⁸ For example, a firm that is unusually small might have higher costs than others, because larger firms enjoy the benefits of economies of scale. However, the regulator will aim to ensure that the small firm can earn its cost of capital provided it is operated efficiently (given its size).

asymmetry of information between regulator and regulated firm, this requirement means that firms with lower costs can earn extra profits (“informational rents”) by providing exaggerated cost forecasts to the regulator. The regulator cannot know that these are low cost firms, and therefore gives them prices that would at least allow an (efficient) high cost firm to break even, providing an excess return (higher than cost of capital) to the low cost firm. This is often referred to as the problem of “gaming”.

Under the VTFP approach, the only firms that will opt for TFP are the ones that cannot make convincing high-cost forecasts—ie, the ones which would end up with higher prices under TFP than under building-blocks. In respect of these firms, there is little or no gaming problem in the first place under building-blocks. However, gaming remains an issue with regard to the firms that do not take the TFP price cap, but remain under building-blocks. Furthermore, the firms which take the TFP control and then at the next price control want to switch back would be able to game the regulator’s decision over whether to approve the switch.

Under VTFP, low cost firms would in fact earn at least as much extra profit as under the current building-blocks arrangements, and possibly more: they will only switch to TFP if they can earn higher profits than they would do under building-blocks, and if they stay on building blocks they will earn the same profits as before.

Once firms are under a TFP control, they would request a switch back to building-blocks at a later review if they thought this would lead to a smaller X (higher prices). Under the VTFP proposal, the firm would have to argue its case for going back to building-blocks on the basis that the TFP approach would result in prices below cost even if it were efficient, because the TFP growth rate measured for the comparator group was no longer a good estimate of its own TFP growth prospects. Although the switch could be blocked by the regulator, in order to judge the firm’s request the regulator would be subject to the same information asymmetry as under building-blocks (ie, uncertainty over whether the firm was truthfully claiming to expect unusual inflationary pressures). As a result, the regulator would be unlikely to refuse the request.

Service quality

Both building-blocks and TFP approaches incentivise cost control. Since delivering a high quality of service is generally more expensive than delivering a poorer service, incentive regulation would normally be expected to result in lower service quality. This problem can be addressed by adding an extra term to the price control, such that the firm receives extra revenue if it delivers a better service quality. The “add on” service quality incentive can be applied to both building-blocks and TFP-based price controls.

We do not see any significant difference between the two methods in respect of quality—if in fact the VTFP approach were to strengthen the cost control incentive, the service quality incentive could easily be strengthened in order to maintain quality.

Under TFP approaches, however, changes in service quality delivered by the comparator firms also need to be taken into account. If service quality produced by the comparator group improves over time it is likely that costs will increase also. Unless service quality is included in the TFP index specification, it will appear that TFP growth is low or negative even if the firms are in fact successfully controlling costs, but it is in practice difficult to include service quality in

the TFP index specification because service quality is hard to measure in a way that relates well to cost drivers. While we do not address TFP index specification in this report, we note that if there are significant differences in quality (or safety) standards, either between networks or over time, this may make it very difficult to specify the TFP index correctly and to apply the TFP methodology because it could make unit costs very different in one network than another.

Finally, we note that if there was a change in quality (safety or reliability) requirements, there would be an associated step change in costs. Under a TFP methodology firms would not see a corresponding change in prices, or would only do so with a lag, whereas under building-blocks the firms could request an increase in prices in anticipation of having to meet new requirements.

Investment

Regulated firms determine the quantity of investment they will undertake as a result of the balance between the cost control incentive, which tends to reduce investment, and service quality incentives and regulatory standards which tend to increase investment. If the cost control incentive is strengthened, investment will be lower, other things equal, because the firm keeps a larger proportion of the difference between prices and out-turn costs. If the service quality incentive is strengthened, investment will be higher because the firm would suffer more if service quality is poor. These factors are not significantly altered as a result of switching from a building-blocks price control to a TFP approach.

Nevertheless, the ability of regulated firms to undertake investment (and, more generally, to continue operating) depends on their having good access to capital markets. In turn, this requires that investors in the regulated firms have a reasonable expectation of earning a return on investment at least equal to the cost of capital in the long run. A “pure” TFP methodology, without regular resets of price to out-turn cost, and without protection from above trend cost increases, would probably not give this reasonable expectation. This is so because TFP allows the *average* firm to recover efficient costs. Firms which cannot achieve average efficient costs simply because they turn out to be above average would not recover efficient costs under a mandatory pure TFP approach. The VTFP proposal, in contrast, would see regular resets of price to out-turn costs, and would guide the regulator to apply building-blocks rather than TFP to firms unlikely to be able to achieve the TFP-based cost targets. In this way, many situations in which a pure TFP price cap would have delivered below-normal returns to investors would be avoided.⁹

Other ways to strengthen incentives

Various features of the current building-blocks methodology can be altered to strengthen the incentive to control costs without moving to TFP, and various parameters of the VTFP proposal could be adjusted to strengthen incentives. For example, the price control period could be longer

⁹ If all firms were subject to a pure TFP approach, it is clear that at least some firms would be unable to cover efficient costs because of cost drivers outside management control. At the other extreme, if the regulator believed every firm’s claim to be suffering from firm-specific cost pressures, no firm would be subject to TFP. Any “intermediate” outcome, with at least some firms subject to TFP, means that the firms subject to TFP might be unable to recover their efficient costs. As discussed above, the key issue is the information asymmetry between the firms and the regulator over which firms have above-average costs.

than five years; the efficiency benefit sharing scheme could be tuned to give a greater proportion of cost savings to the firm rather than to customers; or prices could be only partially reset to costs at the start of each price control period. These adjustments could be as well made in the context of a building-blocks price control as a TFP-based price control.

A TFP-based methodology would give a stronger incentive to control costs if it were not optional, because the regulated firm would then be certain that efforts to control costs in the current period would not influence the regulator's decision on the X factor in the subsequent period. It is true that, under the VTFP proposal, the firm would only switch back to building-blocks if the firm itself made the request to do so. Nonetheless, when deciding its level of cost-control efforts at the start of the price control period, the firm would still be uncertain over whether, by the end of the period, it might prefer TFP or building-blocks for the following period. However, making TFP compulsory would remove an important protection for investors, because the firm would no longer be able to argue, at future price resets, that there were significant differences between its own costs and those of the comparator group that it could not control.

The difficulty with any mechanism for strengthening the incentive to control costs is that there are trade-offs to be made: first, the regulator can give the firm a stronger incentive by allowing it to keep a greater fraction of the savings—but in this case customers receive less of the savings and prices may be higher; second, the regulator can base prices less on the firm's own costs and more on external factors, such as the historic rate of TFP growth¹⁰—but in this case prices and costs are more likely to end up far apart, meaning that prices are no longer reflective of costs, and that the firm's investors may not earn a normal return on investment even if the firm is efficient.

To make these trade-offs effectively the regulator needs flexibility in how it sets the parameters of the price control. For example, a “menu” approach where firms choose either a strong incentive to control costs but lower prices, or a weaker incentive to control costs and higher prices, can be used to improve the trade-off between strength of incentives and setting prices too high. A methodology which provides for a mechanical link between historic TFP growth rates and the path of future prices cannot do this.

Conclusion

In our view, the possible benefit of the VTFP proposal in terms of improved cost control incentives, if any, is small, because of the protections built into the proposal: prices are reset to out-turn cost at the end of the price control period, and TFP would be optional. The only difference between building-blocks and the VTFP proposal is that under the latter information on out-turn costs is only used to set initial prices, whereas under the former it is used to set initial prices and it may be, together with other information, used to set X. As a result the difference in cost-control incentives is small, and therefore of marginal benefit.

¹⁰ We emphasise that any “external” basis for prices gives a strong incentive. The regulator could base price changes on TFP growth rates, or could simply “pick a number”, or freeze real or nominal prices—the incentive properties are the same, because the incentive comes from the fact that the price is the same whether or not the firm invests extra effort in controlling costs.

Since TFP would be optional and since the strengthening of the incentive to control costs, if any, is marginal, only firms that expect higher prices under TFP than under building-blocks would request a TFP-based price control. Therefore average prices across all the firms will be higher with the VTFP proposal than if the firms did not have the option to request a TFP-based price control. Nonetheless, the fact that TFP would be optional under the VTFP proposal provides some protection for investors. If a pure TFP approach were not optional it is possible that investors in some firms might not expect to earn a normal return even if the firms were efficient. Alternatively, a mandatory TFP approach that contained design features to permit firm-specific factors to be taken into account would also protect investors.

The most often-quoted disadvantage of the building-blocks approach is that the firm has an incentive to game the system by presenting exaggerated cost forecasts, which may lead the regulator to allow prices to increase faster than they need to (ie, setting X “too low”). There are methods to mitigate the problem of asymmetric information and informational rents by providing firms with an incentive to provide more accurate forecasts (the “menu” approach) However, the VTFP proposal does not help address these problems.

Under building-blocks the regulator has the flexibility to set X using three distinct sources information: the firm’s historic cost data, the firm’s forecast of future costs, and comparisons between the historic and forecast cost data from the regulated firm with that of the other regulated firms. This flexibility could, for example, extend to using TFP measurements as one source of evidence in setting prices. It seems to us that the regulator would benefit from having more information rather than less, and that the current framework in Australia might be improved if the regulator had access to information on historic TFP growth rates, to be used as one of the inputs for determining the appropriate values of X and the components of a building-blocks price control. The advantage of adding a TFP-type methodology as one of the sources of information for setting prices under a building-blocks approach would be that it adds information that the regulator would otherwise not have had—ie, the rate at which average productivity across the industry as a whole is changing.

The value of access to information on TFP in the context of energy regulation in Australia will depend on the availability of necessary data to conduct a TFP study, the extent to which Australian energy networks can reasonably be compared with one another (or firms outside Australia), and the extent to which it proves possible to design a robust specification for the detail of the TFP methodology. These issues are beyond the scope of this report, but would in our view merit further study, for use either within a TFP or building-blocks approach.

1 Introduction

The Australian Energy Market Commission (AEMC) is undertaking a review into the possible use of Total Factor Productivity (TFP) for determining prices and revenues for gas and electricity network operators. The AEMC has asked us to prepare a report comparing the incentive properties of the existing method of setting network price controls, known as the “building-blocks” method, with an alternative proposal based on TFP.¹ We have concentrated on the specific TFP proposal made by the Victorian Government in its rule change proposal (the “VTFP” proposal), but we also discuss related ideas that have been raised during recent debate over the merits of TFP in the context of Australian energy regulation. Where relevant, we also make observations about TFP-based and building-blocks type price controls more generally, including designs which focus on strengthening incentives.

Our report concentrates on the current framework applied by the AER to electricity distribution businesses,² but we believe that our analysis and conclusions can be generalised to the regulation of electricity transmission and gas pipelines.

In this report we do not address the availability of data necessary to implement a TFP approach, nor the detail of index specification. For the purposes of the report we assume that robust data is available and that any technical issues of TFP index specification can be satisfactorily resolved. We therefore do not address any incentive effects that might arise through the detailed specification of the TFP index, but we do not expect these to be significant.³

When network regulators set prices they will have a number of objectives in mind. In the context of Australian energy networks, the overall objective of the regulatory framework is set out in the relevant primary legislation,⁴ and is to:

- “promote efficient investment in, and efficient operation and use of, [natural gas or electricity] services for the long term interests of consumers [...] with respect to price, quality, safety, reliability and security of supply...”

Consumers’ interest in the level of network prices set by the regulator is evident, since retailers will tend to pass on network access charges to their customers. The level of network prices, and the means by which they are set, are also relevant to achieving the regulators’ other objectives because both influence the behaviour of the network companies. In this report, we are

¹ In an earlier report for the AEMC we reviewed case studies of the use of TFP in other jurisdictions (*Use of Total Factor Productivity Analyses in Network Regulation – Case Studies of Regulatory Practice*, report for the Australian Energy Market Commission prepared by *The Brattle Group*, October 2008).

² Since the Victorian proposal relates to electricity distribution.

³ That is to say, we would not expect that one TFP index specification would have stronger incentive properties than another. We would, however, not be surprised if the TFP growth rate determined under one specification were significantly different from the TFP growth rate determined under a different specification. We would also not be surprised if the choice of index specification were to prove controversial.

⁴ The *National Gas Law* and the *National Electricity Law*.

particularly interested in how different methods for setting network prices influence incentives for companies to:

- find ways of reducing costs;
- undertake necessary investment; and
- deliver a good quality service.

The regulator needs to achieve a proper balance between these incentives, while also keeping a downwards pressure on prices. Achieving a balance requires inevitable trade-offs to be made: for example, a method which over-encourages cost-cutting may risk reducing the quality of service below acceptable levels; keeping prices very close to realised costs may mean that the companies have little incentive to control costs.

The purpose of this report is to compare TFP and building-blocks methods according to how effectively each one balances the regulatory objectives described above.

Section 2 of the report gives a brief introduction to price controls and incentives; section 3 describes how the current building-blocks method works; section 4 describes the proposed TFP alternative; we assess the likely strength of incentives under each method in section 5; in section 6 we consider a number of further arguments about strengthening incentives which are relevant to the debate but which do not directly concern the VTFP proposal, and section 7 contains our conclusions.

2 Price caps and incentives

2.1 Price caps

Most energy networks in Australia are subject to regulation of the prices that they charge for providing network services. Price caps⁵ as applied to energy network businesses in Australia generally mean that the average price charged cannot increase over time by more than a certain amount each year. The rate of increase is expressed relative to the rate of general inflation in the economy, and this form of price control is as a result typically known as “CPI – X” price control: prices can increase each year by the rate of inflation, less a certain amount determined by the regulator. In principle, the X factor can be (and often is) different for different companies, and it could be negative (ie, real price increases—for example, if the network is expanding rapidly).

Building-blocks and TFP methods can each be used to set prices under a CPI – X control. The incentives faced by regulated firms depend in part on the form of control (ie, CPI – X) and in part on the way that the price cap is set.

The value of “X” in the price control formula is typically set every five years, and additionally the regulator may impose a “one-off” change in prices at the beginning of each price control period, usually known as a “P₀” change. In general there will be many combinations of X and P₀ which would lead to the same total revenue over the price control period.⁶ Under a building-blocks approach it is common for regulators to determine first the total required revenue over the price control period, and then select P₀ and X such that the expected revenue is equal to the required revenue, and such that the profile of prices over time is relatively smooth. For ease of exposition in this report, however, we will ignore the price smoothing step, because it changes nothing of relevance to the regulated firm (all the firm cares about is the total revenue it receives over the price control period). Ignoring the smoothing step, the effect of the P₀ change is to reset prices to out-turn costs at the end of the previous price control period.

CPI – X regulation is also known as “incentive” regulation, because this form of regulation is designed to give the regulated companies strong incentives to control costs. The defining characteristic of “incentive” regulation, as distinct from “cost-of-service” alternatives, is that prices are determined in advance for a certain period of time, and will not be revised until the end of the period, irrespective of how out-turn costs compare with the forecasts. In contrast, under cost-of-service regulation, as costs change over time either the regulated firm or its customers may call for prices to be revised to bring them back into line with costs, or there may be automatic “true-up” mechanisms to pass changes in costs through to changes in prices.

⁵ Throughout this report we refer to controls on *prices* and *revenues* interchangeably. In practice, the regulatory control will apply either to (a basket of) prices or to total *revenue*, depending on whether the regulated firm faces volume risk or not. We do not consider that the comparison between TFP and building-blocks approaches is sensitive to this issue.

⁶ In NPV terms.

CPI – X regulation works on the assumption that the interests of the regulated firm’s owners are to maximise returns on their investment, and that the interests of the firm’s managers are effectively aligned with those of its owners. Thus, for example, under incentive regulation the firm’s managers can increase profits for the firm’s owners by controlling costs: the managers will do this because the firm’s owners reward them for doing so (eg, through share options or other performance-based compensation). If the regulated firm is in public ownership, either or both of these assumptions may be false: for example, the firm’s owners may care more about keeping prices low than profits high; and it may be more difficult to ensure that the managers’ compensation packages are directly linked to performance. We think it reasonable to suppose that the behaviour of publicly-owned firms might be less strongly influenced by profit-based incentive regulation than the behaviour of equivalent privately-owned firms. Thus, where this report identifies differences in the strength of incentives under different approaches, the differences we identify are an upper bound on the extent to which different approaches would influence the behaviour of regulated firms in Australia.

2.2 De-coupling price and cost

The fact that under CPI – X regulation prices and costs are not directly linked gives the regulated firm an explicit incentive to control its costs. This is the case because, for the pre-determined duration of the price control period, revenues are fixed,⁷ and profits are the residual after out-turn costs are subtracted. If the firm can reduce its costs, its short-term profits will increase in direct proportion. In contrast, under a “cost-of-service” regime, prices can be adjusted in light of out-turn costs. Hence profits are constant, irrespective of how well the firm controls costs,⁸ so the firm is not rewarded for “extra” efforts to control costs. Under CPI – X, the regulator can only examine actual out-turn costs and use this information to reset prices once the price control period has expired.

Prices and costs are completely de-coupled *within* the price control period because, leaving aside possible “pass-through” mechanisms⁹ for uncontrollable costs (such as changes in taxation), the level of prices is completely determined at the start of the price control period. However, there is a link between costs in one period and prices in the subsequent one: in general, the regulator will use information about actual costs in period 1 when determining prices for period 2. Since the regulated firm knows this will happen, when deciding how much effort to invest in controlling costs during period 1 it will take into account the fact that the firm will lose some of the benefits of reduced period 1 costs when prices are set for period 2.

⁷ Leaving aside the question of volume uncertainty.

⁸ In practice, prices are unlikely to be reset every year under cost-of-service, and when they are reset cost information is available only with a lag, so the firm retains some incentive to control costs. Nevertheless, the incentive is weaker than under a price cap control.

⁹ We recognise that such mechanisms are part of energy network price controls in Australia, but we do not believe that they are likely to be a relevant consideration in this work, because the kinds of cost that can be subject to the pass-through mechanism are limited. Specifically, they are costs over which the business has no control, so the issue of incentives does not arise.

Other things equal, the incentive on the firm to control its costs is greater if the period of each price control is long. However, the longer the price control period, the more time elapses before the benefits of successful cost control feed through to customers as lower prices. If there is no (or only small) incentive to control costs, costs will turn out higher than they would have been under a more powerful incentive arrangement: controlling costs takes management effort, and managers will not expend that effort if they do not see the prospect of some reward.

2.3 Incentive to control cost

Following the logic set out above, the benefit to the regulated firm of controlling costs comes from the fact that prices and cost are de-coupled. The strength of the incentive does not depend on the *level* of prices.¹⁰ We can illustrate this important point with a simple numerical example. Suppose that there are two identical firms, each with initial cost 9 but with the opportunity to reduce costs to 8. The regulator does not know about the opportunity to cut costs for the first firm, but for the second one the regulator has better information: as a result, prices for the first firm are set at 10 in year one and 10 in year two, and for the second firm the price is set at 10 in year one but 9 in year two. These parameters are set out in Table 1, which illustrates that both firms have the same incentive to control costs, even though the level of prices and the absolute level of profits of the two firms are different.

Table 1: illustrative example of incentives

	Firm 1		Firm 2	
	Year 1	Year 2	Year 1	Year 2
Prices	10	10	10	9
Without effort				
Cost	9	9	9	9
Profit	1	1	1	0
With effort				
Cost	9	8	9	8
Profit	1	2	1	1
Extra profits due to effort	0	1	0	1

Although the strength of the incentive to control costs does not depend on the level of prices, and hence on the X factor, in any given price control period, it will depend on prices (and X) in the following period *if the prices in the second period depend on out-turn costs in the first*

¹⁰ Incentives under two very different price levels might be different: for example, if, at the low price level only, extra effort to control costs might allow the firm to continue with dividend payments it might have an “extra” incentive to control costs that it would not have if prices were higher (because, under the “signalling” theory of corporate finance, it is costly to the firm to reduce its dividend). However, we think that any such effects are unlikely to be important because they relate to extremes.

period.¹¹ The strength of the incentive depends on the *relationship* between prices in the second period and costs in the first period. The weaker the relationship, the stronger is the incentive—ie, if a cost reduction of \$10m in period one leads to a price reduction of \$10m in the second period, the incentive to achieve the reduction is smaller than if the same \$10m reduction leads to a price reduction of \$5m in the second period. At the same time, the only way that the benefit of reduced costs in one period can be passed back to customers in the following period is if there is a relationship between price and cost. Thus there is a trade-off between providing an incentive to control costs, and ensuring that the benefits of cost control reach customers.

2.4 Incentive to invest

For a number of reasons there is often only a weak link, in the short run, between the amount of investment undertaken by an energy network company and the service it delivers. For example, many of its assets are long-lived, and replacement investment may be postponed by accepting a slightly increased risk of failure; or when load is growing it may be possible to run existing assets harder rather than investing in new capacity additions. In the short to medium term, a lack of investment may not immediately manifest itself in network failure or reduced service quality. For these reasons, regulators may be concerned about the extent to which the regulatory framework encourages firms to maintain the right level of investment.

In one sense, the incentive to invest is the inverse of the incentive to control costs: “avoided investment” is one way of reducing costs, and avoided investment does not (immediately) result in reduced revenues.¹² Thus, under a price cap, the regulated firm has a *disincentive* to invest (relative to cost-of-service regulation, for example), because investment is a cost and it has an incentive to control costs. The level of the price cap should be sufficient to provide a “normal” return on a certain level of investment, after operating and other costs are deducted. At least in the short run, the regulated firm is better off if it invests less than this baseline (conversely, if it invests more than this baseline its return on investment during the price control period will be below the required normal rate of return). The quantity of investment that the firm in practice chooses to undertake is also influenced by other factors, such as the need to meet quality and safety standards, but these do not directly relate to the way that prices are set.

Regulated firms subject to price caps do invest—because, if they do not, service quality will suffer and they could risk breaching their various regulatory and legal obligations. Thus the firm’s investment results from balancing the immediate financial incentive to control costs with the more indirect incentive to maintain quality and comply with regulatory and legal standards.

The regulator’s decision on the cost of capital has a very small impact on the firm’s investment incentives, at least in comparison to other factors influencing the level of investment. This is because if the firm avoids capital expenditure the investment is not made but the firm

¹¹ More precisely, the strength of the incentive is determined by the firm’s *expectation* for how period two prices will be influenced by costs in period one.

¹² Just as part of the rationale for choosing “incentive” regulation rather than cost-of-service is to avoid the problem of over-investment (the “Averch–Johnson effect”).

receives return and depreciation for the remainder of the price control period. Thus it might benefit from returns of say 8% for three years. If, in contrast, the investment is made and regulator over-estimates the cost of capital by 1%, the firm benefits from “extra” returns of about 1% for as many years as the cost-of-capital overestimate continues. Even if the regulator permanently over-estimates the cost of capital (ie, the regulator’s error is repeated in several price control reviews), the benefit is unlikely to be more than about 10% of the investment. The benefit from deferring investment is almost always greater than this.¹³ Furthermore, under at least some TFP methodologies, a forward-looking cost of capital estimate is an input to the TFP-based price cap.

Although the firm’s incentive to invest is not changed if the regulator over-estimates the cost of capital, it is important to bear in mind that on average the regulator must provide the firm with the expectation that it will at least earn its cost of capital on average in the long run. If potential investors expect to earn less than the cost of capital, the firm will not be able to access capital markets and will be unable to operate.¹⁴ Regulatory frameworks typically include an explicit requirement that the regulator allow efficient firms the opportunity to earn their cost of capital. Providing a stable regulatory framework that is conducive to providing investors with adequate returns is usually held to be crucial to the success of the framework.

Since energy network assets have long lives, returns on those assets typically span several price control periods. The regulated firm’s expectation about future returns may therefore relate as much to its view of the “regulatory philosophy” as to the precise details of the rules for the immediately forthcoming price control, since the detailed rules are subject to change. In addition, the long life of network assets means that if a firm invests *more* than the baseline level that is consistent with a normal return in the current price control period, the extra investment will nevertheless start earning a normal return in the next price control period, assuming that prices are then reset to costs.¹⁵ Provided that the regulatory regime is stable, therefore, the regulated firm bears only a small portion of the costs associated with investing more than the assumed baseline amount.

2.5 Service quality

The customers of energy networks care about service quality as well as service price, and, in general, it is likely to be cheaper to deliver a low-quality service than a high-quality one. As a result, it is recognised that price cap regulation could lead to reductions in service quality over time. Regulators therefore often supplement price caps with an additional term relating to service quality, such that the price cap automatically increases if service quality improves, and/or

¹³ If the investment would otherwise have been made in the last year of a price control period, the deferral benefit would be approximately equal to the cost of capital.

¹⁴ This may not be a constraint for state-owned firms, for example where the firm’s debt is guaranteed and therefore earns a normal return by definition.

¹⁵ Subject, in the case of gas pipelines, to a “prudence test”.

decreases if it falls. The additional service quality incentive therefore counteracts the pressure to reduce service quality that firms face because of the price cap.

Of course, such a service quality incentive relies on being able to measure service quality. For electricity distribution, for example, this may be done in terms of “customer minutes lost”, or “interruptions per 1,000 customers”, or on several such measures. Linking a firm’s service quality score (or changes in that score over time) to a financial incentive requires an implicit valuation of service quality: for example, a 10% fall in the number of customer minutes lost might result in the price cap increasing by 1%.

The presence of a service quality incentive tends to increase the incentive on the firm to undertake necessary investment, because, at least in the long run, there is a link between investment and service quality. However, the lag between under-investment and reduced service quality may be significant, and managers may be tempted to make cost reductions and risk a reduction in service quality in five or ten years’ time (when those managers may no longer be in post). Thus regulators may not rely entirely on the service quality incentive to ensure that firms invest. The regulator may, for example require the firm to undertake an audit of the condition of its assets, and check how the firm is implementing its maintenance and replacement policies.

Clearly, aspects of service quality or reliability can be dealt with directly by agencies other than the economic regulator mandating and enforcing standards. In this case, firms would be required to meet the relevant standards (and to bear the costs of doing so).

2.6 Passing savings back to customers

If, at a certain point in time, the regulator set a price cap and made a credible commitment that it would never subsequently be reopened, the regulated firm would have a very strong incentive to control costs: any reduction in costs would result in an equal increase in profits. However, since the firm’s prices have been fixed in advance, its customers would never see the benefits of the cost control.¹⁶ Such an arrangement would therefore be expected to deliver good efficiency within the regulated firm, but the firm’s prices would not reflect its efficient costs. In practice, regulators wish not only to encourage efficiency within the regulated firm, but also to keep the firm’s prices somewhat related to the costs. Doing this allows for correct price signals to be sent to the firm’s customers, and also provides for a more “equitable” sharing of the benefits of efficiency improvements within the regulated firm.

Firms which are subject to below-average cost inflation will be able to earn above normal profits, because of information asymmetry. In order to set prices close to the firm’s costs, the regulator needs to make a forecast of the firm’s future costs. The firm may know its own costs, but it will try to conceal this information if, by doing so, it can persuade the regulator to set higher prices. Given uncertainty about the firm’s future costs and opportunities to reduce costs, setting a price cap involves balancing two risks: if the price cap is set high, prices are less likely to be close to cost; if the price cap is set low, prices may be *below* costs.

¹⁶ On the reasonable assumption that the regulator would be unable accurately to forecast the path of efficient costs, so (over time) the firm’s prices would be less and less likely to reflect the firm’s costs.

Thus the regulator is faced with a number of difficulties:

- if the firm's efforts to reduce costs feed directly into future price caps, the firm's incentives to control costs are reduced;
- if prices are not reasonably close to the firm's actual costs, customers do not see efficient price signals, and there may not be an equitable distribution of efficiency savings; and
- the regulator is uncertain about the firm's (efficient) costs.

Regulators have developed various techniques to manage these problems, described in section 2.7.

2.7 Options for incentive regulation

Over time, various techniques have been developed to help make the trade-off between incentives to control costs and passing back efficiency savings to customers. The following subsections provide a brief description of some of these techniques.¹⁷

2.7.1 Building-blocks approach

The building-blocks approach as implemented in Australia is described in detail in section 2. In general, under the building-blocks approach the regulator reviews information from the regulated firm on both historic costs and forecast future costs. The price control is set on the basis of an adjusted version of the firm's cost forecast. Before accepting the firm's cost forecast, the regulator looks for evidence that the forecast is reasonable: for example, it could compare the forecast costs with the trend of historic costs; it could compare the firm's cost forecasts (formally or informally) with those of other regulated firms; and it could employ independent experts to review the forecasts. In practice the regulator will set prices on the basis of a cost forecast that is below that presented by the firm wherever it has robust evidence to justify the reduction.

2.7.2 Menu approach

Under the "menu" approach, the regulator offers the firm several different possible price caps. The relatively high price cap goes together with a mechanism to "claw back" most of the difference between the price cap and out-turn costs, whereas under the relatively low price cap, the firm would be allowed to keep a larger proportion of any cost savings. The menu approach induces the regulated firm to reveal to the regulator whether it thinks it has high or low costs. It

¹⁷ For a broader review of theory and practice, see *Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks*, CWPE 0607 and EORG 0511 working papers, Paul L. Joskow (February 2006).

helps to overcome the problem of information asymmetry and “gaming” of cost forecasts, and helps to balance the risks of setting prices too high or too low.¹⁸

The different price cap options on the menu could be derived from the building-blocks approach, but with the regulator taking a more or less aggressive stance in reviewing the firm’s cost forecasts. The menu approach has been implemented in the UK,¹⁹ and has been discussed in Australia.²⁰

2.7.3 Benchmarking

Under a “benchmarking” (or “yardstick”) approach, the regulator examines the out-turn performance of several firms in order to set price caps. In the limit where there are several firms which face the same external operating environment, the regulator can set the price cap for the first firm on the basis of the out-turn costs of the other firms. This maximises the strength of the incentive to control costs—since the price cap in the second period is not set with reference to the firm’s own costs in the first period—and simultaneously maximises the pass through of savings to customers. Where firms do not face identical external environments, for example because one is larger, or has a less dense network, the regulator must take into account these differences through some kind of normalisation. In general it will be difficult to identify what part of the cost differences between firms is due to “external” differences (eg, network density), and what part is due to one firm being more efficient than the other.

In practice, elements of a benchmarking approach can be and are included within the building-blocks approach, either formally or informally. Benchmarking could be applied to components of total costs (for example, operating costs alone), or on a unit costs basis. Benchmarking can also be applied to service quality. Benchmarking can only be done where there are several regulated firms that are comparable in terms of their operating characteristics (usually, but not necessarily, operating in the same jurisdiction), or where differences due to operating characteristics can be satisfactorily adjusted for.²¹

¹⁸ See, for example, “REx Incentives: PBR Choices that Reflect Firms’ Performance Expectations”, Johannes P. Pfeifenberger, Paul R. Carpenter, and Paul C. Liu *The Electricity Journal*, November 2001, p. 44. The theoretical background is explained in *A theory of incentives in procurement and regulation*, Jean-Jacques Laffont and Jean Tirole (MIT Press, 1993).

¹⁹ Ofgem implemented a menu approach at the last electricity distribution price control review. See *Electricity Distribution Price Control Review, Final Proposals*, Ofgem, November 2004, paragraphs 7.65 on.

²⁰ Australian Competition and Consumer Commission, *National Electricity Market: Statement of Regulatory Intent for the Regulation of Transmission Revenues, Issues Paper*, May 1998.

²¹ It would make sense to include firms from other jurisdictions if these firms were reasonably comparable in terms of their cost drivers. Since geography, climate, and safety and quality standards are all likely to be important cost drivers, and may all be different in different jurisdictions, including other firms may not always make sense. Furthermore, the regulator may not be able to obtain the necessary information from firms outside its own jurisdiction.

2.7.4 Total factor productivity

The total factor productivity approach as proposed by the Victorian Government is described in detail in section 3. In general, TFP approaches are a form of benchmarking, where the price cap for one firm is set with reference to the average out-turn rate of TFP growth of a set of comparator firms.²² As with other benchmarking approaches, one advantage of TFP methods is that the firm's price cap is not in general set with reference to its own out-turn costs, so the incentive to control costs is maximised. Furthermore, under TFP the price cap is designed to replicate the discipline that market forces impose on firms in competitive parts of the economy. These forces compel firms that realize productivity gains to pass these gains on to their customers in the form of lower prices, after accounting for changes in input prices. Thus, if all industries in an economy were competitive, output prices in the economy would grow at a rate equal to the growth rates of input prices net of TFP growth. If the regulated industry were just like the typical industry in a competitive economy, the discipline of competitive forces could be replicated by limiting the rate of growth of regulated prices to the economy-wide rate of input price inflation, less the economy-wide rate of TFP growth.

²² As the name implies, the method is based on *productivity*, defined as the difference between the rate of output growth and input growth (see, for example, *Use of Total Factor Productivity Analyses in Network Regulation – Case Studies of Regulatory Practice*, report for the Australian Energy Market Commission prepared by *The Brattle Group*, October 2008. The price cap for the regulated firm increases at the same rate as the rate of TFP growth measured in the comparator group.

3 The building-blocks approach in Australia

3.1 Introduction

The current regulatory framework in Australia requires the AER to apply a building-blocks approach. For example, rule 6.3 of the National Electricity Rules is headed “Building block determinations”, and, together with subsequent provisions, sets out what is meant by the term. Although the current arrangements have only recently been introduced, price controls set under the older legislation were of a similar form (building-blocks) to those being set under the new rules. The AER has issued determinations for the New South Wales and ACT electricity distribution businesses for the 2009–14 period, but price control reviews for the seven companies in Victoria and Queensland are in the very early stages. The most recent decisions are based on “transitional” versions of the new rules, which are different in some respects from the version that will be used hereafter. Hence, evidence on the outcome of building-blocks price controls in Australia is only available from earlier control periods, and the detail of the building-blocks approach continues to evolve.

For the purposes of this report we describe the current building-blocks approach, but we also make reference to the outcomes of determinations under the old rules. We do not intend to provide a comprehensive description, rather to describe the method in sufficient detail to permit comparison with alternative TFP-type approaches.

We understand that the principles underlying the building-blocks approach to energy network regulation in Australia are common to gas and electricity and to distribution and transmission, although there are differences of detail. In this report we draw specific examples from rules and decisions relating to the regulation of electricity distribution networks, but we intend our analysis and conclusions to be generally applicable.

3.2 General approach

The regulator sets a cap on initial prices (“ P_0 ”) and the rate at which prices can increase over time in real terms (“ X ”), with the possible addition of incentive payments (described below). The basic idea is to estimate the total revenue that the firm will require each year over the forthcoming price control period to provide its investors with a reasonable rate of return and to allow it to meet efficiently-incurred costs. Total revenues recovered from charging at the price cap set by the regulator must, in present value terms over the period of the price control, be equal to the total required revenue. Since it is the total amount of revenue that is the target of the regulatory determination, there is in principle no restriction on the amount of revenue or prices in any one year of the control. However, a pragmatic approach is usually taken (and, in Australia, is required under the electricity rules) to smooth the change in prices from one price control period to the next. The regulator’s task is to determine the required revenue by breaking it down into various components of cost and return to investors (hence “building-blocks”):

- operating costs that the firm should incur if it operates efficiently;
- capital expenditure, if the firm undertakes necessary investment efficiently;²³
- a rate of return on investment in the regulated assets;
- depreciation of regulated assets; and
- tax.

Thus, the total required return is equal to the sum of forecast: operating costs + tax + return on assets + depreciation of assets. In addition, the companies may receive additional income (or be penalised) through the operation of incentive schemes. The individual building-blocks are described in sections 3.4.1 to 3.4.5, and the additional incentive schemes are described in section 3.5.1.

The price cap depends on the *forecast* of each of the building-blocks, irrespective of out-turn. At the start of the subsequent price control period, the opening regulatory asset base is adjusted to take out the difference between actual and forecast capital expenditure, but during the price control only the forecast amounts count in setting the cap on prices.²⁴

²³ Capital expenditure forecasts do not directly form part of the estimate of required revenue, but are an input to the calculations of the total regulated asset base (RAB) in each year of the price control period. Required return on investment and depreciation, which are components of the total required revenue, are derived from the RAB calculation.

²⁴ In setting the price control for one period, the regulator will take into account the firm’s forecasts for that period, and may also take into account any differences between forecast and actual costs for the *preceding* period.

3.3 Process

The process for carrying out an electricity distribution price control review involves the following elements:

- the AER publishes detailed “guidelines” on various topics (outside the cycle of individual price control reviews), which will guide all of its subsequent decisions;
- prior to each price control review, the AER must publish a “framework” document, setting out its proposed approach to the forthcoming review, the general form of the price control, and whether it intends to apply incentive arrangements;
- each firm submits a detailed “proposal” to the AER, containing the firm’s views on all of the building-blocks for the following price control period;
- the AER reviews the firm’s proposals against the criteria set out in the relevant Rules and its own guidelines, and publishes a draft determination which explains in detail for each of the building-blocks whether the AER proposes to accept or modify the firm’s proposal;
- the companies submit modified proposals; and finally
- the AER issues its final decision, explaining in detail its conclusions on each of the building-blocks, as well as the total required revenue and the schedule of prices (P_0 and X) for the forthcoming price control period.

Subsequent to the AER’s final determination, the companies have the right to appeal the AER’s decision. Appeals can be on a point-by-point basis (eg, a firm could appeal the decision on the risk-free rate component of the cost of capital, without appealing the decision on the debt premium). The appeal is a “merits” appeal, but grounds for an appeal must include either a material error of fact or an “incorrect” or “unreasonable” exercise of discretion on the part of the AER.²⁵ There are three possible outcomes of the appeal process: the AER’s decision can be affirmed; the AER’s decision can be over-ruled and the issue sent back to the AER for re-determination; or the appeal body itself can substitute its own decision for the AER’s.

3.4 The building-blocks

3.4.1 Operating costs

The operating cost building-block is a forecast of operating costs in each year of the forthcoming price control period. It must take into account expected demand, and the need to meet relevant safety and quality standards and other regulatory obligations.

When the AER examines a firm’s proposal for operating costs, it considers whether the costs represent what a prudent firm would efficiently incur in the circumstances facing the network

²⁵ See *National Electricity Law*, s. 71C, version of 17/7/2008.

firm making the proposal. When assessing efficiency, the AER is able to make use of a range of evidence, including information about the firm's past operating costs, and the AER's view of an efficient forward-looking benchmark.

In practice, the AER engages technical consultants with detailed industry expertise to assist with reviewing firms' cost forecasts. The consultants typically undertake both top-down and bottom-up reviews: the top-down approach considers how costs might evolve starting from the known past costs in a base year, and the bottom-up approach involves "identification of the basis of the forecasts in each expenditure category; consideration of the main expenditure drivers; identification of the impact of external factors; review of the impact of cost escalation and the treatment of forecast real increases in costs; review of the efficiency of the estimated costs (and of unit costs where relevant); and consideration of the adequacy, efficiency and application of the DNSPs' policies and procedures."²⁶

Clearly, the operating cost building-block is one where the regulator relies heavily on information provided by the firms. It must use its judgement (supported by technical consultants) to determine whether the firms' forecasts are reasonable.²⁷

3.4.2 Tax

The tax allowance is a forecast of the firm's tax bill. It is calculated on the basis of pre-tax profits, estimated from the other building-blocks. The tax allowance is set *ex ante*, so if the firm is able to reduce its tax bill below that assumed by the regulator, it will keep the difference as increased profits. The tax allowance calculation requires an assumption on the use of imputation tax credits by the firm's equity investors. However, the calculation does not require information provided by the regulated firm additional to that provided in the context of the other building-blocks.²⁸

3.4.3 Cost of capital

The cost of capital building-block provides the owners of the network business with a return on their investment. Required returns are calculated on a post-tax basis, and there is no need to adjust for the effect of corporation tax because the firm receives a separate tax allowance (see

²⁶ The quoted description is of Wilson Cook's review of NSW distribution company operating cost forecasts in *New South Wales draft distribution determination 2009–10 to 2013–14*, p. 167 (AER November 2008).

²⁷ The relevant legislation sets out some details on what reasonable means in this context.

²⁸ *New South Wales draft distribution determination 2009–10 to 2013–14*, pp. 204–211 (AER November 2008).

section 3.4.2). Required returns are based on the Capital Asset Pricing Model,²⁹ and are formally calculated as a nominal rate of return multiplied by a nominal (ie, inflated) regulated asset base.³⁰

While there is scope for disagreement between the regulator and the firms in respect of the estimation of required rate of return, it is not an area in which the regulator must rely on information from the firms. Determining the size of the regulated asset base itself is described in section 3.4.5.

3.4.4 Depreciation

The depreciation building-block is calculated by dividing each firm's assets into a number of classes. Each class has a defined "standard life", representing the expected economic life of that asset class, and an "average life remaining", which is the expected economic life less the average age of the assets. Depreciation on the asset base is then calculated on a straight-line basis over the average life remaining, and forecast inflation of the regulatory asset base is subtracted to yield the "regulatory depreciation" allowance.³¹ The size of the asset base in each year of the price control period is determined by adding (net) capital expenditure and subtracting depreciation (see 3.4.5).

As with the tax allowance, the depreciation building-block is calculated in a relatively straightforward manner from inputs to the other building-blocks. There is relatively little scope for disagreement, with the possible exception of the need to define a standard life for each asset.³²

3.4.5 Capital expenditure and the regulated asset base

The size of the regulated asset base is an input to calculating the required return on investment, depreciation, and tax. The size of the regulated asset base in each year of the forthcoming price control period is determined from: the opening value of the asset base at start of the price control period; less regulatory depreciation (see section 3.4.4); plus a forecast of capital expenditure. In principle, it is straightforward to calculate the opening value of the asset base at the start of the price control period—it is equal to the closing value of the asset base at the end of the preceding price control period, as originally determined in the preceding price control decision, adjusted for the differences between:

- actual inflation during the preceding price control period, and that originally forecast;
- actual capital expenditure during the preceding price control period, and that originally allowed; and

²⁹ See, for example, clause 6.5.2 of the *National Electricity Rules* (version 24).

³⁰ There is no "over-compensation" for inflation, however, because inflation is subtracted from the calculation of regulatory depreciation (see section 3.4.4). Thus the rate of return can be expressed as (nominal RAB) $\times$ (1 + nominal WACC—inflation).

³¹ The calculations are explained in the AER's *Post-tax Revenue Model*, AER June 2008.

³² *New South Wales draft distribution determination 2009–10 to 2013–14*, pp. 212–219 (AER November 2008).

- regulatory depreciation during the preceding price control period (recalculated to take into account actual capital expenditure), and that originally allowed.

Thus, the opening value of the regulatory asset base depends on actual capital expenditure during the preceding price control period, whereas the revenues in the preceding price control period depended on the forecasts approved by the regulator at the start of that control. All capital expenditure actually incurred is added to the regulatory asset base—under the National Electricity Rules there is no *ex post* assessment of whether the expenditure was “prudent”.

Once the opening value of the regulatory asset base has been calculated, a forecast of capital expenditure during the forthcoming price control period is needed to estimate the value of the regulated asset base in each year of the new control period. This forecast is determined in a similar fashion to the forecast of operating costs: the firm makes a proposal which is reviewed by the regulator.

The firm’s forecast must take into account expected demand, and the need to meet relevant safety and quality standards and regulatory obligations. When the AER examines the proposal, it considers whether the expenditure represents what a prudent firm would efficiently invest in the circumstances facing the firm making the proposal. When assessing efficiency, the AER is able to make use of a range of evidence, including information about the firm’s past capital expenditure, and the AER’s view of an efficient forward-looking benchmark. The AER can also make use of comparisons between the submissions of different firms making proposals at the same time.³³

Again, as with operating costs, in practice the AER engages technical consultants to assist with reviewing firms’ capital expenditure forecasts.³⁴

In assessing the reasonableness of the capital expenditure forecasts the regulator relies heavily on information provided by the firms.

3.5 Modifications to required revenue addressing service quality and other issues

3.5.1 *Earnings sharing / efficiency incentive scheme*

In addition to the “standard” building-blocks of the price control described in section 3.4 above, incentive/penalty payments may also be added to the regulated firms’ revenue allowances, according to their out-turn performance. Under these schemes, the actual revenue that the firms are allowed to collect from customers is equal to the required revenue, as determined under the building-blocks method, plus or minus additional payments that depend on, for example, whether the firm meets certain service quality standards or not.

³³ *Ibid.* p. 122.

³⁴ *Ibid.* pp.119–154.

The National Electricity Rules allow for three such schemes:

- an efficiency benefit sharing scheme;
- a service quality incentive scheme; and
- a demand management incentive scheme.

This section describes the efficiency benefit sharing scheme that applies to electricity distribution companies, and sections 3.5.2 and 3.5.3 describe the service quality and demand management incentive schemes.

The efficiency benefit sharing scheme is designed to fine-tune the key incentive properties of the price control with respect to cost efficiency. As discussed above in section 1, a defining characteristic of CPI-X-type price controls is that they give the regulated firm an incentive to control costs:

- in respect of operating costs, if out-turn costs are below the operating cost building-block allowance, the firm keeps the difference as additional profits; and
- in respect of capital expenditure, if out-turn costs are below the capital expenditure building-block allowance, the firm benefits from depreciation and required return on the avoided expenditure.³⁵

There are at least three features of these incentives which may not be ideal.

First, many operating cost efficiency savings are “recurrent”—ie, a fall in out-turn costs relative to the allowance will be repeated in subsequent years. A recurrent saving made in year one of a price control period will yield benefits to the regulated firm in all the years of the price control, before the operating cost allowance is reset at the start of the following price control period (other things equal, the operating cost allowance in the following price control period might be set equal to the actual out-turn operating cost during the first price control period). However, if the same saving were made at the end of the price control period, the firm might see the benefit only for one year. This is undesirable because, for example, the firm therefore has an incentive to ignore an opportunity to make operating cost savings at the end of one price control period, so that it could achieve a higher operating cost allowance in the subsequent period, then make the savings at the beginning of that period and retain them for the full duration of the second period. This incentive is undesirable because it makes the firm better off by doing something that makes customers worse off.

Second, a similar argument applies to capital expenditure savings: a reduction in the last year of the price control period results in a depreciation and required return benefit for the firm for just

³⁵ The required return and depreciation building-blocks elements of the total required revenue depend on the capital expenditure allowance approved at the start of the price control period, rather than on actual capital expenditure, but the opening asset base at the start of the following price control period depends on actual expenditure during the preceding control period.

one year, whereas if the firm postpones the opportunity to make a saving to the beginning of the next price control period, it may benefit for up to five years.

Third, “one-off” reductions in operating costs result in benefits for the firm, but no benefits for customers (because there is no mechanism for a one-off reduction in operating costs to feed through into a reduced operating cost allowance at the following price control review).

These potential deficiencies with the standard building-blocks approach can be corrected by “carrying over” cost reductions from one price control period to the next. The idea is that the firm should benefit from cost reductions for a full period of five years, irrespective of when during the price control period the saving is made, and that all savings should be shared with customers. The AER’s efficiency benefit sharing scheme addresses the first and third of the points made above (the AER’s scheme does not apply to capital expenditure, for reasons explained below). The scheme works by carrying forward for five years the incremental difference between operating cost allowance and out-turn costs in each year. Thus, for example, the carryover amount in year two of the second price control period is equal to the sum of incremental efficiency savings in years three to five of period one and years one and two of period two. The scheme is symmetric, so that increases in out-turn costs from one year to the next are rolled forward as penalty payments.³⁶

The effect of the AER’s scheme is that all operating cost efficiencies, irrespective of when they occur or whether they are one-off or recurring, are shared in the approximate ratio of 30:70 between the firm and its customers (according to the AER’s estimates).³⁷ The AER scheme does not apply to capital expenditure because the regulator felt that it would be too difficult to identify and remove the impact of deferred rather than avoided capital expenditure.³⁸

3.5.2 Service quality incentive

Under a pure building-blocks price control, the regulated firm has a strong incentive to reduce costs. In theory, the firm would benefit from reducing the quality of the service it provides to its customers if, in so doing, it reduced its costs. One regulatory response to this theoretical problem is to require the firm to meet compulsory service quality standards. If the firm did not do so, it would presumably face some kind of fine or other deterrent. As an alternative or an addition to compulsory minimum standards, the regulator can implement an incentive scheme, whereby the firm is rewarded with additional revenue (over and above the required revenue under the price control) if it delivers improved service quality. Conversely, it can be penalised if it delivers reduced quality.

³⁶ The scheme also attempts to correct for possible problems such as incentives to game capitalisation policy.

³⁷ See worked examples in *Electricity distribution network service providers—Efficiency benefit sharing scheme*, pp. 23–43 (AER 2008).

³⁸ If capital expenditure is deferred from one control period to the next, under a roll-forward scheme the benefits to the firm can be much greater than the benefits to customers (see *ibid.* pp. 23–43).

The AER has implemented such an incentive scheme for electricity distribution companies.³⁹ Firms are rewarded if their performance on reliability and quality of supply and customer service exceeds their historical average (ie, the past performance of that firm). If performance is worse than the historical average, the firm is penalised. In addition, a similar incentive arrangement operates in respect of compensation payments to customers that are interrupted: the firm has an additional revenue allowance under the price control which is equal to its historic average compensation payments. Any increase in compensation payments must be funded by the firm, and it can keep any savings if fewer customers require compensation.

3.5.3 Demand management incentive

The electricity distribution rules also allow for the implementation of a demand management incentive scheme. The purpose of the scheme is to provide financial incentives to the network companies to encourage them to implement efficient non-network alternatives to meet demand or to manage the expected demand for network services in some other way.

The AER has not implemented a set of national guidelines on demand management incentives for electricity distribution businesses, as it has for efficiency benefit sharing and service quality, but it has implemented or is proposing to implement schemes in NSW and in Victoria as part of the price control reviews currently ongoing, and there is a guideline for Queensland and South Australia.

The schemes consist of two elements: first, the AER allows a small amount of additional revenue over and above the required revenue calculated under building-blocks (of the order of \$1m per firm per year), to be used to fund additional work to manage demand; and second, the companies may be allowed to raise prices to compensate for reduced demand, where the reduced demand is caused by investments made under the demand management incentive scheme.⁴⁰ The rationale for the second element is that where there is a price control rather than a revenue control, the business is exposed to volume risk: if out-turn demand for network services is lower than forecast, the business will not be able to earn its required revenue. Where the reduced demand is caused by successful demand management it may make sense for the business to be able to recover the originally forecast revenues.

³⁹ *Electricity Distribution Network Service Providers—Service target performance incentive scheme*, AER 2008.

⁴⁰ See *Demand management incentive scheme for the ACT and NSW 2009 distribution determinations, Demand management innovation allowance scheme*, AER (February 2008).

4 Total factor productivity—the rule change proposal

4.1 Introduction

Under a TFP approach the rate at which prices charged by the regulated firm can increase is capped at $CPI - X$, just as with the building-blocks approach. However, the regulator's method for determining the value of X is different.

In the following sections (4.2 to 4.9) we describe the TFP methodology as proposed in the Victorian Government's rule change proposal.⁴¹ We do not provide a full description of all the elements of the proposal, but we highlight the aspects which we consider relevant to assessing the incentives that businesses would face if the proposal were implemented.

In this report we do not attempt to assess the quality of historic cost and output information that may be available to the regulator, either for the purposes of applying the standard building-blocks approach or in order to apply a TFP methodology. Both methods will suffer if the quality of information is poor.

4.2 Basic approach

The basic approach is that initial prices at the start of each price control period would be reset to actual out-turn costs at the end of the preceding price control period, through applying a “mini building-blocks” methodology. It would be “mini” in the sense that it would only look backwards at out-turn costs (perhaps in a single year), together with a “standard” forward-looking cost-of-capital assessment.⁴² The rate of price increase over time (ie, the X factor) would be set equal to the historical average rate of change of productivity achieved by a sample of comparator firms. X therefore depends on the average performance of a group of comparator firms, and the regulated firm's own actions will not influence the regulator's choice of X in subsequent periods.

Under the VTFP proposal the TFP approach would be an alternative to the building-blocks approach. Each regulated firm would have the option to request either the current building-blocks approach or the TFP alternative. The AER's agreement would be required.

As under the current building-blocks approach, the length of a TFP price control period would be five years or more. The VTFP proposal specifically rules out one alternative possibility under which the price control period would not be defined in advance, but would come to an end

⁴¹ On 23rd June 2008, the Minister for Energy and Resources (Victoria) submitted a proposal to amend the electricity rules to allow the use of the Total Factor Productivity methodology as an alternative economic regulation methodology to be applied by the AER in approving, or amending, determinations for distribution network service providers.

⁴² See section 4.4 below.

(with prices being reviewed, and reset to out-turn costs) if out-turn profitability fell outside certain pre-defined thresholds.⁴³

4.3 Process for applying TFP

The institutional process for applying TFP would be similar to that currently used under the building-blocks methodology. Instead of making a detailed proposal containing the regulated firm's views on each of the building-blocks, the firm would make a proposal containing its views on the elements of the TFP approach. If the regulator approved the firm's TFP proposal, the subsequent process would be similar to that described above for building-blocks: the regulator would give an initial view on the firm's proposal, the firm would respond, and the regulator would make a final determination (subject to appeal). Alternatively, if the regulator did not approve a TFP proposal, the firm would be required to submit a building-blocks proposal.⁴⁴

At subsequent price control reviews, any business already under a TFP control would require AER consent to revert to a building-blocks control.

In deciding whether to accept a TFP proposal, the AER would have to consider the following factors:

- the availability of data necessary for applying the TFP methodology;
- whether there is likely to be a change in the business's costs in the forthcoming price control period which "cannot be accommodated" within the TFP methodology; and
- whether the business's productivity growth is likely to reflect industry-wide productivity growth in the forthcoming price control period.

All of the design issues (discussed in sections 4.4 to 4.9) would also be addressed by the AER in a set of detailed regulatory guidelines, similar in function to the existing guidelines for building-blocks price controls. The businesses would be able to refer to the AER guidelines in their TFP proposals.

4.4 Setting initial prices

The basic idea is that initial prices would be set to reflect costs at the start of each price control period. Costs would be assessed using the building-blocks method, but focusing only on

⁴³ This alternative approach has been used in North American jurisdictions and is known as "off-ramps".

⁴⁴ We note in passing that it is sometimes argued that TFP-type price controls are likely to require fewer resources on the part of the regulator and the regulated firms. We think that this is unlikely to be the case in practice, particularly if firms have the option to continue with a building-blocks approach, in part because the details of a TFP methodology are usually contentious. Furthermore, we think it unlikely that administrative cost savings would justify switching to a methodology that did not have superior outcomes in terms of incentives.

one year.⁴⁵ However, unlike under the building-blocks approach, the cost assessment would not involve forecasting, or would involve only a short time horizon forecast (the year for which costs were being assessed would be the last year of the then current price control period, which would be the actual year or perhaps one year in the future, depending on the timetable for the price control review process). The cost of capital element would be forward-looking in the sense that the risk-free rate and other components would be assessed for the forthcoming price control in the same way that they would be for the standard building-blocks methodology.

4.5 Comparator firms

Under the proposed TFP approach the X factor would depend on the historic average rate of change of productivity of a group of comparator firms, referred to the “industry-wide” rate of productivity growth. The VTFP proposal envisages that “industry-wide” could refer to any of the following possibilities:

- all electricity distributors in Australia;
- all Australian electricity distributors, plus others overseas;
- distributors in one or more Territories / States; or
- any of the above possibilities, but with certain companies excluded.⁴⁶

The guiding principle is that the comparator group should be chosen such that the productivity growth rate of the target firm will “reflect” productivity growth in the comparator group over the forthcoming price control period.⁴⁷ We assume that the intention is that the comparator group should be chosen such that the target firm has opportunities for productivity growth that are similar to those available to the comparator group. Clearly, if there are significant differences in TFP growth rates among the various companies in Australia and elsewhere, the definition of the comparator group will make a significant difference to the results of the methodology.

4.6 Defining the productivity growth index

Productivity growth is generally defined as the difference between the rate of growth of total outputs and the rate of growth of total inputs, where “total inputs” is the weighted sum of all the inputs used by the network business, and “total outputs” is the weighted sum of all the outputs

⁴⁵ The rule change proposal specifies a slightly different method for assessing costs depending on whether the business is already under a TFP control or not. However, the two appear to be equivalent, in that both target costs in the last year of the then current price control period, on the basis of a building-blocks assessment. (See rule change proposal 6.6A5.)

⁴⁶ It is possible to ensure that no firm can influence TFP growth measurement, either by ensuring that the index covers many firms or by defining the index so that it excludes the firm for which the index will be used to set prices.

⁴⁷ See rule change proposal 6.6A6 1(2)(iii).

produced by the network business. The VTFP proposal does not specify the definition of the index, in terms of which inputs and outputs should be measured or how.

In principle there are a wide range of index methodologies.^{48,49} The basic idea is to divide a physical measure of inputs (eg, length of wire at various voltages, number of transformers, hours worked) by a physical measure of output (eg, MWh distributed, number of customers, peak MWh). The estimated average change in productivity over a certain period of time (for example, five years) is then used to set X. X is equal to the average TFP growth, less an adjustment for input price inflation described in section 4.7.

The proposal envisages that either a fixed or “rolling” method could be used. Under the fixed approach, the X factor for the duration of a price control period would be based on the historical average TFP growth of the comparator companies. For the “rolling” method, the X factor would be continually updated during the price control period (eg, the X factor in year N could be the average TFP growth of the comparator companies during years N—6 to N—2).⁵⁰ A claimed advantage of the rolling method is that industry-wide changes in costs would feed through automatically into prices before the end of the price control period.⁵¹

4.7 Inflation index

TFP relates the change in output growth to the change in input growth. Thus, by definition, output price growth is equal to input price growth less TFP growth. However, price caps usually relate regulated prices to a rate of *output* price inflation (the CPI in $CPI - X$ refers to inflation of the price of a basket of consumer goods, which are outputs). Hence it is usual, when using TFP growth rates to determine price caps, to set X equal to TFP growth rate less the difference between input and output price inflation.

The VTFP proposal specifies that the inflation adjustment is equal to the historic average CPI inflation less the historic average inflation for prices of inputs used by electricity distribution businesses (by implication, the same inputs should be included in the inflation measure as are used to define the TFP growth index).

⁴⁸ For a discussion of different ways to select an index number methodology, see Jeffrey I. Bernstein and Charles Zarkadas, “Measurement of TFP Growth for U.S. Telecommunications”, in R. Cooper and G. Madden ed., *Frontiers of Broadband, Electronic and Mobile Commerce*, Physica-Verlag Press, 2004.

⁴⁹ For a discussion of how index-number TFP growth is defined and used in electricity distribution in New Zealand, see *Use of Total Factor Productivity Analyses in Network Regulation – Case Studies of Regulatory Practice*, report for the Australian Energy Market Commission prepared by *The Brattle Group*, October 2008.

⁵⁰ ie, a rolling period of 5 years, with a delay to allow for the collection of necessary data.

⁵¹ Presumably the period over which TFP growth is to be measured for the “rolling X” method would have to be of the order of the length of the price control period, or probably shorter, otherwise the method would bring no advantages—changes in cost would be passed through in any case through the reset at the end of the price control period before they could be passed through via the X factor.

4.8 Efficiency benefit sharing mechanism

The VTFP proposal allows for an additional efficiency benefit sharing mechanism that would be similar to the mechanism that can be applied to the current building-blocks approach. The purpose would be similar: to fine-tune the incentives on the regulated firms to find cost savings (and the mechanism would work in a similar way). As with the efficiency benefit sharing mechanism under the building-blocks approach, the faster savings are passed back to customers, the smaller is the incentive on the regulated firm to find the savings. The mechanism under TFP would work in the same way as under the current building-blocks approach, by providing an additional payment to/from the regulated firm during one price control period representing a carrying forward of efficiency gains/losses under the preceding price control period (as described in section 3.5.1 above).

4.9 Additional incentive arrangements

The VTFP proposal would allow additional incentive arrangements, such as in relation to service quality or demand management, to apply to the TFP approach in the same way as they can apply to the current building-blocks approach.⁵²

⁵² In theory, service quality could be a component of the “total outputs” used to define the TFP index. If it were, changes in service quality would be automatically captured by the TFP methodology. However, in practice regulators have found it difficult to do this in a robust way, and the Victorian proposal does not include a direct incorporation of service quality in this way.

5 Comparing the strength of incentives

5.1 Introduction

In this section we compare the strength of incentives under the building-blocks and TFP approaches described in sections 1 and 1 respectively. Sections 5.2 to 5.5 consider the relative strength of incentives under TFP and building-blocks. One of the features of the VTFP proposal is that firms may be able to switch between the TFP and standard building-blocks approaches. This optionality is likely to influence the strength of incentives, and we discuss this issue separately in section 5.6.

5.2 Controlling costs

Under a price cap, the strength of the incentive to control costs depends on the extent to which the firm benefits from its efforts. If cost reductions during one price control period result in the price cap for the second period being lower than it would have been otherwise, the firm's incentive to control costs in the first period is reduced. The key question in comparing the relative strength of the incentive to control costs under building-blocks and TFP approaches is therefore how, under each approach, effort to reduce costs influences prices in the subsequent price control period.

Under both building-blocks and TFP approaches, prices are reset with reference to out-turn costs at the start of the price control period.⁵³

Under both building-blocks and TFP approaches, an efficiency benefit sharing scheme operates to modify the extent to which firms keep the difference between the price cap and out-turn costs.

However, one source of difference is that although initial prices are reset to out-turn costs under both methods, the path of prices in the subsequent period, and hence the total allowed revenue in the subsequent period, may differ. In particular, under building-blocks X might depend on efforts to control costs in the current period, whereas under TFP there can be no link between efforts to control costs in one period and the path of prices in the second (ie, X).⁵⁴ This is so because the path of prices depends only on the measured TFP growth of the group of comparator firms. Under building-blocks, the AER has some discretion in how it sets the path of prices.

⁵³ As discussed above, we are ignoring the fact that in Australia P_0 and X are in practice “re-balanced” to smooth changes in price. This rebalancing does not affect our analysis because it does not change the total allowed revenue under the price control.

⁵⁴ We emphasise that we are ignoring the smoothing of prices. Another way of putting this argument is to say that under building-blocks a certain proportion of the firm's revenues in the second period are affected by cost-control efforts in the first period. Under VTFP, a smaller proportion of the firm's revenues are affected.

Suppose that the firm has forecast that its costs will rise at 3% per annum in real terms in the following price control period. The AER has a number of options under the building-blocks approach (the descriptions which follow are stylised and are not intended to be fully realistic: the key point is that under each of the following options the AER uses different kinds of information, sometimes including information relating to out-turn cost control in the current period).

1. It could accept the forecast, and allow prices to rise at 3% (ie, $X = -3\%$).
2. It could observe that other firms have forecast cost increases of 0%, investigate why the first firm was forecasting increases, and end by allowing 2% (ie, $X = -2\%$).
3. It could commission a detailed (bottom-up) technical review of the forecasts, revealing that half of the forecast inflation was unlikely to be justified, and allow $X = -1.5\%$.
4. It could observe that in the current price control period this firm had out-turn costs decreasing at 5% per annum, whereas the firm had previously forecast zero decrease in costs during the current period. On this basis it might allow $X = +2\%$.

Of these methods, 1 and 2 do not use information relating to the firm's cost control efforts in the current control period. Option 4 does use this information, and option 3 might do so, depending on how the technical review was carried out (for example, the technical review might look at trends in the firm's unit costs over time, which would depend on the firm's current-period cost control efforts, or it might look at industry-wide unit costs, which would not).

In considering the strength of incentives to control costs, it is the regulated firm's *expectations* about how the subsequent price control would be set that count. From the discussion above, it seems at least possible that the AER might use firm-specific cost information as one source of evidence in setting X for future price controls under the building-blocks approach. However, it is unlikely that this would be the only or the main piece of evidence. For example, technical reviews have been a regular part of AER's price control review process, and it would seem strange for the technical review to consider separately each firm's cost projections—it would seem more efficient, when the AER is setting the price controls for several distribution companies, for the technical review to consider the evidence on costs across the companies being reviewed. In practice, we think it likely that the assessment for each company would depend in part on an analysis of firm-specific costs, including the out-turn costs in the preceding price control period, and in part on a wider assessment of costs across the industry as a whole.

We can illustrate how the two approaches might give rise to slightly different incentives with a hypothetical example, shown in Table 2. Table 2 assumes that TFP growth rate is 3%, but that under building-blocks X is set to 1% in the first period.⁵⁵ Costs fall at 3% per year in the business as usual (BAU) case, but if the firm undertakes "extra" effort to control costs in period 1, it is able to achieve annual reductions of 6%. In period 2, under building-blocks the regulator observes the difference between prices and costs in period 1, and sets X for period 2 to be equal to X in period 1 plus half of the difference between X in period 1 and the rate at which costs

⁵⁵ The results are not sensitive to the choice of X in the first period.

actually fell (ie, 2% if the firm does not invest extra effort in controlling costs, 3.5% if it does). Again, this is a stylised and not a fully realistic characterisation of how a regulator would in fact use firm-specific out-turn cost information. Under TFP X is 3% in period 2 irrespective of what the firm does in period 1.

Table 2: Hypothetical example illustrating strength of incentives to control costs⁵⁶

	Year	Building-blocks				Benefit to firm	TFP				
		Prices		Costs			Prices		Costs		Benefit to firm
		BAU	Extra effort	BAU	Extra effort		BAU	Extra effort	BAU	Extra effort	
Period 1	X factor	1.0%					3.0%				
	Annual cost reduction			3.0%	6.0%				3.0%	6.0%	
	0	100	100	100	100	0.0	100	100	100	100	0.0
	1	99	99	97	94	3.0	97	97	97	94	3.0
	2	98	98	94	88	5.7	94	94	94	88	5.7
	3	97	97	91	83	8.2	91	91	91	83	8.2
	4	96	96	89	78	10.5	89	89	89	78	10.5
	5	95	95	86	73	12.5	86	86	86	73	12.5
NPV in year 0 of period 1 benefit					31.4						31.4
Period 2	X factor	2.0%	3.5%				3.0%	3.0%			
	Annual cost reduction				3.0%					3.0%	
	6	84	71	83	71	-1.2	83	71	83	71	-
	7	82	68	81	69	-2.4	81	69	81	69	-
	8	81	66	78	67	-3.5	78	67	78	67	-
	9	79	64	76	65	-4.5	76	65	76	65	-
	10	78	61	74	63	-5.5	74	63	74	63	-
	NPV in year 0 of period 2 benefit					-9.6					
Total year 0 NPV of period 1 and period 2 benefit @7%					21.8						31.4

Notes

In the building-blocks case X in period 2 is X in period 1 plus half of the difference between period 1 X and achieved annual cost reductions in period 1. NPVs at 7%.

The benefit to the firm in period 1 of making extra effort to control costs is independent of X in period 1 and hence independent of whether building-blocks or TFP were used to set X. It is 31.4 in both cases. However, in this example the regulator uses the difference between X in period 1 and the rate at which costs actually fell in period 2 to set X for period 2. As a result, the total benefit⁵⁷ to the firm is lower (21.8) under building-blocks than under TFP (31.4). We emphasise that this conclusion rests on an assumption: that the difference between price and cost in period 1 influences the value of X in period 2. This is not intended to be a realistic characterisation of setting X under the building-blocks approach (for example, it does not place any weight at all on the firm's own cost forecasts), but to illustrate that the incentive under building-blocks might be weaker than under TFP.

⁵⁶ For simplicity we assume that the regulator is able immediately to reset prices to out-turn costs at the start of the second period.

⁵⁷ In this hypothetical and simplified example, the total benefit in the "extra efforts" case is the same under building-blocks and TFP. In fact, because the firm retains more of the benefits under TFP, it would invest more "extra effort" under TFP than building-blocks, and hence would achieve even lower costs. The difference, however, would be small in comparison to the difference between the two price control methods shown in Table 2.

Table 2 does not include an efficiency benefit sharing scheme, which would tend to increase the benefit to the firm of controlling costs (by the same absolute amount in both TFP and building-blocks cases). Furthermore, the fact that the firm benefits less from making a cost-reduction effort in the building-blocks case means that the firm's customers benefit more (the net total benefit being the same under building-blocks and TFP approaches). Table 2 shows not only that the benefit to the firm of undertaking extra effort to control costs is greater under TFP than under building-blocks, but that prices in period 2 are lower if the firm undertakes extra efforts than if it does not. Note, however, that this result rests on the assumption that firms believe the regulator would set period 2 prices under building-blocks by taking into account the difference between price inflation and out-turn cost inflation in period 1, and also that the firm is subject to TFP when it would have higher profits under building-blocks (we return to this latter point in section 5.6).

We conclude as follows:

- the main determinant of the strength of the incentive to control costs is the fact that prices are reset to costs at the end of each price control period, modified by the operation of the efficiency benefit sharing scheme;
- these two factors are common between the building-blocks and TFP approaches;
- the TFP approach may have a marginally stronger incentive because, under building-blocks, the regulator can use evidence of past efforts to control costs in setting the path of prices, as well as the starting-point, whereas under TFP it cannot (but this is only marginal because under building-blocks there is not a direct link between costs in period 1 and prices in period 2—period 1 costs are one piece of evidence that the regulator can use to set prices in period 2);
- if the incentive to control costs is greater, a smaller proportion of the cost savings is passed back to customers (although, other things equal, a greater incentive to save costs should result in costs being lower overall); and
- the balance between the incentive to control costs and the passing back of cost savings to customers can in any case be adjusted through the efficiency benefit sharing scheme. The magnitude of the adjustment possible through the efficiency benefit sharing scheme is greater than any difference in the strength of incentive between building-blocks and TFP approaches.⁵⁸

5.3 Passing on cost savings

In the preceding section we noted that there is a trade-off between the incentive to control costs and passing back savings to customers: under both building-blocks and TFP, increasing the incentive to control costs by allowing the firm to keep a greater proportion of the savings means

⁵⁸ In principle, the efficiency benefit sharing scheme could be adjusted to give any proportion of the total savings to the firm, for example through the use of “multipliers” (see *Electricity distribution network service providers Efficiency benefit sharing scheme*, AER (June 2008), p.17.

that there is commensurately less to pass back to customers in future price controls.⁵⁹ At the same time, the greater the incentive to control costs, the lower overall costs should be at the subsequent price control. In this section we examine how the price customers pay in the current price control might depend on the choice of price control methodology.

Under both building-blocks and the VTFP proposal prices are reset to out-turn costs at the start of the price control period. However, under the two approaches the path of prices, and hence the total allowed revenues over the price control period as a whole are different. Under TFP the firm cannot influence the total allowed revenues because the path of prices depends on the measured TFP growth among the comparator firms.⁶⁰ However, under building-blocks, the path of prices is based at least in part on the firm's own forecasts of its costs. If the firm is able to persuade the regulator that its costs are growing, whereas in fact it expects to be able to reduce them over time, the firm is able to generate "cost savings". Although part of these savings will be passed back to customers through the price reset at the start of the following period, part will be retained by the firm.

The difficulty facing the regulator when assessing the firm's cost forecast is that the firm has better information than the regulator. Being uncertain about the firm's future costs (more uncertain than the firm itself), the regulator has to balance two risks: on the one hand, setting prices too high gives the firm an un-necessary reward; on the other hand, setting prices too low means that the firm may not earn a normal return on necessary investments.⁶¹ In general, given the requirement that efficient firms be allowed to earn a normal return on investment, one should expect that the information asymmetry between the firm and the regulator would lead to the price cap being set above the firm's (private) expectation of its costs during the period (ie, one might expect: firm's cost submission to the regulator > price cap set by the regulator > firm's expectation of out-turn costs). To the extent that the regulator is able to employ methods such as benchmarking of unit costs or the "menu" approaches described in section 2.7, the difference between the firm's expectation of costs and the regulator's decision on the price cap might be reduced, but the difference will always be positive.⁶²

⁵⁹ And, because of the regulator's uncertainty about the firm's future costs, the regulator has to set prices above where the firm privately expects its costs to turn out.

⁶⁰ We assume that the regulator would be able to correct for any attempt to manipulate starting costs (ie, costs in the last year of the preceding price control period).

⁶¹ Note that if prices are too low for the firm to earn a normal return on necessary investments, the firm's incentive to make those investments is little changed. As discussed in section 5.2, the firm's incentive to control costs is independent of the level of the price cap; we discuss investment incentives in section 5.4.

⁶² The regulator does not know whether exogenous factors mean that the firm will have relatively high or relatively low costs. Since the framework requires the regulator to allow all efficient firms to earn a normal return, the firms in a low cost environment will always be able to earn above normal returns by persuading the regulator that they are in fact in a higher cost environment. See discussion in *A theory of incentives in procurement and regulation*, Jean-Jacques Laffont, Jean Tirole, MIT Press (1993).

In order to compare the relative performance of TFP and building-blocks approaches we need to consider whether the TFP approach would, on average, result in a price control with higher or lower prices than building-blocks.

Under TFP, prices grow at the historic average rate of TFP growth. When output is constant and the rate at which costs change over time is constant, this implies that prices should grow at the same rate as costs. Under the same conditions, the building-blocks approach would see prices grow at the same rate as costs, plus an extra margin that relates to the regulated firm's ability to exploit the information asymmetry between it and the regulator. Therefore, under conditions where trends in costs over time are stable, TFP might lead to lower prices than building-blocks.⁶³

If historic costs are not a good guide to future costs, TFP would give prices that are “too high” if costs turn out to be below the historic trend, and “too low” if costs turn out to be above the historic trend. Under the building-blocks approach, however, the process of “negotiation” between firm and regulator should result in prices adjusting somewhat in response to expectations about future costs. Hence, if future costs are above the historic trend, building-blocks should lead to prices above TFP prices, and if future costs are below the historic trend, building-blocks prices could be below TFP prices.

We therefore conclude as follows:

- under building-blocks, prices will be above out-turn costs by an amount relating to the extent of information asymmetry between the regulator and the firm;
- under TFP the regulator assumes that future costs will be equal to the extrapolated trend of past industry-wide costs, and sets prices on this basis without taking into account any other information, so
 - if future costs are below trend, TFP prices will be above costs; and
 - if future costs are above trend, TFP prices will be below costs.

We note, in relation to the issue of information asymmetry, that TFP in essence side-steps the problem because it makes no use of *forecast* costs. Under building-blocks the regulator is free to select from a range of information, including TFP growth rates, but also including what the firm says it expects future costs to be. It is the latter information which gives rise to the asymmetry under the building-blocks approach, but it does not do so under TFP because TFP ignores this information.

Finally, we emphasise that under VTFP the firm can choose whether to remain on building-blocks or switch to TFP. We discuss in section 5.6 the implications of optionality for relative prices with and without the TFP option.

⁶³ However, the TFP approach effectively assumes that either: a) all firms face exactly the same exogenous drivers of cost; or b) that the firms in the higher cost environment will earn a lower return than those in the lower cost environment.

5.4 Investment

In section 2.4 we discussed why firms subject to a price control invest. The existence of the price cap means that, however the price cap is set, firms are better off in the short term if they do not undertake additional investment (avoiding investment is a way of controlling costs). This pressure not to invest is counterbalanced by the fact that underinvestment will, in the longer term, lead to reduced service quality (and possibly reduced volumes). Firms might have a direct financial incentive in relation to service quality through a specific incentive scheme, and or service quality might be the subject of safety and other regulations. The firm chooses how much to invest as a result of the balance between these two pressures.

We therefore consider that investment incentives would be the same under either building-blocks or TFP approaches. However, it is also important to consider several further points relating to investment.

If the regulator overestimates the firm's cost of capital, the value to the firm of undertaking additional investment is greater than if the regulator estimates the firm's cost of capital correctly. However, this extra value is likely to be small in comparison with the incentive to defer investment that comes from the fact that prices are capped. We illustrate this with the hypothetical example shown in Table 3. Suppose that the firm's actual cost of capital is 8% but the regulator estimates it as 9%, and that the firm is considering an investment of 10 in an asset with a regulatory life of 30 years. The value to the firm of deferring investment might be returns of 9% for three years (assuming that the investment was to have been made part way through the price control period), which have a net present value of about 25% of the investment foregone. If the regulator had correctly estimated the cost of capital, this figure falls to 23%. If the firm does invest, the net present value is zero (by definition) if the regulator correctly estimates the cost of capital, and up to 9.6% if the regulator over-estimates the cost of capital by 1% (depending on how long the over-estimate continues). Hence, by deferring the investment the firm makes a net saving of 23% if the cost of capital is correctly estimated, and between 15% and 23% if the cost of capital is over-estimated by 1%.⁶⁴ At the margin (ie, in relation to the least profitable investment actually undertaken by the firm), the apparent saving to the firm from not investing is just balanced by other factors, such that the firm nevertheless invests. Under incentive regulation the firm would benefit from over-investing⁶⁵ if the regulator over-estimates the cost of capital, but this effect is counter-balanced by the incentive (resulting from the price cap) to delay investment.

While over-estimating the cost of capital does increase the benefit to the firm of investing relative to the case where the regulator estimates the cost of capital correctly, we do not think that the building-blocks methodology gives the firm a significant incentive to "expand the RAB", even if the regulator is systematically generous in its cost of capital estimate, because the change is relatively small compared the magnitude of the other factors influencing the firm's investment

⁶⁴ The change in investment incentive is greater for investments that would have been made towards the end of the price control period, and less for those that would have been made towards the beginning.

⁶⁵ The well-known Averch-Johnson effect under cost-of-service regulation.

decisions. We note in any case that the VTFP proposal would include a forward-looking cost of capital determination, as described above in section 4.4.

Table 3: Impact on investment incentives of mis-estimating the cost of capital

Regulator's cost of capital	8%		9%	
Firm's actual cost of capital	8%		8%	
Investment	10.00	0.00	10.00	0.00
NPV of returns	10.00	2.29	10.96	2.51
Deferral incentive		2.29		1.55

Year	Returns			
1	0.89	0.89	0.97	0.97
2	0.89	0.89	0.97	0.97
3	0.89	0.89	0.97	0.97
4	0.89		0.97	
5	0.89		0.97	
6	0.89		0.97	
7	0.89		0.97	
8	0.89		0.97	
9	0.89		0.97	
10	0.89		0.97	
11	0.89		0.97	
12	0.89		0.97	
13	0.89		0.97	
14	0.89		0.97	
15	0.89		0.97	
16	0.89		0.97	
17	0.89		0.97	
18	0.89		0.97	
19	0.89		0.97	
20	0.89		0.97	
21	0.89		0.97	
22	0.89		0.97	
23	0.89		0.97	
24	0.89		0.97	
25	0.89		0.97	
26	0.89		0.97	
27	0.89		0.97	
28	0.89		0.97	
29	0.89		0.97	
30	0.89		0.97	

Notes

The first two columns of returns are returns on investment of 10 at 8% for 30 years.

In the third and fourth columns the returns are at 9%.

Net present values are at the firm's true cost of capital, assumed to be 8%.

In the first and third columns the firm makes the investment, in the second and fourth columns the investment is in the price control allowance but is not in fact made.

In the long run, the regulator must allow the firm to expect a return at least equal to the cost of capital, because otherwise the firm will not be able to access necessary capital. Since energy

network assets are long-lived, this long-run constraint relates more to the general “regulatory philosophy” than to the application of detailed rules, because in the long run the detailed rules are subject to change. Therefore individual decisions (for example, on the cost of capital) are probably less important as an influence on investment than the regulator’s overall philosophy in relation to, for example, asset stranding or predictability in decision-making.

We discussed above (section 2.4) the importance of the regulatory framework delivering an expectation that investors in an efficient firm will see a return at least equal to the cost of capital. Without this expectation, regulated firms will be unable to access capital markets and will be unable to operate. It is difficult to see how a compulsory “pure” TFP mechanism could offer sufficient guarantees to investors, because there is no reason to suppose that a period where costs are above past trends would be followed by an offsetting period where they would be below trend. For example, a step-change in costs due to a new safety standard would lead to a period where TFP growth was below trend. Over time, as the new (higher) costs fed into the historic average, prices would rise to reflect the new costs, and returns would go back to a “normal” level. However, during the adjustment period returns would be below normal, and there would be no offsetting period of above normal returns. In contrast, under building-blocks, foreseeable cost changes can be taken into account in setting prices. It is presumably for this reason that the VTTFP methodology has been designed to be optional (see section 5.6 below). Alternatively, a mandatory TFP approach that contained design features to permit firm-specific factors to be taken into account would also protect investors.

We note that in some jurisdictions⁶⁶ an additional factor is added to the price control which attempts to compensate the firm in the case that out-turn investment is significantly above the level consistent with the firm earning a normal return on capital. We have not studied such mechanisms in detail, but in our view they should not be needed to deal with “unexpected” extra investment, because, on average, actual investment needs are as likely to be above as below expected levels. Alternatively, the extra investment might be “expected”, in the sense that it was foreseeable that the price cap would not be high enough to cover required investment (as in the example of new safety standards given above, or the “wall of wire” sometimes claimed to be needed, perhaps because of bunching in the asset age profile). In that case however it is not clear why an adjustment mechanism is better than an alternative in which the price cap was set to reflect expected efficient costs directly. The additional mechanism seems unnecessary, and its details can be difficult to relate to underlying economic fundamentals, leading to a potential perception of increased regulatory risk.⁶⁷

⁶⁶ For example, electricity distribution in Ontario.

⁶⁷ In contrast, however, an additional factor which increases prices if actual investment is higher than expected may be beneficial if the likely investment need is particularly uncertain (such as, for example, when there is the prospect of significant and rapid, but uncertain, load growth).

5.5 Service quality

Incentive regulation by means of a price cap gives the firm an incentive to control costs. Other things equal, it is reasonable to suppose that delivering a high service quality to customers costs the firm more than delivering a low service quality, so price caps should lead to service quality declining over time if there were no counter-balancing incentives to maintain or improve quality.⁶⁸ For this reason, the regulatory framework typically includes a service quality incentive which provides an additional payment to the firm (over and above the price cap) if the firm meets or exceeds a service quality target. Such a scheme is in place for electricity distribution companies in Australia, under which the companies are rewarded if quality improves relative to the historic level, and penalised if it drops. Each firm is measured relative to its own historic performance.

We do not see any difficulty in adding a service quality incentive to a price control set using TFP. Since the service quality incentive is needed to counter-balance the incentive to control costs, to the extent that the latter was stronger under TFP it might perhaps be necessary to increase the power of the service quality incentive, but otherwise we expect that it would operate in the same way under TFP as under building-blocks.

In addition to the need to incentivise service quality, which would be common to building-blocks and TFP approaches, there may be additional quality issues under TFP which do not arise to the same extent under building-blocks. Networks are usually subject to various safety and engineering standards which have an impact both on service quality and costs. The clearest example is the choice between “N-1” and “N-2”—whether the network is required to withstand one or two independent faults without service being affected. Where two networks have different safety or quality standards, or where the standards applying to the same network change over time, it is highly likely that there will be a step change in costs. This situation could give rise to difficulties under building-blocks: when undertaking a technical review of cost forecasts, it will be harder for the regulator to make use of industry-wide data or to use historic performance if standards are not uniform across firms or over time. However, the difficulty under TFP will be greater, because under TFP there is no mechanism that could attempt to adjust for such changes or lack of comparability (other than, for example, excluding from the benchmark industry-wide group any networks with different safety or quality standards). In particular, when standards change over time, it is difficult to see how a TFP method could successfully address the resulting step change in expected costs. Furthermore, to the extent that service quality delivered by the comparator firms changes over time, the measurement of TFP growth needs to take service quality into account. This is difficult, because the relationship between service quality and cost drivers is not strong.⁶⁹ Thus, for example, the difference between service quality output measured

⁶⁸ For example, a recent survey of the academic literature notes that “a monopoly supplier of a single product will always supply less than the welfare-maximizing quality when the firm is required to sell its product at a fixed price.” (David Sappington, “Regulating Service Quality: A Survey”, David E.M. Sappington, *Journal of Regulatory Economics* 27:2 123-154, 2005, p.131).

⁶⁹ See, for example, experience in New Zealand (*Electricity Distribution Business Productivity and Profitability Update*, Meyrick and Associates (December 2007)).

for a network with “N–2” and “N–1” standards might well be smaller than the difference in inputs.

5.6 Switching between TFP and building-blocks approaches

An essential feature of the VTFP proposal is that firms would not be able to switch from building-blocks to TFP without the regulator’s consent, nor would they be able to switch back from TFP to building-blocks without its consent. Furthermore, the regulator would not be able to initiate the switch from building-blocks to TFP or back again. In principle, therefore, only those firms that think they would have higher profits under TFP than under building-blocks would request TFP. Therefore, for the VTFP proposal to be of net benefit to consumers, the benefits (eg, from strengthening the incentive to control costs) would have to be greater than the magnitude of the additional profits.

If, subsequently, the firms thought that they would do better to go back to building-blocks, they would presumably request this. In making its decision on whether to approve a change in price control methodology for a particular firm, the AER would be required to have regard to several factors, including:⁷⁰

- whether, having regard to any previous change in costs, there is any real likelihood of a substantial change in costs; and
- whether it is likely that the productivity growth of the Distribution Network Service Provider will, or is likely to, reflect industry-wide productivity growth.

The inherent optionality has two important consequences, in respect of incentives to control costs and the level of prices seen by customers.

First, the optionality changes the incentive properties of both the building-blocks and TFP approaches. We explained above that the incentive to control costs depends on whether and how cost-control efforts in period 1 will impact prices in period 2. Consider, for example, a firm operating under TFP in year 1 of period 1: if TFP is compulsory, the firm knows that extra cost control efforts now will not result in lost profits in period 2; however, under the VTFP proposal the firm will be able to consider the option, four or so years later, of switching back to building-blocks. If it does so, the year 1 period 1 cost control efforts may have an impact on its period 2 prices. For the reasons set out in section 5.2, we think that the difference in cost control incentives under (compulsory) TFP compared with building-blocks is small. It is further reduced if TFP is optional—because for most of the time in one price control period the firm will not know whether it will be under TFP or building-blocks at the next price control.

Second, the optionality means that the VTFP proposal will either be unused (ie, no firms select TFP) or is very likely to lead to higher prices than if there was no TFP option available. This is so because only those firms that expect to see higher prices under TFP than building-blocks will request the switch to TFP. The firms which expect lower prices will not switch—so,

⁷⁰ See rule change proposal, 6.2.4A.

on average across all firms prices will be higher if some of the firms are allowed to switch. Once firms have switched to TFP, it is possible that in future price control periods these firms might expect lower prices under TFP than under building-blocks, and hence request to switch back. It will be open to the firms to argue that they should be allowed to do so due to expected future cost increases, or because they will not be able to maintain historic productivity growth rates. Judging the application will expose the regulator to exactly the same information asymmetry that it faces under the building-blocks approach. We therefore expect that any firm which would receive higher prices under building-blocks than under TFP would be allowed to switch back.

The existence of the TFP option would provide the AEMC with information that it would not have had under building-blocks: the TFP option would reveal those firms which expect that an X factor based on building-blocks would be higher (ie, lower prices) than the historic rate of TFP growth. This information is revealed because those firms will request a TFP control, and the other firms will request building-blocks. It is unclear what value, if any, should be ascribed to this information, because it does not lead to the regulator being able to set lower prices for those firms revealing themselves to have the ability to cut costs—in fact, by definition it results in those firms having *higher* prices than they would have done under building-blocks. An effective scheme for incentivising firms to reveal their expectations is one that gives the firms an incentive to reveal their expectations about their future costs at a point in the process where the regulator can use the information in setting prices. We mentioned such a scheme in section 2.7.2 and we describe it in more detail in section 5.

6 Other ways to strengthen incentives

Much of the discussion in connection with the VTFP proposal has centred on the difference between TFP and building-blocks methods in terms of the strength of the incentives they give to the regulated firms (and for this reason AEMC asked us to undertake a comparison between TFP and building-blocks approaches in those terms). In fact the discussion above suggests that there is little difference between building-blocks and TFP approaches in terms of the strength of incentives, especially given the necessary protections which are built into the VTFP proposal. Since the discussion centres on the strength of incentives, in this section we describe several alternative ways that the incentive to control costs could be strengthened, some of which have been mentioned in the debate in Australia over the possible introduction of TFP, and some which have been developed in other contexts. Some of these are modifications to the building-blocks approach, and some are alternative TFP approaches.⁷¹

6.1 Longer price control periods

The longer the gap between price control reviews, the greater is the proportion of cost savings which accrue to the firm before prices are reset to costs at the end of the review. Thus, longer periods give stronger incentives. This is true whether the price control is based on building-blocks or on TFP.

Having a price control period longer than the standard five years necessarily risks that prices and costs could be further apart for longer. On the one hand, this could mean that the firm earns significant returns above its cost of capital, without customers seeing the benefits of cost reductions. On the other hand, if costs turn out higher than expected (building-blocks), or productivity lower than the historic trend (TFP), the firm's investors will receive less than the cost of capital for an extended period. Prices will also be further away from the efficient cost-reflective level for longer.

Although a period of longer than five years could be applied under either TFP or building-blocks, we think that if anything a longer period is less likely to be practical with TFP than with building-blocks, because the risk that the regulated firm will end up with prices significantly below costs is greater with TFP than with building-blocks.

One way to manage the risks associated with a longer price control period is to employ “triggers” or “off-ramps”. The regulator could, in advance, set rate of return thresholds—for example, 2% either side of the cost of capital. Year by year through the price control period, the out-turn returns achieved by the firm would be compared to the thresholds. If returns are outside the thresholds (too high or too low), either the price control period could be prematurely ended, with prices being reset to costs, or prices could automatically be adjusted to bring returns closer to the cost of capital. These mechanisms would prevent prices getting too far away from costs. However, they would also weaken the incentive to control costs—which is the reason for having a longer price control period in the first place. There is a fundamental trade-off to be made

⁷¹ There may be other possible improvements not considered here.

between the strength of incentive to control costs, and the risk that costs and prices end up a long way apart.

6.2 “Partial reset”

Another way of strengthening the incentive to control costs is for the P_0 change at the start of the new price control to be equal to less than 100% of the difference between prices and costs at the end of the preceding period.⁷² Thus, for example, if prices in the last year of period 1 were 110, and costs in the same year were determined to be 100, the P_0 change might be 8—ie, prices for the new period would be moved 80% of the way towards costs. Presumably such a system would be symmetric: if costs turned out to be 120 and prices were 110, the new price would be 118 (ie, prices would be deliberately set below cost). This method strengthens the incentive to control costs because it weakens the link between reductions in cost and reductions in prices: if the firm invests extra effort in controlling costs in period 1, only 80% of the fall in costs is reflected in reduced prices at the start of period 2.

A “partial reset” could be applied equally well within a price control based on building-blocks as one based on TFP.

As with other ways of strengthening the incentive to control costs, this mechanism cannot escape the fundamental relationship between the incentive to control costs and the risk that a significant gap might open up between price and cost.

6.3 “Rolling” X-factor

One possible implementation of a TFP approach would use a “rolling” X-factor. Rather than fixing X at the start of the price control period, with X being the long-run average rate of TFP growth across the group of comparator firms, X would be the “rolling” average rate of TFP growth rate. X would then be updated each year through the price control period. The claimed advantage of this approach is that the incentive to control costs is strong (it is the same as it would be if X were the long-run average and did not change through the price control period), but that cost savings are passed on to customers in the form of lower prices more quickly (although we note that cost increases would also be passed on more quickly). This is so because if costs at the firms in the comparator group change, the regulated firm’s X factor will automatically adjust accordingly, resulting in prices tracking costs of the comparator firms more closely (with a shorter lag).

In our view a rolling X-factor could have disadvantages that outweigh any benefits of more rapid pass through of cost changes. First, usual practice in constructing a TFP index would be to use a reasonably long time series—for example, long enough to allow for smoothing of “noise” in the data and to smooth out the impact of the business cycle. This would point towards using a period of at least five years. The longer is the period over which the average is measured, the

⁷² This approach is discussed in *Incentive Power and Regulatory Options in Victoria*. Pacific Economics Group (2005).

smaller the impact of moving to a “rolling” average. Second, regulated firms might be unwilling to accept a price cap without knowing the actual level of the cap. Under a rolling method, the firms’ price cap would change from year to year as new information from the comparator group became available, but the firms would have no opportunity to disagree with the new level of the price cap. In contrast, if the “normal” approach were taken, the firms would have the opportunity to dispute the calculation of the price cap. For example, it is possible that unusual circumstances (at the comparator firms) might lead to rapid changes in the apparent rate of TFP growth. With hindsight, this might lead to a review of whether the comparator group or the TFP index definition was appropriate—but under a rolling method this would not be possible.

6.4 Financial risks and innovation

It is sometimes claimed that incentive regulation leads to firms adopting capital structures that are undesirable from the perspective of the economic regulator or public policy more generally. Our understanding of the logic of this argument is as follows.

1. Incentive regulation means that firms see a greater benefit from seeking cost reductions than they do under cost-of-service regulation.
2. One source of savings is the adoption of more efficient capital structures—ie, taking on debt, which, up to a certain point, offers a reduced weighted average cost of capital because interest payments reduce the firm’s tax bill.
3. In practice firms have adopted highly levered structures in at least some jurisdictions—for example, UK water companies.
4. UK regulators have been concerned about rising levels of debt.
5. Concerns have focused on dealing with the consequences of high gearing, with regulated firms being required to maintain an investment-grade credit rating, and with the introduction of special rules to deal with insolvency of regulated firms.
6. There are theoretical grounds for believing that regulated firms might take on additional debt as a way of encouraging the regulator to raise prices when the firm’s own costs rise.⁷³

A somewhat related argument has been cited in favour of the VTFP proposal.⁷⁴ The Victorian ESC argues that building-blocks regulation prevents regulated firms from engaging in desirable, but risky activities such as investing in or facilitating others investing in distributed generation because the firm is incentivised instead to invest in “traditional” assets which result in a larger

⁷³ Suppose that the firm is highly geared, and suffers a cost increase. The regulator is more likely to allow prices to rise than if the firm had less debt, because the highly geared firm may be able to threaten bankruptcy, with its associated risks for the regulator and consumers. See, for example, *Regulatory Risk and the Cost of Capital*, Ch.3., B Pedell (Birkhäuser, 2006).

⁷⁴ This argument was offered in evidence by the Essential Services Commission of Victoria in its submission to the AEMC issues paper reviewing the use of TFP, particularly at page 55.

regulated asset base, and because having little equity capital available, the firm cannot undertake risky activities. We disagree with the logic of the ESC's argument. First, as discussed in section 5.4, we do not agree with the assertion that price caps based on building-blocks give regulated firms an incentive to expand the asset base. Price caps give firms an incentive to reduce costs, including capital costs.⁷⁵ Second, if it is true that incentive regulation encourages regulated firms to take on more debt than they would have under cost-of-service regulation, it is the fact that prices are not directly linked to costs under incentive regulation that encourages firms to do this. The incentive to take on more debt is therefore at least as high under TFP as it is under building-blocks. Third, even if it were true that TFP-based price caps resulted in a lower level of debt, it is not at all clear that this would be a desirable outcome: moving to a lower level of debt means that the firms have higher tax payments.⁷⁶ Finally, we think it is unlikely that unavailability of equity finance is preventing or could prevent regulated firms from engaging in “desirable” activities such as distributed generation or advanced metering or other innovations—in our view, it is more likely that these activities are not undertaken because the benefits to the firm from innovating are smaller than the costs.⁷⁷

6.5 Information asymmetry and the “menu approach”

The major difficulty with implementing incentive regulation is addressing the trade-off between the strength of the incentive to control costs, and being able to keep the prices charged by each firm reasonably close to that firm's costs. If regulators did not care about keeping prices close to costs, they could simply set prices equal to the costs of the highest-cost firm, plus a margin for unexpected events. Since regulators do care about the margin between prices and costs, regulators want to set low prices for firms with low (future) costs, and higher prices for those firms with higher costs. The difficulty is that the regulator can only observe historic costs, and the regulated firm has an incentive to hide from the regulator its expectations about future costs. All regulated firms will “pretend” to expect high future costs in the hope of receiving a lenient price control (a small X factor). As discussed elsewhere in this report, TFP methodologies do not attempt to address this issue—they ignore it by assuming that all firms are “average” and that the past is a good guide to the future.

The menu approach works by giving firms a choice between several different price caps. For example, the regulator might offer a choice between two price caps: one has a relatively weak

⁷⁵ And, in any case, the magnitude of the regulated asset base is an input to calculating starting prices under the Victorian TFP proposal.

⁷⁶ In fact, firms under a TFP price cap might need a higher “equity buffer” than under building-blocks because TFP gives a greater risk that the firm's prices will be below cost. The cost of the additional equity would have to be passed on to customers in higher prices.

⁷⁷ Or because the benefits from undertaking these activities are external to the firm, for example accruing to society generally, or to customers through the regular resetting of prices to out-turn costs.

incentive to control costs (is “low-powered”),⁷⁸ but has high prices; and the other has a strong incentive to control costs but lower prices. A firm which knows it has high costs and few opportunities to reduce them (even if it exerts extra effort under the influence of a high-powered incentive scheme) will opt for the higher prices. However, a firm which knows that has low costs and/or could easily reduce costs will opt to take the lower prices because the reduction in profits can be more than offset by its share of the cost savings it will make in response to the higher-powered incentive scheme.⁷⁹

If the regulator had not implemented the menu approach, it would have had to offer both firms a high price, because the firm with low costs would have been able to persuade the regulator that it in fact had high costs.

⁷⁸ The strength of the cost-control incentive would be adjusted by an automatic partial “true up” of revenues to out-turn costs, or by an allowance at the next price control that corrects for part of the difference between prices and costs in the current one (like the efficiency benefit sharing scheme described in section 3.5.1).

⁷⁹ We give a fuller explanation and a hypothetical example in Appendix 1.

7 Discussion and conclusions

In section 1 we compared TFP and building-blocks approaches according to the strength of incentives to control costs, deliver savings to customers, invest, and deliver a high quality service.

In respect of service quality, we concluded that there is likely to be no significant difference between the two methods, although we also noted that TFP approaches may be difficult to implement if service quality in the comparator group is not constant, or if standards vary across the group or over time.

In respect of cost control, TFP methods should in theory have better incentive properties than building-blocks, because in principle TFP disconnects future prices from out-turn costs. However, in practice, we think that the improvement in cost control incentives would be small for the VTFF proposal, for the following reasons.

- Under both building-blocks and VTFF methods, prices would be reset to cost at the start of each price control period. As a result, under both methods cost control efforts do influence prices in the subsequent review periods.
- Under both methods the length of the review period and the operation of the efficiency benefit sharing scheme can in any case be adjusted to alter the strength of the incentive to control costs.
- Where firms are able to make sustained efforts to control costs (ie, costs fall faster year on year), part of the resulting cost reductions may be transferred into reductions in prices faster under building-blocks than under VTFF, because under building-blocks the regulator can use the firm's own out-turn costs as evidence when setting X at the subsequent review. However, this difference depends on the firm's expectation for how the regulator would carry out the building-blocks review.
- Even if there is in general a difference between TFP and building-blocks, the VTFF proposal would make it possible for firms to switch back to building-blocks. As a result, during each period firms subject to TFP will be uncertain whether they will be subject to TFP in the following period. This uncertainty will further reduce any difference in incentives.

The regulated firm's incentive to invest does not depend on the level of the price cap, nor is it different under a building-blocks method from under TFP. The existence of the price cap gives the firm an incentive to avoid investment (thereby reducing costs), but this is counter-balanced by the service quality incentive and by the need to comply with various legal and regulatory standards on safety, quality, and other matters. None of these factors is influenced by changing from a building-blocks to a TFP methodology for setting price caps.

In the longer run, any framework of economic regulation must give investors in the regulated firm a reasonable expectation that they will see a return at least equal to the firm's cost of capital. Without this expectation, the regulated firm will be unable to access capital markets and will be unable to source the funds it needs to operate. As a result, the regulatory framework is typically designed explicitly to deliver this expectation (in Australia, for example, the framework includes

the over-arching principle that firms should be able to recover at least their efficiently-incurred costs). A TFP framework could breach this principle, because in theory TFP completely disconnects prices from costs. As a result, TFP methodologies in practice contain various safeguards: the VTFP proposal would make TFP optional, and includes regular resets of price to out-turn costs; other implementations of TFP include automatic adjustments to price if the firm's return on capital falls outside pre-defined bands, or adjustments for firm-specific costs. In our view these kinds of safeguards would be essential: an alternative where prices are set equal to TFP growth rates with no adjustment for firm-specific costs would pose a significant risk that the firm would be unable to attract investment. Nevertheless, these safeguards also have undesirable features. An earnings-sharing mechanism blunts the incentive to control costs, and making TFP optional means that industry-wide prices with the TFP option are likely to be higher than without the option. Under the VTFP proposal, TFP is optional. Thus, only firms which expect to have higher prices under TFP than they would have had under building-blocks will request a TFP-based price cap. By definition, therefore, the average price across all firms will be higher than it would have been if they were all under a building-blocks control.

The most-often quoted disadvantage of the building-blocks approach is that the firm has an incentive to present exaggerated cost forecasts ("gaming"), which may lead the regulator to allow prices to increase faster than they need to. The regulator cannot give the firm lower prices because the regulator cannot discount the possibility that the firm really does have high costs (for reasons outside the firm's control), and therefore that the firm needs high prices in order to earn a normal return on investment even if it operates efficiently. The regulator is unable to distinguish between low cost firms that pretend to have high costs, and high cost firms that really do have high costs. TFP does not help the regulator to address this problem of information asymmetry—rather, it simply side-steps the issue by not using the firm's cost forecasts at all in setting prices. Prices in aggregate can be set closer to costs under building-blocks (without the TFP option), because if firms could achieve higher prices under TFP than under building-blocks, they would exercise this option. When, under building-blocks, the regulated firm would have been able to persuade the regulator to give a low X by submitting exaggerated cost forecasts, under the VTFP proposal the firm would, in the same way, be able to convince the regulator not to apply a TFP methodology. Although a TFP method can be operated without relying on subjective judgements or forecasts once the method has been developed and the detail of the index specification determined, the process of determining the detail of the method can be difficult. Often small changes to the detail of the specification—for example, the choice of start and end years—can result in significant changes to the results. The decision on index specification may therefore be highly contentious and require a significant degree of judgement.

Under building-blocks the regulator has the flexibility to set X on the basis of both historic cost data, the firm's forecast of future costs, and comparisons between the historic and forecast cost data from the regulated firm with that of the other regulated firms. This flexibility could, for example, extend to using TFP data as one source of evidence in setting prices (the advantage of a TFP-type methodology is then that it can generate information that the regulator would otherwise not have had—ie, the rate at which average productivity across the industry as a whole is changing). Although in using cost forecasts the building-blocks approach suffers from information asymmetry and gaming, as explained above, an "optional" TFP approach would still be subject to this problem, over the decision to allow firms back onto building-blocks.

Enhancements to the building-blocks approach, such as the “menu” option, have been developed to help overcome the problem of information asymmetry by providing the firm with an incentive to reveal an unbiased forecast of its future costs.

There are several adjustments to the parameters of the price control which would lead to stronger incentives to control costs: for example, the price control period could be longer; the efficiency benefit sharing scheme could be changed to give the firms a greater proportion of savings; or prices could be only partially reset to costs at the start of each control. Any of these adjustments could be as well made in the context of a building-blocks control as a TFP-based control.

We are aware of arguments to the effect that a TFP-based price control would encourage firms to be more innovative, perhaps because firms regulated under TFP would adopt a less highly-g geared capital structure than they would do under a building-blocks control. In our view these arguments are mistaken: firms tend to use more debt under incentive regulation than under cost-of-service regulation because they fear that if they do not, the regulator will not allow prices to rise when there are cost shocks.⁸⁰ Thus, higher gearing is associated with incentive regulation *per se* and attempts by the regulator to de-link prices from the firm’s out-turn costs; it is not associated with the building-blocks methodology. Furthermore, we have seen no evidence that it is a lack of access to equity capital that prevents regulated firms from innovating. If it is indeed the case that regulated firms underinvest in innovation, we think a more likely explanation is that it is because the benefits of innovation to the firm do not outweigh the costs, for example because prices are regularly reset to out-turn costs.

Finally, we note that any application of a TFP methodology relies on being able to identify, for each regulated firm, a group of firms to which it can reasonably be compared. The comparator group should be subject to similar external drivers of cost. The existence of multiple jurisdictions, as well as geographic and other external factors that may be significant cost factors, might make this practically difficult to achieve in Australia.

⁸⁰ If the firm is relatively highly geared, the regulator has to allow prices to rise in line with costs because otherwise the firm can make a credible threat of insolvency, with its attendant costs for customers and the regulator. If the firm has less debt this threat is less credible (because shareholders have more to lose from insolvency in this case).

Appendix 1: The menu approach

The regulator has two goals: first, it wants prices to be reasonably close to out-turn costs, because this limits profits and keeps prices low; second, it wants to give the firm an incentive to keep costs low by making prices independent of out-turn costs. In order to do this, therefore, the regulator would like to fix prices in advance at a level close to where costs are likely to turn out. It is difficult for the regulator to do this because the regulator typically has poor information about what the firm's costs are likely to be. If the regulator can only offer a single price, therefore, it will offer the firm a high price (in case it turns out to have high costs). If the regulator wants to avoid some firms making excessive profits, it may decide to sacrifice the cost-control incentive by determining that firms which turn out to have low costs will have to pay back the cost savings. Thus, the regulator must choose between a strong incentive to control costs, but some firms making high profits; or a weak incentive to control costs.

In contrast, the menu approach allows the regulator to avoid excess profits from gaming, while simultaneously giving firms an incentive to control costs. It works as follows:

- the regulator offers the firm a menu of options with a different link between prices and out-turn costs under each option;
- the firm can choose high prices, but low reward if costs turn out lower; or
- the firm can choose low prices, but a high reward if costs turn out (even) lower.

Once the firm has made its choice, it must stick with it until the next price control review.

Firms which think that they will be able to achieve a low-cost outcome will tell the regulator that they have low costs, in return for a reward from the regulator if they achieve (or beat) these low cost targets. The low-cost firms will not claim to have high costs, because if they do so and subsequently achieve lower costs, their prices will be adjusted downwards to pass the savings directly to customers. Firms with high costs will tell the regulator that they have high costs, and the regulator will believe them and allow high prices, because both sides know that if the firm turns out to have low costs, the firm would have done better to have chosen the option with lower prices but a greater reward for cutting costs.

An example set of options is shown in Figure 1 overleaf.⁸¹ For all of the options the price the firm can charge during the price control depends on out-turn costs, but the relationship between out-turn costs and prices is different under each option. If the firm chooses a high price / high cost option (Option C), yet turns out to have low costs, it would have been better off choosing a lower-price option because under Option C prices and out-turn costs are strongly related, and profits are relatively insensitive to cost-reduction. As a result, in this example, firms expecting to have costs around 60 will choose Option A; those expecting costs around 70 will choose option B; and those expecting costs around 80 will choose Option C.

⁸¹ This example is adapted from "REx Incentives: PBR Choices that Reflect Firms' Performance Expectations", Johannes P. Pfeifenberger, Paul R. Carpenter, and Paul C. Liu *The Electricity Journal*, November 2001, p. 44

If the regulator had not implemented the menu approach in this case, it could have fixed prices at Option C, to ensure that even a high cost firm would be able to earn a normal return on capital (ie, price equal to cost). But Option C has a weak incentive to control costs. If the regulator wanted to keep the strong cost-control incentive of Option A, rather than fixing prices at Option C it could have used Option A* instead—this has a strong incentive to control costs, like Option A, but higher prices like Option C. The menu approach allows the regulator to have the best of both worlds.

Figure 1: Example menu of options

