Developing Network Monopoly Price Controls: Workstream B

Balancing incentives

A final report prepared for Ofgem

March 2003

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Context

In August 2002 Ofgem released a consultation document setting out the objectives of its work on Developing network monopoly price controls. The aims of that project are to:

- improve the framework of price controls applying to all network monopoly companies and, where appropriate, increase consistency in the approach that is taken in setting price controls; and

- lay the foundations for the next distribution price control review (DPCR) in 2003/04 including identifying the objectives, key issues and principles that will be used in setting the price control that will be implemented from April 2005.

We have been asked by Ofgem to investigate the incentives that are faced by the companies under the existing regulatory arrangements. In particular we have been asked to investigate whether these incentives are well balanced and where they are not, to propose ways in which the balance between different incentives might be improved. The work has given particular focus to the DNOs but many of the issues are relevant to all network monopoly companies.

Incentives in regulation

One of the characteristics of a regulatory regime is the strength of the incentives for cost reduction faced by a firm. We can quantify the strength of an incentive regime by calculating the proportion of any efficiency saving which the company retains. This proportion will be determined by:

- the period for which the benefit is retained; and

- the proportion of the benefit retained in each year.

Both of these are influenced by the form of the regulatory regime (e.g. price cap, sliding scale, yardstick competition) and by the parameters and processes adopted by the regulator. We also consider how companies can be provided with incentives to deliver an appropriate level of quality. Since improving quality is costly, there is a trade off between cost reduction and the provision of quality.

Executive Summary

From the framework we present we have drawn a range of conclusions.

- Incentive power increases with the length of time for which companies are allowed to retain efficiency savings. At some point increases in incentive power cease to benefit customers as the increase in the share of such savings retained by the company outweighs the incremental savings induced.

- Direct comparison of the benefit to companies from a one-off (recurring) gain in operating expenditure against the benefit of a one off (recurring) gain in capital expenditure suggests that companies face stronger incentives to make operating expenditure savings. This explains why companies might find capitalising their operating expenditure profitable. However, if most capital savings are one-off, while most operating expenditure savings are recurring, then the strength of incentives the companies face are better balanced.

- Companies can be given stronger incentives to make efficiency savings through either increasing the retention period or through making more use of benchmarking.

- Benchmarking and yardstick competition offer significant benefits over regulatory regimes in which there is less direct comparison of performance across companies, through increasing the incentive power of the regime without reducing the amount of benefit passed through to customers.

- If Ofgem had a robust system for comparative efficiency analysis, allowing it first to adjust price differentials to reflect only differences in efficient costs, it could then implement a system of yardstick competition, where prices are reset in line with movements in industry costs. Such a mechanism can provide strong incentives to companies to reduce costs while ensuring that the benefits of any cost reduction are passed through to customers quickly.

- There are a number of common criticisms of yardstick competition (see Annex 1), but we believe that these criticisms can be answered through robust modelling and careful regulatory design.

- Since a regulated company profits from reducing its costs, but quality tends to increase with cost, there is a trade off between cost efficiency and the delivery of improved quality. While companies can be expected to deliver some level of quality of supply, companies can only be expected to place an appropriately high value on quality if it affects their profitability.

- There are two generic approaches to providing companies with incentives to deliver quality. Marginal rewards/fines will encourage companies to select the optimal level of quality, given the size of the marginal payment and the cost of providing quality. If the marginal payment is calibrated such that it is equal to the social cost/benefit of quality then what is optimal for the company will be the economic and efficient level. Absolute fines result in the regulator choosing the level of quality that companies will deliver. A combination of the two could be used to ensure minimum standards of quality while providing companies with incentives to deliver additional quality if it is valued.

Capitalisation of operating expenditure

Operating costs might be capitalised in two ways. Either through reclassification of expenditure as a capital cost when it would be more appropriately classified as an operating cost, or through deciding to undertake capital expenditure when operating expenditure represents the most efficient option. Either policy might lead to higher prices for customers and make regulation more difficult.

We discuss some regulatory responses to the problem of capitalisation. We investigate ways in which the existing building blocks approach to regulation might be modified to reduce or eliminate this perverse incentive. The discussion we present is primarily based on an analysis of Ofwat's current method of assessing efficiency and determining allowed revenue, together with our view of how companies have responded to this regime. We also discuss a possible solution to the distortion of incentives between operating costs and capital costs with an efficiency model based on total costs. We discuss the issues that Ofgem would need to resolve before relying on a total cost model and provide advice on how capital costs might be treated under such a model.

On the basis of this analysis we have reached a set of conclusions.

- The approach to benchmarking adopted by Ofwat, in which each component of cost is benchmarked in a similar way, is attractive in principle. However, such a system requires careful calibration as it might encourage gaming.

- Adopting a regulatory model based on total cost raises a series of modelling issues centred on the treatment of capital costs. We believe that, with more detailed investigation, Ofgem could resolve these issues.

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Periodicity

The periodic reviewing of costs and resetting of prices, which form a common element of many regulatory environments, can provide regulated companies with an incentive to distort their behaviour. This incentive arises as a result of the cyclical nature of regulatory proceedings, implying that companies retain a greater share of the benefit of cost reductions made early in a regulatory period, rather than later.

We discuss the system of incentive payments put in place by Ofwat and by the regulator in Victoria, Australia to address this problem. The central idea that underpins these incentive payments is that the companies should be able to retain the benefits of any efficiency saving for a fixed length of time (e.g., five years), irrespective of the timing of price reviews and the timing of efficiency savings.

We have reached a number of conclusions.

- Periodicity distorts companies' incentives to time their efficiency savings, rather than making savings as soon as possible.
- Periodicity can therefore lead to inefficiency.
- The mechanism introduced by Ofwat to eliminate periodicity is sensible and could be adopted by Ofgem.
- Ofgem should consider whether to introduce separate or combined floors on operating and capital expenditure incentive payments. While the effect is unlikely to be substantive, we favour the approach adopted by the regulator in Victoria, where both operating and capital expenditure performance are combined before a floor is set. We favour Ofwat's calculation of capital expenditure payments as it is more effective in removing incentives to time efficiency savings than the incentive payments used in Victoria.
- In the absence of firm evidence to the contrary, we suggest that Ofgem should adopt a 5 year retention period in any incentive mechanism it might choose to adopt. Ofgem might like to consult more widely on this, or consider whether there is reason to suppose that a longer period might be required.
- Ofgem could modify the schemes introduced by Ofwat such that prices charged to customers are smoothed.

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Regulating quality

We identify a number of practical measures that Ofgem could adopt to provide companies with incentives to deliver an appropriate level of quality, which include the existing IIP mechanism. We also discuss the progress that Ofgem has made in developing the available data on quality, in addition to outlining how targets for the provision of quality might be set.

- There are a number of ways in which quality could be incorporated into the regulatory regime. Indeed, quality is already included through the IIP incentive mechanism introduced in April 2002. Suitably calibrated and refined, such that marginal payments reflect the social cost/benefit of quality, the existing IIP program should encourage efficient delivery of quality by the companies.

- In principle the level at which quality targets are set will not influence the companies behaviour (depending on the way in which incentive rates are set), although it will affect the rate of return they earn. However, if targets are updated in line with company performance then companies will make fewer quality improvements than they would if targets were never updated. Ofgem will be better placed to decide how frequently quality targets should be updated as more data becomes available.

- The quality variables on which the performance of the DNOs is currently measured are the number and duration of interruptions and telephone response. Ofgem should review whether these are the appropriate variables on which to continue setting quality targets or whether there are other/additional variables that could be used. In any event, there may be difficulties with the measurement of quality which might make it difficult to set targets and/or incentives in a mechanistic way.

1. Introduction

In August 2002 Ofgem released a consultation document setting out the objectives of its work on Developing network monopoly price controls. The aims of that project are to:

- improve the framework of price controls applying to all network monopoly companies and, where appropriate, increase consistency in the approach that is taken in setting price controls; and

- lay the foundations for the next distribution price control review (DPCR) in 2003/04 including identifying the objectives, key issues and principles that will be used in setting the price control that will be implemented from April 2005.

We have been asked by Ofgem to investigate the incentives that are faced by the companies under the existing regulatory arrangements. In particular we have been asked to investigate whether these incentives are well balanced and where they are not, to propose ways in which the balance between different incentives might be improved. The work has given particular focus to the DNOs but many of the issues are relevant to all network monopoly companies.

The remainder of this report comprises the following sections. In Section 2 we set out a framework for quantifying the incentive power of a regulatory arrangement, based on an analysis of the share of any efficiency saving which the company retains. Section 2 provides the motivation for each of the following sections in the report. Section 3 provides a discussion of possible regulatory responses to the capitalisation of operating expenditure. We describe the approach used by Ofwat and also discuss the use of total cost benchmarking. In Section 4 we describe the problem of periodicity and outline how this problem can be overcome. Finally, in Section 5 we set out some practical approaches to incorporating quality in a regulatory regime.

2. Incentives in regulation

In this section we provide a framework for understanding the strength of the incentives which companies face under the existing regulatory arrangements. We begin by outlining briefly the concept of the managerial firm. We then discuss how the characteristics of a regulatory regime influence the strength of the incentives faced by a firm. Finally, we discuss ways in which incentives to reduce costs can be balanced with incentives to provide an appropriate quality of supply, before providing a summary and a set of recommendations.

The framework presented in this section provides the motivation for the remaining sections of this report, in which we investigate ways in which the incentives we analyse can be balanced.

2.1 The managerial firm

Shareholders own companies, but decisions within those companies are taken by managers. Managers attach a positive value to the profits they create for shareholders, but they dislike profit variability (risk) and also value other aspects of their role that may have a non-pecuniary benefit. A manager focused purely on profit maximisation as a goal would pursue *any* feasible cost savings *whatever* the retention period of those profits, and irrespective of the possibility that external shocks might, *ex post*, out-weigh the effect of the cost reduction. Consequently, a model of the managerial firm recognises that the choice of any cost reduction strategy will be influenced not just by the expected value of that choice, but also by the managerial effort required to achieve a cost saving and the likely risk associated with it. The "managerial firm" is central to the insights of regulatory economics. The management of a firm must be given incentives to reveal the efficient cost level.

2.2 Regulation defining a sharing rule

Given these characteristics, it follows that the greater the level of profit gained from making a given improvement in performance, the more cost savings companies can be expected to deliver. With this in mind, one interpretation of regulation is that it determines a sharing rule that sets out the proportion of a saving that is retained by the company. In the following sections we discuss this concept in more detail under price cap regulation, before considering how the share of benefits retained by the company might influence the total size of the savings that might be delivered and how these two factors determine the benefits passed through to customers.

2.2.1 The power of an incentive regime

We define the power of the incentive regime as the proportion of the present value of cost savings retained by the firm. For example, if a firm reduces annual operating expenditure by £1mn annually, then the present value of that cost saving, over the indefinite future, is £14.3mn based on a discount rate of 7%. If the company retains all the benefit of this saving for 5 years and then passes all of the saving through to customers[1], the present value of the benefit retained by the company is £4.1mn. This is equal to 29% of the total value. We can think of 29% as a measure of the strength of the incentive provided to the company. If the company retains 50% of the saving (i.e. £0.5mn per year) for 10 years before the full benefit is passed through to consumers then the value retained by the company has a present value of £3.5mn and implies an incentive regime with a power of 25%.

The discussion above highlights the two parameters that determine the proportion of the benefit retained by the company. These are:

- the period for which the benefit is retained; and
- the proportion of the benefit retained in each year.

2.2.2 Incentive power and the treatment of operating and capital expenditure

In the example above we focussed on the treatment of operating expenditure. Capital expenditure, in recognition of the long-lived nature of these costs, is treated differently to operating costs. Typically, they are rolled into an asset base, which is then depreciated over time and on which a rate of return is allowed. This different treatment requires us to define carefully what we mean by an efficiency saving in each of operating and capital expenditure.

Defining an operating expenditure efficiency saving

Companies are rewarded for making savings compared to their operating expenditure projections. A saving in operating expenditure in any year is calculated as a reduction in the level of recurrent operating expenditure,

[1] Under price cap regulation companies retain the benefit of any saving, by outperforming the expectations of the regulator, until the next regulatory review. At the next regulatory review the regulator typically adjusts the allowed revenues of the company to reflect a projection of the efficient level of costs, and thereby passes the benefit of any reduction in assumed cost levels through to customers.

that is, we assume that once made a saving should be maintained indefinitely. As we have noted above, a £1mn saving in operating expenditure has a present value of £14.3mn, some proportion of which will be retained by the company.

Alternatively, we can consider cases where a one off saving against operating expenditure budgets is made. In this case, there is no ongoing benefit to consider. As such, the company retains the full value of any such saving as there is no future benefit that can be passed to customers.

Defining a capital expenditure efficiency saving

Under existing regulatory arrangements, companies are rewarded for making savings against their capital expenditure budgets through their RAB (regulatory asset base). For the years between price controls, prices are set on the basis of an opening value together with a stream of projected capital expenditure figures. If a regulated firm is able to save £1mn compared to its projected investment in a given year, then it earns the rate of return plus a depreciation payment on the £1mn saved for the years until the next price review. At each review, the RAB and depreciation payments are recalculated on the basis of actual investments, and the benefit of any capital expenditure saving passed through to customers. The stream of payments associated with this process is illustrated in Table 1.

Table 1: Illustration of the benefits associated with a one off £1mn saving in capital expenditure (assuming saving made in the first year)

	Year 1	Year 2	Year 3	Year 4	Year 5
Opening value of saving	1.000	0.975	0.950	0.925	0.900
Depreciation (A)	0.025	0.025	0.025	0.025	0.025
Closing value of saving	0.975	0.950	0.925	0.900	0.875
Return (B)	0.070	0.068	0.067	0.065	0.063
Benefit retained by the company (A+B)	0.095	0.093	0.092	0.090	0.088
Present value of benefit retained by the company	0.38				

Notes: Assumes an asset lifetime of 40 years and a regulated rate of return of 7%. Return on capital calculated on opening value, based on an assumption that depreciation occurs at year end (for illustration only). If the assumed asset life were 20 years the present value of the benefit retained by the company would be 0.47.

Again, there are two approaches to considering the share of any capital expenditure saving retained by the company. We can consider the benefit of a one off reduction in capital expenditure, which we do not expect to be repeated. Alternatively we can assume that the saving in capital expenditure will recur in all future years.

First we assume that the saving will not recur, for example, we consider an investment project that has been completed for, say, £1mn less than was expected. Just as with a one off saving in operating expenditure, the value of this saving is £1mn. However, while companies retain the full benefit of any saving in operating expenditure, Table 1 illustrates that the benefit of a similar reduction in capital expenditure is only £0.38mn, based on a retention period of 5 years.

Alternatively, we can assume that a saving in capital expenditure is recurring (i.e. that a cheaper way of undertaking a given task has been identified and can be repeated in subsequent years). The company will retain a proportion of the benefit of this saving for the length of the retention period defined in the regulatory arrangements, before the full value is passed through to customers.

Finally, we note that a differential application of benchmarking can weaken the incentives for capital expenditure efficiency savings still further. Any differences in the choice of the benchmarking technique between one component of cost and another, or how the resulting efficiency scores are applied, might invalidate the assumption that a company's allowed revenues are reset to costs at a regulatory review. For example, if allowed operating expenditure is set on the basis of the industry average, while allowed capital expenditure is set on a company specific basis, then incentives to reduce operating expenditure will be even stronger than this analysis suggests.

We consider ways in which the relative "strength" of the benchmarking methodology applied to each component of cost can be equalised in Section 3.

2.3 Incentive power and the length of retention period

Based on similar calculations to those set out in Table 1, together with the more straightforward calculations for savings compared to allowed operating expenditure, we can assess what impact changing the retention period has on the share of benefits retained by the company. This is illustrated in Table 2. We show illustrative calculations for a recurring operating expenditure saving, a one off capital expenditure saving and a recurring capital expenditure saving.

Table 2: Shares of a £1mn efficiency saving in operating and capital expenditure retained by the company under different retention periods[2]

Retention period (years)	Operating expenditure (one off)	Operating expenditure (recurring)	Capital expenditure (one off)	Capital expenditure (recurring)
2	100%	13%	17%	2%
3	100%	18%	24%	4%
4	100%	24%	31%	7%
5	100%	29%	38%	11%
6	100%	33%	43%	14%
7	100%	38%	49%	18%
8	100%	42%	53%	22%
9	100%	46%	58%	26%
10	100%	49%	62%	30%
11	100%	52%	66%	34%

Notes: Using a rate of return/discount rate of 7%. For operating expenditure, calculations are based on a recurring saving of £1mn per year. For capital expenditure, calculations are based on a one of saving of £1mn in a given year, for an asset with an assumed lifetime of 40 years. We also assume that prices are reset to actual costs at the end of the retention period. If the assumed asset life were 20 years then the figure for a one off capital expenditure saving would be 47% and the figure for a recurring saving would be 13%, assuming a 5 year retention period.

Table 2 provides some interesting insights into the relative strength of the incentives which companies face to make operating expenditure reductions compared to capital expenditure reductions. If we assume that both operating and capital expenditure savings are recurring then it is clear that an operating expenditure saving is more rewarding for the companies than a similar reduction in capital expenditure. However, if we believe that most capital expenditure reductions are one off, rather than recurring, while operating expenditure savings are recurring, then this conclusion no longer holds and instead we would conclude that the strength of the

[2] The retention period does not need to be equal to the length of the regulatory review cycle, as incentive payments can be structured such that some benefit continues to be retained by the company beyond the regulatory period in which savings are made. This is discussed in more detail in Section 4

incentive to make efficiency savings is comparable for both operating and capital expenditure.

The nature of capital expenditure savings, when compared to operating expenditure savings that we assume to be recurring, is therefore central to determining whether companies need to be given stronger incentives to make capital expenditure reductions.

However, it is clear that a one off reduction in operating expenditure is worth more to a regulated company than a one off reduction in capital expenditure. It is this difference in the strength of incentives that makes the capitalisation of operating expenditure a profitable strategy. We explore capitalisation in Section 3.

2.3.1 Implications of balanced incentives

In practice it is very difficult to assess what the appropriate sharing rule should be to deliver a certain level of savings. Similarly, it is difficult to second-guess what the balance of operating and capital expenditure savings achieved by companies will be. It seems intuitive to suppose that it becomes increasingly difficult to deliver savings as more and more savings have been made. Further, it seems clear that it is more likely that an inefficient business would initially be able to make operating expenditure savings more easily than investment savings. However, at some point, if the regulatory incentives are balanced, the benefit of a cost saving on operating expenditure will be equal to the benefit of an investment saving. If the incentives are unbalanced then the regulated business could be induced to make too much cost savings in one area and not enough in another, with the effect that the total cost of the business is higher than it would otherwise be.

Consequently, economic efficiency is served not by setting differential profit retention shares for operating and capital efficiencies in an attempt to estimate the managerial effort required, but through setting equal incentives and allowing companies to pursue the least total cost option.

2.4 Incentive power and different regulatory arrangements

So far we have based our discussions on the usual form of price cap regulation, under which prices are updated periodically to match prevailing costs. In this subsection we discuss two alternative forms of regulatory arrangement: sliding scale regulation; and benchmarking and yardstick competition.

2.4.1 Sliding scale regulation

Sliding scale regulation is an alternative to the usual RPI-X methodology and has been successfully employed in the regulation of NGC's system operator activities. Under this form of regulation, the prices a company can charge fall by an agreed proportion of any cost reduction (usually with an agreed cap and collar[3]). Hence a proportion of the benefit remains with the company, while the remainder is passed through immediately to customers. In particular, we note that the percentage retained by the company can be set at a level that would replicate the incentive power of RPI-X (at least until the cap or collar is reached), by calibrating the share retained by the company and the retention period in an appropriate way. As such, sliding scale can be considered within the same broad framework. Sliding scale regulation is usually considered appropriate where there is more uncertainty about what constitutes a reasonable target level of costs. Under sliding scale regulation a single point estimate is not required and a likely range of performance is agreed instead. This usually demands less information.

2.4.2 Benchmarking costs and yardstick competition

Above we have assumed that the regulator lacks the information to determine what the efficient level of costs and prices should be. The firm can reveal this information, by its actions, but will only do so if it receives additional profits for this. If, however, the regulator can obtain additional information from outside the firm about how far its costs can fall, then it is possible to have larger immediate price cuts for customers while retaining the same level of incentives, or higher incentives while retaining immediate price cuts. This is the principle that makes benchmarking costs and yardstick competition appealing.

Where companies begin a regulatory period with different levels of relative efficiency, benchmarking companies against one another enables the regulator to set differential price cuts for each firm which are not based on their own costs, but on the costs of other firms[4]. Where companies begin a regulatory period with the same level of efficiency yardstick competition could be introduced. Under yardstick competition, companies are given equal price cuts, based on movements in industry costs, without the need for benchmarking.

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[3] A cap and collar on a sliding scale arrangement set the maximum gain and loss which the company can make through the sliding scale mechanism.

[4] This assumes that the information on costs gathered from one company are informative about the level of costs of another.

We can examine the incentive power of this kind of regime. First we consider a case where there are two equal-sized firms and a regime that allows them to keep any cost savings for five years, and at price reviews adjusts the two firm's prices equally so that their average price equals their average cost level. For its own cost reduction, made in the first year of a review, each firm would keep:

- 29 per cent as a result of holding onto the additional profits for five years, as usual; but also
- half of the remaining 71 per cent, because its own cost reduction is weighted by 0.5 when calculating the industry cost reduction.

Overall, the incentive power of the regime is therefore 64% (29% + 71%*1/2), rather than the 29% under an RPI - X regime based on the firm's own costs. As we extend the number of firms, so the strength of the incentive power would increase. For example, such a regime with 14 firms would have an incentive power equal to 29% + 71%*13/14 = 95 %.

This high-powered regime is very different from options like lengthening the price control period. The incentive power has increased without reducing customer benefits. Both firms face the same very high incentives and both can therefore be expected to make greater efficiency improvements. If they make the same cost reduction, then each firm's price falls at the price review by the full amount of the cost reduction. Thus, customers get the full 71 % of the present value of the cost reduction, even though the power of the regime is 64 %. The trade-off, where the regulator must "pay" the companies to make efficiency improvements, has improved. Incentives are higher while maintaining customers' share of any benefits. Similarly, customers' share of the benefits could be increased (for example by shortening the price control period) while maintaining the strength of the incentives. This has been achieved by making use of additional information when setting prices for each company, reducing the value of the private information held by each company.

In principle, the introduction of yardstick competition mechanism such as this introduces no additional risk to the industry as a whole. Consider the case where we set the yardstick on the basis of average industry performance. It now follows that, while some firms will make excess returns and other will make low returns, the industry as a whole will make the regulated rate of return. As such, any additional risk faced by an individual company can be diversified away, by holding a portfolio of all shares in the sector. Since this risk is therefore diversifiable, it will attract no additional return. However, managerial risks would have increased, which are harder to diversify.

Given the strength of the incentives engendered by benchmarking costs and yardstick competition, there might be some concern that the delivery of quality might be harmed. Since the delivery of quality is not costless (we discuss this in more detail in Section 2.6), strong incentives to reduce costs will need to be matched with sufficiently strong incentives for the delivery of quality. Under these conditions, it should be clear to companies that reducing quality in order to look better in a cost yardstick would not necessarily be a profitable strategy, as it would result in offsetting losses through reduced quality. This requires the mechanism that provides incentives for the provision of quality to be well calibrated so that companies value quality at the appropriate level (i.e. its social value).

Ofgem's existing approach to regulation for the DNOs already incorporates the benchmarking of costs, with allowed operating costs being set in large part on the basis of industry rather than company costs.

Common criticisms of yardstick competition

From the discussion above, it is clear that yardstick competition has a number of compelling benefits. However, there are also a number of criticisms that are often levelled at yardstick competition. We note that these criticisms could also be applied to benchmarking. We review each of these and discuss ways in which they can be addressed in Annex 1.

2.5 Customer benefits and optimal retention periods

We have discussed how changes to a regulatory regime can alter the incentive power of the regime. But we have not yet discussed whether increases in incentive power are necessarily a good thing for customers.

As incentive power increases we expect companies to make further savings. However as the incentive power increases this would tend to mean that less of these savings are passed through to customers. Whether an increase in incentive power benefits customers depends on how large the increase in savings is compared to the impact of the diminished share of benefits retained by customers. This implies that there is some optimal length of retention period, which maximises the benefits received by customers.

In practice, it is not possible for the regulator to identify what this optimal retention period might be. For the regulator to make such a calculation, it would need to know how the savings made by a company might be expected to differ as the retention period changes, which is very difficult to observe in practice. Any such calculation would also be further complicated by the need to balance incentives for efficiency with incentives to provide an appropriate level of quality. In the absence of a calculation to derive the optimal length of the retention period, regulators must rely on judgement and industry and consumer consultation to decide on an appropriate length.

While savings are comparatively easy to find, for example in the period immediately following privatisation, a relatively short retention period is likely to be enough to stimulate substantial efficiency savings. As these easy pickings are exhausted and more effort is required to make savings, it is possible that a longer retention period might be required to stimulate continued improvement, although, as explained above, effective benchmarking can give very strong incentives even with relatively short retention periods.

2.6 The trade off between cost efficiency and quality of supply

In the first part of this section we considered the incentive power of a regulatory regime in isolation. However, this ignores the links between costs and quality[5]. Improved quality cannot be delivered without cost and either operating and capital expenditure can be increased to deliver increased quality. For example, more engineers could be employed at additional sites to enable faults on the distribution grid to be attended to in less time. This would naturally result in higher operating expenditure. Similarly, more reliable, but more expensive, network equipment could be installed in order to reduce the expected number of outages that occur in the first place. This would naturally result in higher capital expenditure. This suggests that a firm that is high cost and delivers a high level of quality is not necessarily inefficient, while a firm that is low cost and low quality is not necessarily efficient. Ideally, efficiency should be assessed while taking full account of quality. If consumers had a choice of network services in a competitive marketplace, they would be able to select the

[5] While this subsection concentrates on the relationship between costs and quality, it is worth stressing that quality is just one of the outputs which are of value to customers. Any assessment of company performance undertaken by Ofgem would certainly extend beyond an assessment of only cost and quality.

combination of price and quality that best suited their personal preferences. But they cannot "vote with their feet" against a monopoly supplier. It therefore falls to the regulator to ensure the customer is well-served, not only in terms of price but also in terms of quality.

If the regulator provides strong incentives for companies to reduce costs, there is clearly a danger that companies will respond to these signals by cutting costs through reducing quality, rather than through making 'genuine' improvements in efficiency. In this section we discuss how companies can be given incentives to internalise quality in their decision making processes in order to encourage companies to strike the right balance between cost and quality. This section provides a framework for analysing practical measures for including quality in a regulatory regime, which we discuss in Section 5.

2.6.1 Generic approaches for providing incentives to deliver quality

While companies can be expected to deliver some level of quality of supply in order to avoid any regulatory response to poor quality, they can only be expected to place an appropriately high value on quality if it affects their profitability , which will be apparent where some form of financial incentive is in place. This is the case in both competitive and regulated markets. We consider the two generic ways in which companies operating in regulated markets can be given a financial incentive to improve their quality of supply. In the following two subsections we assume that companies can choose the level of quality they choose to supply for simplicity. This assumption is clearly unrealistic, as out-turn levels of quality will depend on many random factors which are largely beyond the control of the company, principally the weather, although the company may be able to mitigate the impact of random events. However, we might expect much of this "noise" to be smoothed out of the data on quality on which any incentive mechanism might work, for example through normalising for factors outside the direct control of companies, suggesting that the simple frameworks we present here remain valid. For example, a slightly more complex version of this model would be based on the view that companies can select a range in which quality will fall and that companies have reasonable control over the upper and lower bound of that range.

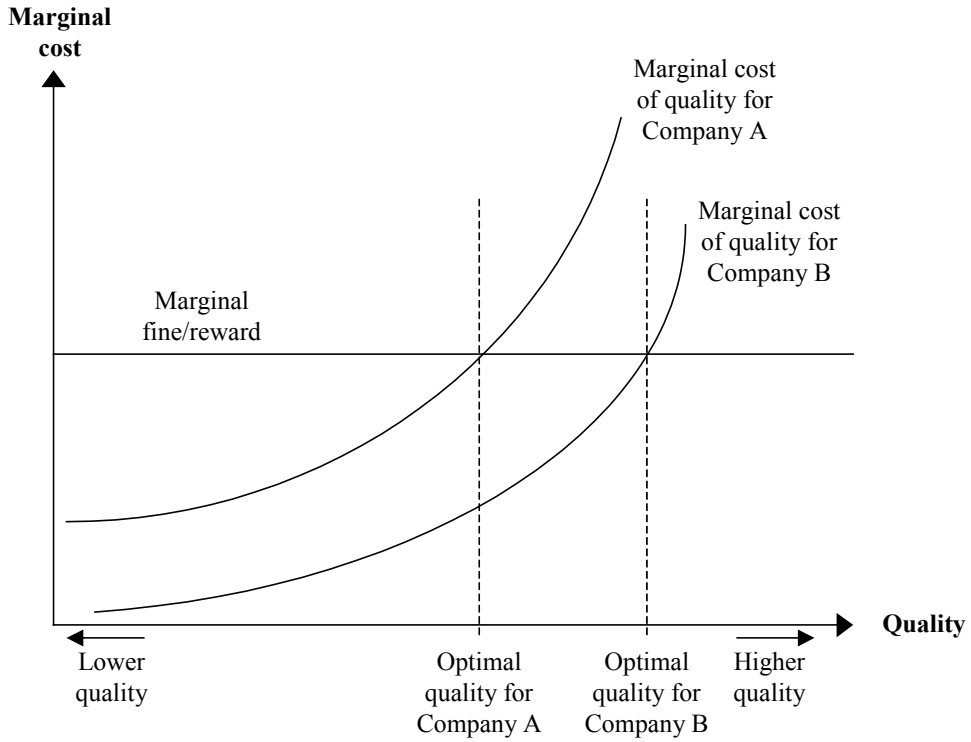
Marginal rewards/fines

Under this kind of scheme, companies receive a marginal reward for improving their quality by one unit, or equivalently a fine for allowing their quality to fall by one unit. In response to this regime, companies

would theoretically deliver a level of quality where the marginal cost of quality is equal to the unit cost of the reward (fine)[6].

Different companies facing the same regime will deliver different levels of quality, as we would expect each company to have a different cost schedule for the delivery of quality. This is illustrated in Figure 1. While these different levels of quality represent the rational and efficient response for each of these companies, the delivery of different levels of cost can be politically difficult for the regulator. Since these kinds of mechanisms allow the firms to decide what level of quality to deliver, they are often referred to as decentralised. The existing form of the IIP represents a complex form of such a mechanism, with caps and collars.

Figure 1: Illustration of the response of two different companies to a system of marginal rewards/fines for quality



[6] As we have described above, managers of a regulated firm would consider the effort required, in addition to the profits resulting from any action, when choosing the level of quality to deliver.

In principle the level of the reward/fine can be set a level that reflects the social value (or marginal benefit) of the additional unit of quality. There is also no reason to suppose that this marginal value is the same at all levels of quality. In principle a sloping, or even non-linear, schedule of rewards/fines could be introduced, which could vary by geographic location (i.e. different companies could be given different reward/fine schedules). However, in practice, the difficulties in estimating such a schedule for the social value of quality may make such sophistication difficult to achieve.

Absolute rewards/fines

The alternative to marginal fines is to introduce a system of absolute fines. If quality falls below a certain threshold, the company is fined a pre-determined and usually large amount. It might be argued that companies already face an absolute incentive of this kind, as failure to deliver some minimum level of quality would be likely to prompt a discrete regulatory response. This arrangement could be formalised by drafting a licence condition setting out the minimum quality standards that network companies must reach, where failure to meet the required standard could result, as an ultimate sanction, in a company's licence being revoked.

In response to this kind of mechanism, companies should rationally seek to deliver a level of quality just above the threshold. Any lower and a large fine will be incurred. Any higher and the company has provided costly quality for which it receives no financial reward[7].

Under this kind of mechanism the regulator has essentially chosen the level of quality which companies are expected to deliver. For this reason, this kind of mechanism is often referred to as centralised.

From the perspective of economic efficiency, marginal mechanisms are more appealing if the reward/fine schedule is calibrated to match the social benefit of quality. Under these conditions a marginal mechanism encourages companies to find the optimal level of quality to provide, based on the social value of quality. We also note that a combination of marginal and absolute incentives can be employed. This kind of approach can combine the key benefits of each mechanism, allowing companies some freedom to decide on the right level of quality, while ensuring that customers are protected through guaranteed minimum standards.

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[7] The same logic applies with absolute rewards. The company will deliver just the right amount of quality to earn the reward but no more.

2.7 Summary and recommendations

- The incentive power of a regime can be quantified by considering what proportion of the value of any efficiency saving made the company is allowed to retain.
- Incentive power increases with the length of time for which companies are allowed to retain efficiency savings. At some point increases in incentive power cease to benefit customers as the increase in the share of such savings retained by the company outweighs the incremental savings induced.
- Direct comparison of the benefit to companies from a one-off (recurring) gain in operating expenditure against the benefit of a one-off (recurring) gain in capital expenditure suggests that companies face stronger incentives to make operating expenditure savings. This explains why companies might find capitalising their operating expenditure profitable. However, if most capital savings are one-off, while most operating expenditure savings are recurring, then the strength of incentives the companies face are better balanced.
- In principle, economic efficiency is served by offering equally strong incentives to make operating and capital expenditure efficiency improvements, allowing the companies the opportunity to choose which type of efficiencies to make. Firms will then be given the balanced incentive to reduce total costs, rather than a particular component of cost.
- Companies can be given stronger incentives to make efficiency savings through either increasing the retention period or through making more use of benchmarking.
- Benchmarking and yardstick competition offer significant benefits over regulatory regimes in which there is less direct comparison of performance across companies, through increasing the incentive power of the regime without reducing the amount of benefit passed through to customers.
- If Ofgem had a robust system for comparative efficiency analysis, allowing it first to adjust price differentials to reflect only differences in efficient costs, it could then implement a system of yardstick competition, where prices are reset in line with movements in industry costs. Such a mechanism can provide strong incentives to companies to reduce costs while ensuring that the benefits of any cost reduction are passed through to customers quickly.

- There are a number of common criticisms of yardstick competition (see Annex 1), but we believe that these criticisms can be answered through robust modelling and careful regulatory design.

- Since a regulated company profits from reducing its costs, but quality increases with cost, there is a trade-off between cost efficiency and the delivery of improved quality. While companies can be expected to deliver some level of quality of supply companies can only be expected to place an appropriately high value on quality if it affects their profitability.

- There are two generic approaches to providing companies with incentives to deliver quality. Marginal rewards/fines will encourage companies to select the optimal level of quality, given the size of the marginal payment and the cost of providing quality. If the marginal payment is calibrated such that it is equal to the social cost/benefit of quality then what is optimal for the company will be the economic and efficient level. Absolute fines result in the regulator choosing the level of quality that companies will deliver. A combination of the two could be used to ensure minimum standards of quality while providing companies with incentives to deliver additional quality if it is valued.

3. Balanced benchmarking of operating and capital expenditure

3.1 Introduction

Operating costs might be capitalised in two ways. Either through reclassification of expenditure as a capital cost when it would be more appropriately classified as an operating cost, or through deciding to undertake capital expenditure when operating expenditure represents the most efficient option. Either policy might lead to higher prices for customers and makes regulation more difficult.

In Section 2 we have outlined why companies might have an incentive to capitalise their operating expenditure. This incentive follows from the share of the benefit that companies retain from any single one off reduction in operating expenditure, being greater than the benefit from a one off reduction in capital expenditure as a result of the way in which capital expenditure savings are rewarded through adjustments to the RAB.

In addition, these incentives are increased to the extent that the approach to setting allowed operating expenditure is more consistent with a yardstick mechanism and is more highly powered than the approach to setting allowed capital expenditure.

In this section we discuss some regulatory responses to the problem of capitalisation. We investigate ways in which the existing building blocks approach to regulation might be modified to reduce or eliminate this perverse incentive. The discussion we present is primarily based on:

- an analysis of Ofwat's current method of assessing efficiency and determining allowed revenue, together with our view of how companies have responded to this regime; and

- a possible solution to the distortion of incentives between operating costs and capital costs with an efficiency model based on total costs.

We discuss the issues that Ofgem would need to resolve before relying on a total cost model and provide advice on how capital costs might be treated under such a model. Finally, we draw together the analysis presented in this section and provide conclusions and recommendations.

3.2 Ofwat's approach to cost benchmarking

In this subsection we outline the benchmarking techniques used by Ofwat to regulate the operating and capital expenditure decisions made by the regulated water and water and sewerage companies. This approach is centred on benchmarking each component in a similar way. We provide a description of:

- the techniques used to determine allowed operating expenditure, capital maintenance expenditure and capital enhancement expenditure;
- the incentives with which companies are provided by this separate benchmarking of different cost components; and
- the strategies that companies might have followed in response to these incentives.

Finally we draw some conclusions from Ofwat's experience.

3.2.1 An overview of Ofwat's approach to benchmarking

The description of Ofwat's benchmarking in this section is based on Ofwat's approach at the price control review in 1999. Ofwat has consulted on its approach to the 2004 price control review and is intending to adopt a similar approach. Where appropriate we highlight changes.

In determining the price limits and efficiency factors for the regulated water and water and sewerage companies, Ofwat reaches a decision on the efficiencies that can be achieved in each company's operating, capital maintenance and capital enhancement expenditure. The efficiency gains that can be achieved in each component of expenditure feed into the allowed revenue for that company.

Ofwat benchmarks a company's operating and capital expenditure separately. Ofwat further separates capital expenditure into capital maintenance and capital enhancement expenditure and regulates them separately. Capital maintenance expenditure is expenditure on maintaining the existing assets whereas capital enhancement expenditure is expenditure on improving or expanding service provision.

Each of the companies regulated by Ofwat is given an efficiency target for each element of their cost. This target has two components:

- a minimum efficiency target for every company regardless of their current efficiency; and
- an additional target for the less efficient companies for catching up with the most efficient ones.

The details of Ofwat's approach to target setting on each component are set out in Annex 2.

After Ofwat had determined the companies' efficiency target in each of these areas, Ofwat placed each company's operating expenditure efficiency on a scale of A to E, where A was most efficient and E was least efficient. The same process was used to classify each company' capital maintenance expenditure. These two rankings were then combined to produce a grid, which was used as an informal way to compare company's rankings on operating and capital maintenance expenditure.

Table 3 presents the grid that Ofwat used at the 1999 price control review. It shows, for example, that a company with operating expenditure efficiency in band A and capital maintenance efficiency in band E has to reduce capital maintenance expenditure by 9% compared to the 10% catch up required for companies whose capital maintenance efficiency was band E and operating efficiency was band B. This provides some benefit for companies that are on the frontier on one dimension but off the frontier on another, compared to the treatment of companies off the frontier in both dimensions.

Table 3: Adjustments to opex and capital maintenance catch up targets

	Capital Maintenance efficiency				
Opex efficiency	Band E	Band D	Band C	Band B	Band A
Band A	Opex: nil Capex: -9%	Opex: nil Capex: -8%	Opex: nil Capex: -6%	Opex: nil Capex: -3%	Opex: nil Capex: nil
Band B	Opex: -5% Capex: -10%	Opex: -5% Capex: -9%	Opex: -5% Capex: -7%	Opex: -5% Capex: -4%	Opex: -4% Capex: nil
Band C	Opex: -10% Capex: -11%	Opex: -10% Capex: -9%	Opex: -10% Capex: -7%	Opex: -10% Capex: -4%	Opex: -8% Capex: nil
Band D	Opex: -14% Capex: -11%	Opex: -14% Capex: -9%	Opex: -14% Capex: -7%	Opex: -14% Capex: -4%	Opex: -12% Capex: - nil
Band E	Opex: -17% Capex: -11%	Opex: -17% Capex: -9%	Opex: -17% Capex: -7%	Opex: -16% Capex: -4%	Opex: -15% Capex: - nil

Source: Ofwat

3.2.2 The interaction of incentives

Since there are substitution possibilities between the different components of cost that Ofwat benchmarks, companies can shift expenditure between these components.

At the 1999 review, Ofwat noted that some companies appeared to perform well in operating expenditure benchmarks and less well in capital maintenance expenditure benchmarks. Ofwat recognised that if a company appears efficient in one area and inefficient in the other, this could reflect a strategy to increase spending in the inefficient area in order to appear efficient in the other and that such a strategy might be profitable. Ofwat has recognised that its balanced approach to benchmarking, where all components of cost are treated in broadly the same way, might give the companies an incentive to do this and has attempted to address this through its process of banding, as set out in Table 3.

However, this process of banding of companies' efficiency might still leave incentives for companies to 'game' the system.

3.2.3 Company strategies in response to Ofwat's benchmarking

In the 1994 periodic review, Ofwat set separate benchmarks for operating and capital expenditure. It is not clear that the setting of separate banded efficiency targets for operating expenditure and capital expenditure efficiency leads all companies to respond in the same way.

Companies may have responded to these benchmarks with the following two alternative strategies. Which strategy will be the best to follow depends on expectations of the operating and capital maintenance catch up targets and how big the differentials between bands will be.

Strategy 1: reclassify

One strategy that companies may have used is to change their performance in Ofwat's benchmarking by reallocating costs between operating and capital expenditure. This would lower their costs in either operating or capital expenditure, in order to get lower targets for efficiency in one area for the next price control period. For example, if the operating expenditure benchmark was expected to be tougher than the capital expenditure benchmark companies would shift operating expenditure to capital expenditure, or perhaps postpone some operating expenditure until the next price control period.

Essentially companies attempt to predict where Ofwat will set its bands and in which box of Ofwat's matrix they expect to find themselves. They can then consider whether moving to an adjacent box would increase or decrease expected profits.

This strategy is likely to work well when efficiency catch up targets differ substantially between the companies in the least and most efficient bands. In such situations, moving from one box to another could substantively change the required operating and capital expenditure reductions.

Strategy 2: bring costs forward

An alternative strategy that could have been used by companies involves increasing expenditure on either operating or capital expenditure in the base year before the new price controls are set. In contrast to the above strategy, this strategy will work well if it is likely that the targets for efficiency catch up will not differ substantially between the bands for the most and least efficient companies.

The expenditure of a company determines both the target for efficiency reduction and the base expenditure to which that target is applied. If the company increases expenditure in the base year and the target they are then set by the regulator for catch up efficiency is not significantly more challenging than for more efficient companies, the expenditure they are allowed is high because the target is applied to a large base expenditure.

Ofwat's approach to the 2004 periodic review

In the 2004 periodic review, Ofwat are proposing two studies to understand what influences company investment decisions and what impact there is on financial returns by taking advantage of investment and allocation options. The first study will involve discussions with policy makers at the companies to ascertain the extent to which regulatory policy drives decision-making. The second study will examine the sensitivity of financial returns to various combinations of capital expenditure and operating expenditure. Ofwat will report on these studies in March 2003.

3.2.4 Conclusions on Ofwat's methodology

- Ofwat uses similar approaches to benchmarking of operating, capital maintenance and capital enhancement expenditure.
- Ofwat deals with any apparent distortion between operating and capital maintenance expenditure by making informal adjustments to companies required expenditure reductions through a system of banding.
- There is some evidence to suggest that this system of banding provides the opportunity for companies to increase their profits by following the kinds of strategies outlined above.
- Ofgem could adopt the approach to benchmarking followed by Ofwat, but such a system would need to be calibrated with care in order to minimise the incentives that companies would face to 'game' the system.

3.3 Total cost regulation

To the extent that the incentive to capitalise operating expenditure arises through adopting different benchmarking methods for setting future allowed expenditure for different components of cost, this incentive might be eliminated by replacing the existing building blocks approach with an assessment of efficiency based on total costs. If prevailing prices reflected

efficient total costs then total cost regulation could provide balanced incentives though, for example:

- a yardstick competition mechanism with equal targets for all companies; or
- periodic reviews of total cost using some benchmarking technique.

Before Ofgem could move to a system based on total cost regulation there are two practical issues that would need to be resolved.

- ❒ It is possible that the relative pattern of prices across companies does not reflect the relative pattern of efficient costs.
- ❒ The prevailing asset values of the regulated companies, on which total cost measures would be constructed, might differ arbitrarily, since they will depend at least partially on the somewhat arbitrary valuation placed on assets in place at vesting.

For Ofgem to implement a system of regulation based on total cost benchmarking it must establish a robust and consistent treatment of capital costs. Total cost measures based on a robust measure of capital cost would allow Ofgem to determine:

- whether there are differences in the current efficiency of companies;
- what is driving any differences; and
- what to do about them.

This requires both a technical understanding of how capital costs should be treated together with an understanding of how regulatory decisions impact upon and calculations of capital cost, which we discuss using Ofgem's inherited, inherent, incurred framework. We also include a brief discussion of the relevance of the RAB in total cost regulation.

3.3.1 Defining a measure of total cost

The total costs incurred by a regulated company consist of operating costs together with capital costs. While the treatment of operating costs is straightforward, since they are expensed in the year they are incurred, the treatment of capital costs requires more thought as they are incurred in the installation of long-lived assets. There are two approaches to incorporating capital costs in a total cost measure.

Cash cost approach

Under a cash cost approach, annual operating and capital expenditure would simply be added together to provide the total cost incurred by the company in a given period. These total costs could then be compared against delivered outputs for all companies[8].

The main advantage of this approach is its simplicity. Total cash cost is straightforward to calculate and monitor. However this approach might be described as unrealistic.

Cash cost modelling does not reflect the long lived nature of investments. Under a cash cost model the total cost of an investment, which will result in assets with a lifetime of some 40 years, is reflected in a single year. It might be argued that only one fortieth of this investment should be included in the costs of that year. This line of reasoning argues for the derivation of a measure of annual capital consumption. Similarly, it seems reasonable to suppose that capital consumption figures included in benchmarking should reflect not only the costs incurred in the current period but should also take account of the contribution of assets purchased in previous periods but still in use. Companies could appear either super-efficient or inefficient if no account is taken of the inheritance they receive at the beginning of the period.

Similarly, it is well known that investments are "lumpy" in nature implying that there might be considerable fluctuation in total cash costs from year to year. Given this, benchmarking methodologies based on an assessment of a single years cash costs could be misleading and arbitrary and might exacerbate incentives for companies to time both efficiency improvements and investments. The impact of this lumpiness might be reduced by assessing total cash costs incurred in more than one year (e.g. over the course of a 5 year regulatory period), but this is still not ideal unless there is evidence to suggest that all companies are at similar points in their investment cycles. Unless this is the case we would expect to find some companies in periods of low investment and others in periods of higher investment. Under a cash cost approach the former will look more efficient than the latter, since the cash cost approach essentially ignores existing assets. One approach to resolving this difficulty with the use of cash costs might be to conduct a cash cost assessment using existing network condition as an explanatory factor, although such a model would need to be designed and interpreted with care.

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[8] This assumes that the company being regulated is not unique, i.e. that comparators exist. We also note that the set of delivered outputs should be comprehensive, including, for example quality of supply (as discussed in Section 2.6).

Capital stock models

The alternative to adopting a cash cost approach is to recognise that an investment is long lived and to produce an estimate of annual capital consumption. Under this framework, a stream of annual investment figures is converted into a stock of capital (on which a return is paid) and a stream of annual depreciation figures (i.e. annual capital consumption is equal to an annual depreciation charge plus a return on capital). This kind of approach requires:

- an opening capital account, either an opening value or a detailed breakdown of the opening assets (age, assumed lifetime, gross value);
- a stream of annual investment figures, preferably broken down by asset type where asset lifetimes differ;
- a depreciation methodology which comprises a writing down calculation (e.g. straight line, reducing balance) and a set of assumed asset lifetimes; and
- an opportunity cost of capital.

Adopting this approach requires the regulator to make a range of assumptions and also to collect more data than under the comparatively simple cash cost approach. However, calculations of annual capital consumption based on this kind of capital stock model appear more consistent with the underlying reality of a long-lived asset. The model adopted by the Dutch Electricity Regulator to support total cost benchmarking is consistent with the capital stock approach.

Annex 3 provides some further detail on how a capital stock style measure of capital cost can be constructed.

3.3.2 Regulatory choices and the drivers of total cost efficiency

In the previous subsection we discussed capital stock models of total costs that incorporate the value of assets incurred before vesting. However it is unlikely that Ofgem will wish to base any total cost assessment on costs that were incurred before the companies were privatised. Indeed, Ofgem might wish to go further, by excluding some costs that have been incurred post vesting. For example the regulator might view investments made in the first two regulatory periods as agreed with the regulator and therefore not subject to subsequent review. The decisions that Ofgem might take regarding the treatment of costs incurred in the past will clearly have an

impact on the kind of total cost measure that should be used for benchmarking and for the setting of forward looking efficiency targets. Ofgem has developed a framework for thinking about differences in the relative performance of the companies that we can adopt usefully here.

Inherited costs are those that the company inherited at vesting. Companies cannot control these costs in the short run, but in the long run inherited assets will reach the end of their useful life and will no longer influence costs.

Inherent costs are driven by factors relating to the operating environment that the company faces. Companies cannot fully control these costs and since their operating environment will not change, these factors might result in a permanent wedge between the level of costs of different companies.

Incurred costs are those costs that are the direct result of management action since privatisation and may include the strategy that a company has taken in operating and maintaining the network.

This implies that Ofgem will need to control for both inherited costs and inherent costs, when assessing company performance.

3.3.3 The exclusion of inherited costs from total cost calculations

The regulator might wish to exclude pre-vesting assets from its total cost measures in order to prevent companies from being found inefficient as a result of a differential level of efficiency or asset valuation inherited at vesting. Similarly, the regulator might wish to exclude some assets installed post vesting.

While this approach is entirely reasonable it makes the interpretation of the efficiency measures one might derive from such total cost estimates problematic. For example, with pre-vesting assets excluded, companies that inherited newer networks and have consequently needed to spend less in the years since vesting will appear efficient. The opposite will be true for companies that inherited older networks.

This suggests that efficiency measures based on total cost measures that exclude some assets are likely to be difficult to interpret. In particular the efficiency scores arrived at are likely to be confounded by differences in the starting positions of the companies.

As a result, if Ofgem wished to regard certain assets as uncontrollable, we believe it will be necessary to make estimates of efficiency both including and excluding those assets from the total cost measures. Careful interpretation of the combination of the two sets of efficiency scores will enable Ofgem to reach a conclusion on which companies are efficient on a total cost basis and how much of this inefficiency can be regarded as due to controllable expenditure.

The options for valuing inherited assets

Having identified that pre-vesting assets (in addition to any other assets identified by Ofgem as inherited) must figure in total cost efficiency analysis, even if this is just so that their impact on efficiency scores can be identified, we need to consider how such assets should be valued.

There are three obvious valuations we could place on pre-vesting assets, which are:

- a constructed valuation based on the physical assets in place at the time (based on the kind of methodology set out in Annex 3);
- the CCA value quoted in the flotation prospectuses; and
- the implied value, given the sale price quoted in the flotation prospectuses.

A standardised opening value could be constructed from detailed asset registers, which would account in detail for the position at vesting, based on detailed asset registers. With these data, the regulator can construct a regulatory value, complete with a net asset value and a stream of annual depreciation charges. Such a measure of annual capital consumption would accurately reflect the assets employed by the company and should provide a sound basis for estimating the efficiency with which companies deliver services to customers. However, there are two important difficulties with this approach.

To undertake such an approach the regulator would need to collect a substantial body of data, comprising detailed annual investment data, broken down into a number of different asset types. A full analysis would require such data going back over 40 years or more and it simply might not be available. Even if all these data were available its collection would require a large effort by first the companies and subsequently the regulator (in order to verify company submissions). Furthermore, the net asset values and associated annual capital consumption estimates that such an approach would deliver need not bear any relationship to the cost base on which prices are set. Given this, it is not obvious how efficiency scores

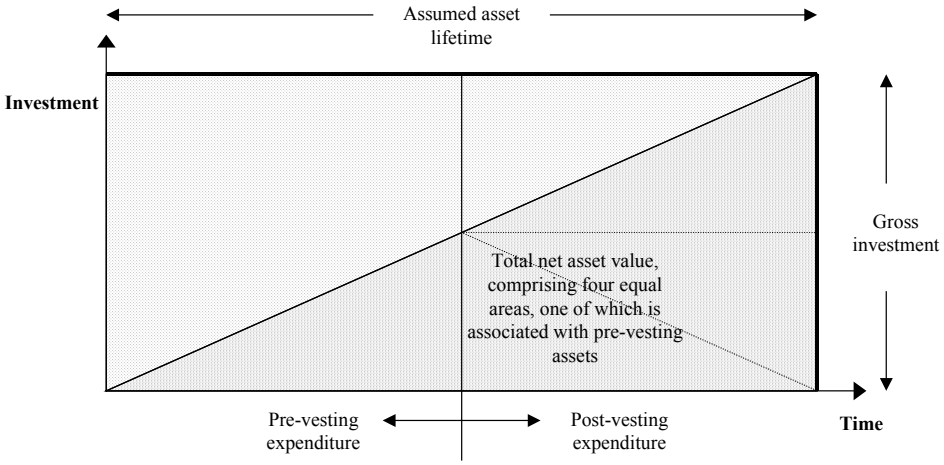
based on such a measure should be interpreted, nor how these scores could be used to set revenue targets for the companies.

Of the remaining two alternatives, we believe that the CCA value quoted in the flotation prospectus is most likely to be reflective of the replacement value of these assets. The share price given in the prospectus will have been determined by more than just the state of the network, such as a desire to ensure a successful flotation.

The impact of a discrepancy in the valuation of pre-vesting assets

How large an impact would we expect post vesting assets to have on estimated total cost figures? We can address this question using a simple, illustrative example. Suppose we have a company in steady state, investing a constant amount in each year for the last 40 years (our assumed asset lifetime in this illustration). We straight-line depreciate these assets over their lifetime to derive a net asset value, on which we pay a return (assumed to be 7% in this example). Further, we assume that vesting occurred 20 years ago, so that the older half of the asset base was installed pre-vesting, with the newer half of the asset base installed post vesting. This assumption would be consistent with, for example, the introduction of total cost modelling for the 2010 DPCR (at which point we would be 20 years from vesting) with all post vesting assets viewed as incurred rather than inherited. As Figure 2 shows, this implies that 25% of the net asset value is accounted for by pre-vesting assets. However, pre-vesting assets account for 50% of depreciation (since half of all assets are pre-vesting). Depending on the assumed cost of capital this would imply that pre-vesting assets account for approximately 35% of annual capital consumption, and this figure would decrease if we factor in some growth (e.g. 1% growth implies pre-vesting assets account for 33%). As such, an error of 1% in pre-vesting valuation will produce an error of approximately 0.35% in estimated capital consumption. Finally, if we assume that capital cost is approximately half of total cost, the impact of a 1% error is approximately 0.17% of total cost.

Figure 2: Illustration of the impact of pre-vesting assets on net asset value



Notes: Gross asset value is represented by the whole rectangle, while net asset value is represented by the large lower right triangle as we use straight line depreciation. Assumes that pre-vesting assets account for half of all asset vintages installed. Also assumes that there is no growth in capital expenditure over time.

From this discussion we conclude that even if the selected opening values contained some discrepancies, this might not have a substantive impact on derived total cost measures and estimated efficiency scores. Furthermore, even if Ofgem suspected that asset valuations contained substantial errors, this could be accounted for by placing an appropriate interpretation on the resulting efficiency estimates, e.g. by setting no catch up target for companies close to but not on the frontier.

3.3.4 Adjustments for inherent network factors

Ofgem identifies certain features of some network businesses as inherent, implying that it would expect these factors to be present regardless of how the company was managed.

Some of these factors could be accounted for relatively simply by adjusting derived total cost measures. For example, companies serving urban areas are usually required to bury their wires, thereby incurring additional expenditure. Total cost measures could be derived to adjust for this, by replacing the actual gross investment in underground cables with a notional gross investment consistent with a price for overhead wires instead. Alternatively, it might be more appropriate to consider capturing such effects, where possible, through the use of carefully selected output factors, rather than through an adjustment to inputs. There is no obvious

reason to suppose that one approach should dominate another. Each possible factor should be assessed independently to determine how it might best be captured in efficiency analysis. Similarly, operational modelling of the networks, which we discuss in relation to the trade of between cost reduction and quality in Section 5.2.4, could provide an approach to capturing and accounting for inherent network factors.

3.3.5 Relevance of the RAB under total cost benchmarking

The output of a robust benchmarking model based on total cost, with a well defined set of outputs[9], would be a set of efficiency scores which reveal what cut in total cost the regulator could impose on each company. Such an efficiency score does not provide information on whether any required reduction in total cost should be made through reducing operating expenditure or capital expenditure.

Under a building block approach to regulation, investments rolled into the RAB are reimbursed in full through the calculation of regulatory depreciation and a return on the RAB. If Ofgem were to adopt a total cost model, Ofgem might not be able to ensure that the value of the RAB in maintained and reimbursed in the same way, unless there is some way of demonstrating that such revenue targets can be met without requiring companies to accept a rate of return below the regulated cost of capital.

One approach might be to conduct separate benchmarks of operating expenditure and annual capital consumption, in addition to total cost benchmarking, and to use these partial efficiency measures to set targets for capital consumption and for operating expenditure. However, one benefit of total cost benchmarking is that it provides the companies with freedom to explore whatever mix of labour and capital they believe will deliver least cost and setting targets for each component of cost might diminish this benefit.

Alternatively, Ofgem might decide that total cost targets are consistent with its existing regulatory arrangements for the distribution companies. It is certainly possible for companies to make rates of return below the regulated cost of capital if, for example, they fail to meet their efficiency targets on operating expenditure. Ofgem might take the view that setting

[9] By well defined we mean that all relevant factors should be included. While a full investigation of what such a set of outputs should include is beyond the scope of this paper, the output set should include the outputs valued directly by customers (e.g. units delivered, peak demand), quality (as discussed in Sections 2 and 5) plus any outputs included to account for inherent factors beyond the control of the companies.

targets for a reduction in total revenue, without detailed analysis of underlying costs, is consistent with this.

3.3.6 A summary on total cost modelling

We believe that Ofgem has, at least, the minimum data required to undertake total cost modelling. Given this, total cost modelling might provide an attractive approach to ensuring that incentives to capitalise operating expenditure are reduced or eliminated. We also offer the following recommendations.

- Ofgem should take a view on the assets it would wish to regard as controllable (e.g. post-vesting assets).

- Ofgem should then undertake two sets of efficiency analysis based on total cost measures which include and exclude non-controllable assets. Careful interpretation of these two sets of analysis will inform Ofgem on the relative efficiency of the companies and how non-controllable assets influence this.

- Ofgem should consider what weight pre-vesting and other assets deemed non-controllable have in annual capital consumption measures, in order to determine whether any error associated with the value of these assets is substantive.

- Ofgem could undertake a standardisation of asset value, based on an analysis of detailed company asset registers. However, the interpretation of efficiency scores derived from such valuations is difficult, limiting the attractiveness of such an approach.

- Inherent network factors could be accounted for in total cost benchmarking through making changes to total cost calculations or through the careful selection of output factors. Ofgem should consider this in detail when deciding on the "model" it intends to adopt to assess the relative performance of the distributors at the next DPCR.

- Ofgem should consider whether a move to total cost modelling would be consistent with its powers, with specific regard for the meaning of the RAB under total cost modelling.

- In this section we have focussed on identifying the properties of a robust cost measure for use as an input to a benchmarking process. It is worth stressing that a complete benchmarking model would need not only a well-defined input, but also a complete set of outputs. These outputs should include not only the direct outputs that customers value (such as units delivered and peak demand) but quality

should also be accounted for, as described in Section 2.6. Furthermore, such a model should take account of any exogenous, environmental factors which might impact on the level of efficient costs that we would expect a firm to incur.

4. Periodicity

The periodic reviewing of costs and resetting of prices, which form a common element of many regulatory environments can provide regulated companies' with an incentive to time their efficiency savings. In this section we:

- illustrate how this incentive arises;
- discuss how it might be eliminated by introducing a system of incentive payments, based on the methodology employed by Ofwat and also by the regulator in Victoria, Australia;
- discuss how incentive mechanisms of this kind can be modified to alter the length of the retention period (as discussed in Section 2.3);
- describe how these incentive payments can be smoothed if Ofgem wishes to avoid annual updating of prices; and
- provide a set of conclusions and recommendations.

4.1 Regulatory cycles and the timing of efficiency saving

As a result of the cyclical nature of regulatory proceedings companies retain a greater share of the benefit of cost reductions made early in a regulatory period, rather than later, i.e. the year in which a saving is made in a regulatory review alters the period over which any benefit is retained by the company. This is illustrated in Figure 3 and Figure 4, both of which assume a regulated firm faces a review every 5 years and that no steps are taken to address the periodicity problem.

Figure 3: Illustration of benefit retained by a regulated company making an efficiency improvement in year 1 of a regulatory period

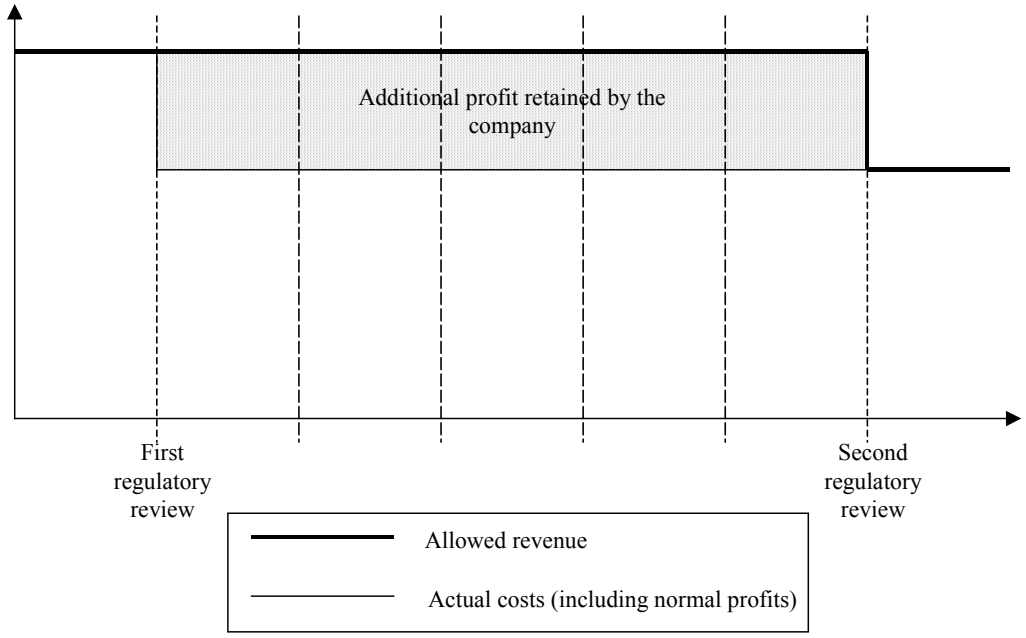
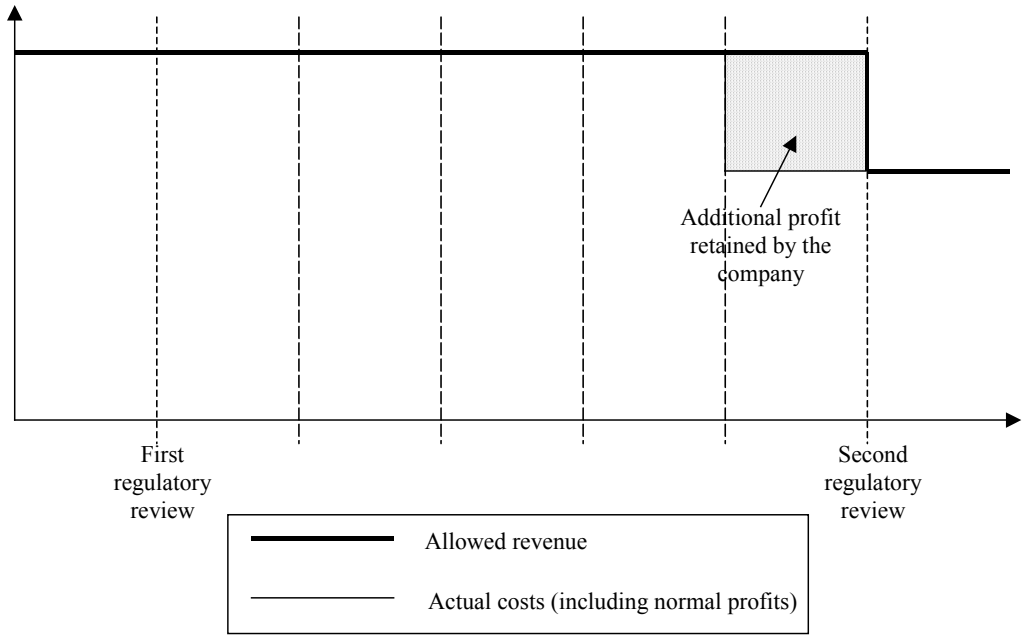


Figure 3 shows the path of costs and revenues for a company that makes an efficiency improvement in the first year of a regulatory period[10]. As a result, the company retains the benefit of this saving for up to five years, before its prices are adjusted by the regulator at the next review, passing the benefit through to customers.

[10] In practice, this assumes that the company makes the saving on the first day of the first year.

Figure 4: Illustration of benefit retained by a regulated company making an efficiency improvement in the final year of a regulatory period



In contrast, Figure 4 shows the path of costs and revenues for a company that makes an efficiency improvement in the fifth and final year of a regulatory period[11]. In this case, the company retains the benefit of the efficiency improvement for at most one year, rather than five. This comparison demonstrates that companies have weaker incentives to make efficiency savings as they progress through a regulatory period. This is likely to have two adverse effects.

- The timing of cost reductions will be influenced by the regulatory timetable (where companies are not allowed to retain savings for a fixed period of time), rather than the firm's own assessment of its business. Presumably, this will be less efficient than a timetable driven solely consideration of the actual costs and benefits of making an efficiency improvement.

[11] In practice, regulatory reviews are often conducted on data pertaining to the penultimate year of a regulatory period as this is typically the timeliest data that is available. This does not alter the principles explained in the discussion above.

- Variation in incentives encourages "gaming". Cost savings can be delayed, hidden or transferred between years. If successful, gaming is bad for customers because it results in higher prices than necessary. Even if unsuccessful, it increases the difficulty of carrying out regulatory reviews as it makes the assessment of efficient costs more difficult.

There is some evidence to suggest that regulated companies in a number of sectors have responded to these signals, delaying savings that could be made in the last few years of a regulatory period and making rapid reductions in costs in the years immediately after a review. In response to this problem, Ofwat has implemented a system of incentive payments that aims to make companies indifferent to the year in which they make efficiency improvements. We describe this system in the following section.

4.2 Incentive payments introduced by Ofwat

The central idea that underpins Ofwat's incentive payments is that the companies should be able to retain the benefits of any efficiency saving for a fixed length of time (e.g., five years), irrespective of the timing of price reviews and the timing of efficiency savings. While this principle is straightforward, the details of the scheme are more complicated. In particular, the regulator needs to gather reliable data on all years in a given period in order to calculate the necessary incentive payments, while in the absence of such a scheme only the final year's data need be analysed in detail.

4.2.1 Ofwat's treatment of operating expenditure efficiency savings

The calculation of the incentive allowance for operating expenditure efficiency improvements is best illustrated using a stylised example (see Table 4).

Table 4: A stylised example of the calculation of operating expenditure incentive payments

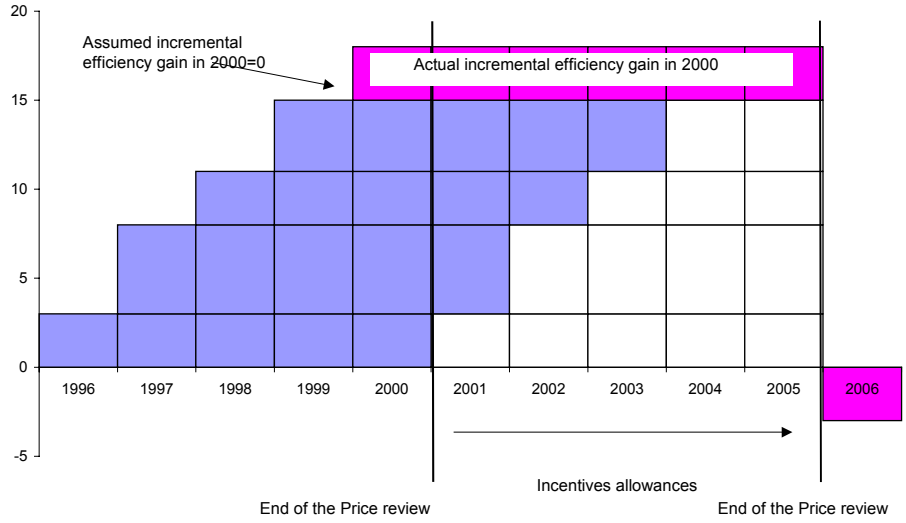
	1996	**1997**	**1998**	**1999**	**2000**
Allowed opex	97	96	95	94	93
Actual opex	94	88	84	79	78
Total efficiency gain	3	8	11	15	15
Incremental gain	3	5	3	4	0
	2001	**2002**	**2003**	**2004**	**2005**
Incentive allowance	5+3+4=12	3+4=7	4	0	0

Table 4 shows allowed and actual operating expenditure for a five-year regulatory period running between 1996 and 2000. As is usual, the company has outperformed its allowed operating expenditure target, and the incentive payments are designed such that this out performance is retained for 5 years. Therefore, the efficiency gain of 3, made in 1996, does not contribute to any incentive payments, as the benefit of this improvement has already been retained for 5 years. The incentive payment for 2001 therefore comprises the incremental improvements in 1997, 1998 and 1999. Similarly, the incentive allowance for 2002 is the efficiency gain in 2000 minus efficiency gain in year 1997 (as by 2001 the 1997 saving has already been retained for 5 years), and so on. These incentive payments are made through an addition to the revenue requirement calculated by the regulator. Since there are no costs associated with these payments, the company in question will earn additional profits that will result in a higher rate of return than the cost of capital allowed by the regulator.

For the last year of any review period, no further out performance is assumed to take place at the current review. This assumption is made for purely practical purposes, since actual data for the final year of the regulatory period is not available when the review takes place. Actual incremental out performance in the final year is taken into account at the subsequent review via an offsetting reduction in the first year of the next pricing period. If such an adjustment were not made, the company would retain the benefit of final year efficiency savings for 6 years. The

calculation of incentive payments based on the data in Table 4 is illustrated in Figure 5.

Figure 5: Incremental efficiency gains and allowances



In this first example we have presented there are no periods in which we need to take account of underperformance. However the calculation of incentive payments must be able to deal with situations where companies fail to meet targets, or where savings made in year two are not as great as those made in year two. Such an example is shown in Table 5.

Table 5: A stylised example of the calculation of operating expenditure incentive payments, with underperformance

	1996	1997	1998	1999	2000
Allowed Opex	100	99	98	97	96
Actual Opex	94	93	89	89	88
Efficiency gain	6	6	9	8	8
Incremental gain	6	0	3	-1	0
	2001	**2002**	**2003**	**2004**	**2005**
Incentive allowance	0+3-1=2	3-1=2	-1	0	0
Actual Incentive allowance	2	1	0	0	0

Ofwat's methodology is asymmetric in the sense that the incentive allowances can only be positive, i.e. companies are not required to retain negative incentive payments for five years, as shown in Table 5. However, implied negative incentive allowances will be carried forward to offset future positive allowances within the same regulatory period. Such a provision is likely to be required, otherwise companies would have an incentive to load costs into one year. In the absence of any carryover of negative payments, the company would be able to benefit from beating the regulator's projection in subsequent years, while not being made accountable for the overspend in this initial year.

For example, the incentive payment in 2001 is only 2, as the incremental underperformance in 1999 (i.e. –1) is used to offset the out performance delivered in 1998 (i.e. 3). However, the incentive allowance in 2003 would be set at 0, rather than at –1, since by 2003 only the underperformance in 1999 would feature in the incentive payment calculation. This –1 would be carried forward and would have been used to reduce any positive payments due in 2004. In our example this does not happen as the 2004 payment is zero and cannot become negative.

4.2.2 Ofwat's treatment of capital expenditure efficiency savings

Companies are rewarded for making savings against their capital expenditure budgets through the RAB, even in the absence of any incentive payment. For the years between price controls, prices are set on the basis of an opening value together with a stream of projected capital expenditure figures. If a regulated firm is able to save £1 compared to its projected investment in a given year, then it earns the rate of return plus a depreciation payment on the £1 saved for the years until the next price review. At each review, the RAB and depreciation payments are recalculated on the basis of actual investments, and the benefit of any capital expenditure saving passed through to customers.

Ofwat's incentive mechanisms for capital expenditure also operate through adjustments to the RAB. In order to equalize the incentives for companies to achieve capital expenditure efficiencies throughout the period, the benefit of such savings is retained for at least five years[12]. This is achieved by adjusting the value of the RAB such that it remains consistent with capital expenditure budgets, rather than actual capital expenditures, for at least five years.

Asymmetric treatment of excess capital expenditure

Ofwat treats efficiency gains and losses asymmetrically. Companies that exceed their capital expenditure budget are not compensated for the excess above their budget, either through an incentive payment or through additions to the RAB. The only exception to this is where a company is able to agree, during a price control period, that additional capital expenditure is required and acceptable but that this amount is not so substantial as to force an interim determination. This process is known as "logging up" (down[13]).

[12] The mechanism Ofwat updates the RAB after the sixth year. Depending on when the company makes the efficiency saving, this implies that the benefit is retained for somewhere between 5 years 1 day and 6 years.

[13] Logging down is the process of a company agreeing with the regulator that less capital expenditure is required than had initially been envisaged. This will be reflected by a reduction in the RAB.

Capital expenditure efficiencies and scrutiny of capital expenditure against projections

Ofwat's regulatory regime includes an assessment of outturn capital expenditure against budgets. This process is designed to investigate not only outturn capital expenditure, but also to review the capital expenditure projections made at the last regulatory review. The level at which this investigation is undertaken is not always clear, but separate budgets are not strictly adhered to, providing that total budgets are not breeched, i.e. overspend and under-spend can be offset against one another[14].

We understand that Ofwat's general approach to capital expenditure assessment is that, provided outputs and quality are satisfactory, then any under-spend would be considered an efficiency saving and would lead to an incentive payment[15]. This suggests that Ofgem would not need to undertake detailed scrutiny of capital expenditure plans in order to implement such an incentive mechanism.

We also note that Ofwat is currently reviewing its approach to calculating incentive payments on capital, as it wishes to draw a distinction between payments for out-performance and payments resulting from the timing of capital expenditure. It is not clear in what way Ofwat might modify its mechanism, although this should become clear as the water review proceeds.

4.2.3 Adjustments for unexpected changes in demand

Both the operating and capital expenditure mechanisms implemented by Ofwat are based on companies out performing Ofwat's projections. Insofar as these projections are based on uncertain demand forecasts, it might be argued that incentive payments should be adjusted to account for differences between demand projections and outturn demand.

It might be argued that Ofwat take some account of unexpected changes in demand through the "logging up" process. In contrast, the regulator in Victoria, Australia (whose mechanism we describe in the following section) decided to make no adjustment for differences between expected

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[14] This is not the case for total spending on water treatment and sewerage, which are assessed separately. Overspend in one of these broad areas could not be offset against under-spend in another.

[15] Our understanding is that this general approach does not preclude Ofwat from reviewing capital expenditure for a company on a project by project basis when deciding whether under-spend is considered an efficiency saving.

demand and actual demand. The principal reason for this is that the regulator took the view that any errors would be symmetric and thus, on average, no adjustment would be required. More generally, the regulator in Victoria has indicated that it does not intend to review projections made at the last regulatory review, except where there has been a change in legislation that might have a material impact on the distributors.

In our view, it is not clear that there is sufficient uncertainty in demand projections to require expenditure projections made at the last price control review to be reopened. In addition, reopening projections made at previous price controls would not improve the incentive properties of any mechanism. Indeed, it is possible that such reopening might weaken these incentives, by encouraging companies to commit management resources to arguing why the projections were wrong, rather than just beating these projections.

4.3 Comparison with the incentive mechanism introduced in Victoria, Australia

The Office of the Regulator-General in Victoria has implemented a similar scheme of incentive payments, as outlined in a document dated September 2000[16]. In most respects, this mechanism is very similar to that implemented by Ofwat. We note two differences.

4.3.1 Calculation of incentive payment floors

With regard to the floor of zero on incentive payments, Ofwat maintains completely separate treatment of operating and capital expenditure incentive payments. Hence under performance in one area would not be used to offset over performance in another area, but would instead be capped at zero. In contrast, in determining the overall gain or loss in any one year, the regulator in Victoria considers combined gains or losses calculated for capital expenditure plus operating and maintenance expenditure.

The approach adopted by the regulator in Victoria has some attractions. In principle at least, separate determination of operating and capital expenditure floors might encourage companies to seek savings in only one area, while slacking in the other. Such behaviour might increase profits since the company would receive positive incentive payments in the area out performance, while not being punished with negative incentive payments for areas in the area of under performance.

[16] "Electricity Distribution Price Determination 2001-2005, Volume 1, Statement of purpose and reasons"

4.3.2 Capital expenditure incentive payments

Ofwat make capital expenditure incentive payments through the RAB, implying that the company receives depreciation in addition to return on any capital expenditure efficiency saving (see Section 2.2.2). In contrast, the regulator in Victoria calculates capital expenditure incentive payments as the regulatory WACC multiplied by the difference in that year's capital expenditure compared to the original benchmark forecast. There is no adjustment included for differences in depreciation. The Office of the regulator argued that including an allowance for changes in depreciation would increase the complexity of the carryover mechanism for little overall gain.

Excluding depreciation payments from any incentive mechanism implies that capital efficiency savings made early in a regulatory period are more rewarding for the company, despite the incentive payments, than similar savings made later in the period. This follows because savings made early in the period earn not only a rate of return but also a depreciation payment through the treatment of the RAB until the next review, while savings made late in the period earn incentive payments which exclude the contribution of depreciation.

We favour the approach adopted by Ofwat, in which incentive payments are made through the RAB and the benefit retained by the company is the same regardless of when the efficiency saving is made.

4.4 Incentive mechanisms and the strength of incentives to reduce costs

One common feature of both Ofwat's mechanism and the mechanism implemented by the regulator in Victoria is the decision to choose to allow the companies to retain the benefit of any saving for 5 years, regardless of the year in which a saving is made. While a retention period of 5 years is consistent with the length of the regulatory cycle in each case, there is no reason to suppose that this length of retention period is optimal. Ofgem could set the retention period to be some value other than 5 years, although identifying the optimal length of retention period is not straightforward (as discussed in Section 2.3). However, it would be straightforward to modify a mechanism of this kind so that the retention period could be set to be any length that Ofgem desired.

4.5 Rolling or smoothed adjustments

The incentive payments implemented by both Ofwat and the regulator in Victoria both yield rolling incentive payments that adjust from year to year. As a result, prices charged to customers are unlikely to follow a smooth path, but might jump from year to year. If this was felt to be an undesirable property then a smooth path of prices could be delivered by smoothing the incentive payments over a given regulatory period. The calculations to achieve this are straightforward, based on calculating the smooth stream of payments that has the same present value as the sequence of rolling payments.

4.6 Conclusions and recommendations

- Periodicity is a problem inherent in most regulatory regimes, introduced by periodic scrutiny of costs and resetting of prices.
- Periodicity offers companies incentives to time their efficiency savings to maximise profits from the regulatory cycle, rather than making savings as soon as possible.
- Periodicity can therefore lead to inefficiency.
- The mechanism introduced by Ofwat to eliminate periodicity is sensible and could be adopted by Ofgem.
- Ofgem should consider whether to introduce separate or combined floors on operating and capital expenditure incentive payments. While the effect is unlikely to be substantive, we favour the approach adopted by the regulator in Victoria, where both operating and capital expenditure performance are combined before a floor is set. We favour Ofwat's calculation of capital expenditure payments, as it is more effective in removing incentives to time efficiency savings than the incentive payments used in Victoria.
- In the absence of firm evidence to the contrary, we suggest that Ofgem should adopt a five-year retention period in any incentive mechanism it might choose to adopt. Ofgem might like to consult more widely on this, or consider whether there is reason to suppose that a longer period might be required.
- Ofgem could modify the schemes introduced by Ofwat such that prices charged to customers are smoothed. Since the calculations involved are straightforward, and the impact is unlikely to be substantive we do not offer a firm recommendation.

5. Regulating cost and quality

In Section 2.6 we set out two generic approaches to providing companies with incentives to deliver quality, based on either marginal or absolute payments. The existing regulatory arrangements for the DNOs already embody schemes of this kind with the existing IIP providing companies with marginal incentives to deliver quality. Similarly, it might be argued that companies already face an absolute incentive scheme as allowing quality to fall below some minimum standard would be likely to prompt a response from the regulator.

In this section we develop the ideas set out in Section 2.6 further, identifying a number of practical measures that Ofgem could adopt to implement these generic approaches. We also include a more detailed discussion of the existing IIP mechanism. Finally, we discuss the progress that Ofgem has made in developing the available data on quality, in addition to outlining how targets for the provision of quality might be set.

5.1 The existing Information and Incentives framework

In April 2002, Ofgem introduced a framework of payments to provide companies with an incentive to deliver quality, as part of its Information and Incentives Project. Specifically, these payments encouraged the delivery of security of supply (defined as the number of interruptions lasting over 3 minutes per 100 customers per year), availability of supply (defined as the number of customer minutes lost per year) and the performance of the companies with regard to answering telephone calls. Up to 1.875% of company revenue was put at risk through this mechanism, comprising 1.25% on the duration of interruptions, 0.5% for the number of interruptions and 0.125% on telephone response.

In practice, the IIP results in a mechanism which is similar in nature to the generic marginal fines/rewards scheme described above in Section 2.6.1, with the addition of a cap and collar on the payments as a result of the cap on the amount of revenue at risk. However, the details of the calculations of the effective incentive payment for each dimension of quality will result in each company being exposed to a different marginal reward. It is unlikely that these incentive payments reflect the social benefit that an additional unit of quality would deliver from company to company.

The IIP represents an important first step towards providing companies clear and transparent incentives to deliver quality. Further work on determining the appropriate level of targets and the appropriate level of the incentive payment (in particular linking these incentive payments to the social costs/benefits of quality) under each dimension of the scheme should improve the effectiveness of this mechanism. Such calibration of the IIP scheme should be possible in the future as Ofgem will have access to better quality data on security and availability of supply (in part through other work undertaken as part of the IIP) and as Ofgem understands how companies have responded to this first set of incentives. A well-calibrated IIP quality mechanism should provide Ofgem with the confidence to increase the incentives on companies to reduce costs, safe in the knowledge that such a mechanism will ensure that companies are financially exposed to the consequences of their decisions on quality.

Furthermore, if this scheme was an addition to a general yardstick mechanism, there would no impact on the risk profile of the companies. For example, since the industry as a whole would earn the regulated rate of return under a yardstick scheme, an industry wide adjustment to the level of costs to account for quality would naturally feed through to prices, ensuring that the industry continued to earn the regulated rate of return[17]. Company specific impacts could therefore be hedged through ownership of a portfolio of shares in all companies in the sector.

5.2 Quality and price controls

The following subsections present some alternative approaches to including quality in a price control framework. We consider a diverse range of mechanisms and discuss the relative merits of each.

5.2.1 Adjusting costs to reflect the value of quality

A simple way of incorporating quality directly into any efficiency analysis would be to adjust costs directly incurred by the business to include the social cost of any interruptions to supply. For example, the number of customer minutes lost could be transformed into a monetary figure based on assessments of the value of interruptions, customer minutes lost, or other valuations of the unsupplied energy, to be added to total company

[17] This assumes that the target level set for quality is appropriate, in that it allows companies to earn the regulated rate of return if all targets (cost and quality) are met. This also assumes that all companies start from a level playing field. Differences in starting position might result in some companies making windfall gains from the introduction of the yardstick, offset by windfall losses for other companies.

costs. The preferred benchmarking model can then be estimated using this adjusted cost base, which factors in the social cost of poor quality. Of course, this approach would require an estimate of the social cost/benefit of quality, in common with any well-calibrated quality regime.

This approach overcomes the technical difficulties of attempting to include quality variables directly into a DEA or econometric model, but does require an estimate of the value of lost load to be determined. Nevertheless, such an approach is simple and transparent, and we believe it has a number of attractions.

This model also has an interesting regulatory interpretation. If the regulator assesses efficiency on the basis of this adjusted cost base, then the regulator should also set targets on the same basis. This implies that regulatory performance targets could be met either by reducing costs while holding quality constant, or increasing quality while holding costs constant, or through some combination of cost cutting and improved quality. In principle, this kind of regulatory process leaves the decision up to the firm, implying that the firm will naturally choose the easiest (i.e. the most efficient) way to meet the target. We would expect behaviour under this kind of mechanism to be the same as under a well-calibrated IIP style mechanism.

5.2.2 Including quality in a two stage efficiency analysis

Another approach is to combine econometric and DEA modelling in a two-stage efficiency analysis. In the first stage the efficiency scores are estimated from a DEA model, which does not include a quality measure. The second stage of the analysis regresses the DEA scores obtained in the first stage on the quality "bad" measure (e.g. minutes lost, number of interruptions). One then obtains the fitted values from this regression as new efficiency scores. Care has to be taken with the estimation method because the dependent variable is limited in range (i.e. bounded above by 100%). A further difficulty arises in the differing assumptions about the distribution of the efficiency scores implied by the different models used. Finally, this kind of approach can be difficult to implement when there is only a small sample of firms.

5.2.3 Firm-specific operational modelling

There are other approaches to defining the cost-quality relationship. The most intrusive would be to require significant amounts of company data in order to establish directly the marginal cost of quality. For example, Ofwat devoted significant time and effort to calculating LRMC in the water industry throughout the 1990s. The approach had the drawback

that it required the companies to calculate their own LRMCs. This led to a wide range of estimates, the spread perhaps having less to do with the underlying cost fundamentals than with a desire to justify the prevailing tariff structure. We would not recommend that Ofgem pursues a similar strategy. By the same token, it may be difficult separately to identify investment that is intended to enhance quality from that which is not, and the data received by companies would need to be subjected to intense scrutiny.

5.2.4 Exogenous operational modelling

The increasing use of Long Run Incremental Cost (LRIC) modelling to inform access prices in industries such as telecommunications raises the prospect of whether this type of approach could be more generally applied. The typical LRIC approach involves the construction of a reduced form network that has the same capability as the real one under regulatory scrutiny, in order explicitly to calculate the long run incremental costs of providing different services for the purpose of defining access prices in vertically integrated businesses.

Ofgem could develop the LRIC model approach. Reduced form analogues of each network could be constructed from engineering data to calculate the relationship between cost and quality for each network operator. We understand that other European regulators are investigating approaches of this kind. This kind of modelling can provide an estimate of the cost of an optimally configured reduced model of each network. This cost figure is related to the difficulty, or complexity, of delivering services for each region and can therefore be regarded as a basis for efficiency analysis.

We believe that this approach is worthy of consideration. In particular, this kind of approach can account for all the factors that individual companies claim are unique to themselves, which is often a tactic simply to discredit the modelling. Furthermore, it can be used in small samples. Finally, we note that this kind of modelling is broadly consistent with Ofgem's approach to the comparison of quality across companies.

5.2.5 Rewarding frontier performance

Firms could be given incentives to improve their quality through a scheme that rewards companies for reaching the frontier of performance on quality. Ofgem has signalled its intent to implement a system that rewards frontier performance at the next DPCR.

Rewarding frontier performance stimulates innovation that benefits all customers, not just the customers of the local network. However, this scheme needs to be designed with care to avoid introducing perverse incentives. Consider a case where there are two regulated firms and a single "prize" is given to the one with the highest quality. The two firms are therefore in a race: it does not matter to a firm how high the quality level is, only that it is a bit higher than its rival's.

Two conclusions which emerge from the economic literature on 'races' of this type are that:

- there may be excessive effort (quality improvement) in a race in which the two firms start from the same point because they each need only make a little more effort to win the whole prize; and

- there may be very little effort by either firm if the starting points differ, because they recognise this danger of excessive effort and those least likely to win simply opt out of the race.

A race, leading to a prize, could result in continuous excessive gold-plating or to a race to the bottom, in which most firms simply decide that they will not receive the prize and follow the alternative strategy of minimising costs. Relative payments schemes require very careful design, since behaviour under such regimes is highly sensitive to that design.

5.3 Measures of quality

Mechanisms that provide companies with incentives to provide a reasonable level of quality of supply can only be effective if there is robust data on which they can be based. Yet the measurement of quality is not straightforward. The regulator must be sure that the variables on which any incentive mechanism will be based accurately reflect the aspects of quality about which customers care. Furthermore, the regulator might need to take account of measurement error and will also need to adjust incentive payments and targets for factors beyond the control of the company (e.g. the weather and other aspects of any differences in the operating environments faced by the companies).

Ofgem has already made some progress in this area, through the ongoing development of a model for comparing DNOs' quality of supply performance and through the information gathering and auditing aspects of the IIP. Over time, this should enable Ofgem to calibrate the existing quality incentive framework and perhaps lend it more weight (by, for example, exposing more company revenue to the mechanism). In addition to this, Ofgem should ensure that the variables on which any

incentive mechanism is based (primarily Customer Interruptions and Customer Minutes Lost and telephone response) accurately reflect the dimensions of quality about which customers care. Specifically, if there are additional areas of service that are valued by customers, these should be measured (or a proxy found) and included in the incentive mechanism. Otherwise, companies will have no financial incentive to deliver on these dimensions of quality.

5.4 Setting a target level for quality of supply in marginal payment schemes

The final element of any marginal incentive mechanism for the provision of quality is setting a target level.

Under an IIP style mechanism the level at which targets are set does not alter the incentive properties of the regime, at least if we assume that rewards for over performance are equal to fines for underperformance. In this case, providing an additional unit of quality delivers the same net benefit (either a marginal reward payment or an equivalent avoided fine) to the company, implying that, in theory at least, the company will not be influenced by whether it is being fined or rewarded, but only by the marginal payment.

However, the target level will clearly have an impact on the profitability of the company. While a harsh target will not influence the level of quality a company might choose to deliver (unless the payments depend directly upon the gap between actual and target performance), it is likely to result in the company receiving regular fines under the quality incentive mechanism, which will lower the rate of return of the company. Similarly, setting a soft target will provide companies with excess returns. The choice of target level therefore has no impact on the strength of incentives a company might face, but on the distribution of benefits between consumers and the industry. Ofgem should find it easier to set reasonable targets for quality as more data on quality becomes available, and as Ofgem learns from the response of the companies to the first period of the IIP incentive mechanism.

One way in which the setting of targets might influence company behaviour is if companies know that future targets for quality will be set on the basis of past performance. If this is the case, companies will face incentives to hold back quality improvements that they might be able to make now. While this will forego some profits in the short run, it will ensure that a softer target is set for the following period, which will allow greater out performance in the future. Rational companies would

therefore make savings at a rate that maximises the net present value of their marginal payments.

This discussion is analogous to the discussion in parts of Section 2, with quality replacing cost as the companies decision variables. We can therefore reach similar conclusions. Allowing companies to retain all the benefit of a quality improvement (i.e. never updating the target level) will deliver the efficient level of quality at the appropriate time, but will be costly to consumers. Passing some of those benefits through to consumers (equivalent to updating quality targets as performance improves) will reduce the speed at which companies make quality improvements (as they face weaker incentives as they no longer retain the full benefit of any improvement), but will be less costly for customers. As explained in section 2.4.2, benchmarking can improve this trade-off. There will be some updating schedule for quality targets that is optimal, in the sense that the path of cost and quality selected by companies and delivered to customers provides the greatest net present benefit to customers. In practice, this period will be difficult to identify, although Ofgem will be better placed to make such a judgement as more data becomes available and as company responses to the existing IIP incentive mechanism are understood.

5.5 Summary and recommendations

- At present the capital expenditure allowance in the main price control is the most obvious driver of quality, with the IIP providing some additional incentives at the margin. In the future the IIP and the main price control will be better coordinated and calibrated to provide companies with clear incentives to achieve an appropriate level of quality.

- In principle the level at which quality targets are set will not influence the companies behaviour, although it will affect the rate of return they earn. However, if targets are updated in line with company performance then companies will make less quality improvements than they would if targets were never updated. Ofgem will be better placed to decide how frequently quality targets should be updated as more data becomes available.

- The quality variables on which the performance of the DNOs is currently measured are the number and duration of interruptions and telephone response. Ofgem should review whether these are the appropriate variables on which to continue setting quality targets or whether there are other/additional variables that could be used. In any event, there may be difficulties with the measurement of quality

which might make it difficult to set targets and/or incentives in a mechanistic way.

- The Asset Risk Management Survey (ARM) could provide a rich source of information on which to assess companies' performance, in particular with regard to quality. However, ARM contains many questions and it is not clear which areas might be the key drivers of efficient asset management. Selecting which variables to use in any assessment will not therefore be straightforward, nor is it clear that simply using an average score is appropriate. Similarly, there is no reason to believe that a score of 5 (on a scale from 1 to 5) is necessarily the most efficient policy. In some instances a lower score might be the most cost effective policy. Possible use of ARM data in assessing company performance should inform its future development.

Annex 1

Common criticisms of yardstick competition

Annex 1: Common criticisms of yardstick competition

Inadequate modelling and/or environmental factors make companies incomparable.

If the regulator is unable, for whatever reason, to accurately measure the relative performance of the companies, then explainable differences in performance might be erroneously identified as differences in relative efficiency. This can lead to an incorrectly determined yardstick providing companies with either windfall gains or windfall loses.

While this criticism is a real concern, it is a concern for any regulatory regime in which there is some degree of comparison. This is best addressed through robust modelling, employing a range of techniques and model specifications. Taking account of the operating environments of the companies (e.g. population density/sparsity) is likely to be important in network industries and robust techniques are required to ensure that any such differences between companies are understood and reflected in any efficiency analysis.

Most problems of comparability that could arise do so in identifying whether the level of costs is relatively efficient. If in fact companies are not comparable, so that there is no compelling evidence of different levels of efficiency, then a yardstick regime can be implemented from prevailing price levels. This can be achieved by setting companies similar or identical productivity growth targets, providing a clear signal to beat the average rate of productivity improvement and thereby retaining the incentive properties of the regime.

The regulator will be unable to commit to letting a company that is a persistent poor performer go out of business (i.e. no bailouts).

A commonly held view of yardstick competition is that it implies that some companies must make returns below the regulated rate of return. If such firms are persistent poor performers, these companies might run into financial distress and might even become insolvent. However, if the regulator commits to bail such companies out, then this would weaken the incentive properties of the yardstick regime, by signalling to companies that poor performing companies would not face any consequences for their poor performance.

This problem requires the regulator to simultaneously demonstrate commitment to the yardstick regime, whilst at the same time signalling sufficient discretion to be able to change the parameters of the regime if, with the benefit of hindsight, they have been inappropriately applied. A regime in which companies fail may not add to its credibility; but on the other hand, changing the regime to assure no business failure is not credible either. A delicate balance needs to be established that will require effective information gathering and monitoring to ensure the ongoing legitimacy of the process.

As well as these institutional characteristics the parameterisation of the regime can ensure the appropriate balance of risks and uncertainty is maintained. For example, the price regime could be based partly on the yardstick and partly on a company's own costs. Alternatively, the yardstick could be modified to reduce or eliminate the risk of a company experiencing financial difficulties. In the examples given above, where we have calculated the incentive power of a yardstick regime, we have set the yardstick on the basis of average company performance. This implies that companies able to reduce their costs at a faster rate than the industry average will make excess returns, while those unable to match the average will make returns below the regulated cost of capital. Under this kind of yardstick regime, it is quite possible for some companies to persistently make low returns and potentially run into financial difficulties. However there is no reason why the industry average need be set as the yardstick.

Suppose we set the yardstick on the basis of the average performance of the two worst performing firms. For all firms except the two setting the yardstick, the full benefit of any saving is retained since movements in own costs do not affect prices at all. The regime has a power of 100% for those firms. For the two firms setting the yardstick, the power of this regime is the same as the two firm example given above, implying that both of these firms also face high powered incentives. But under this regime we have almost every firm (i.e. all firms except the very worst performing company) making persistent excess profits. This demonstrates that yardstick competition does not need to be associated with low rates of return. The choice of yardstick is therefore linked to the distribution of benefits rather than the incentive power of the mechanism, in contrast to the other levers by which incentive power might be increased (e.g. retention period)[18]. As such, if pre-commitment was thought to be a problem, the yardstick could be designed to overcome this difficulty.

[18] Conversely, as an aside, suppose we set prices on the average performance of two best performing firms. For the two best performing firms, the incentive power is the same as the two firm example above. In this example, we would expect the best performing firm to make small excess returns, and all other firms to make a rate of return below the regulated level. This is an example of a regime with high incentive power and low profitability for the companies.

Yardstick competition implies expropriation of value from poorly performing companies.

This has been addressed in the discussion regarding regulatory commitment.

In practice there is the possibility of collusion between companies to frustrate any yardstick.

If a yardstick was applied to a small group of firms there is, at least in principle, the possibility of collusion between the firms. Such collusion would take the form of a commitment not to pursue efficiency savings, thereby ensuring that no company drives down the prices of its competitors. As a result, all companies would make approximately the same (regulated) rate of return and the productivity of the industry as a whole would suffer, while the managers of these firms would enjoy the benefit of a quiet life.

We note that this form of collusion would only benefit the managers of the companies and certainly not its shareholders. Shareholders, just like the regulator, would have a strong incentive to offer managers contracts that provided them with incentives to pursue additional profits, rather than engage in collusion of this kind. Even if the number of independent groups operating DNOs became very small, it is still reasonable to expect shareholders to exert pressure on the managers of companies not to enter into tacit agreements not to pursue cost reductions.

Assessment of this criticism should be centred on an assessment of how many competitors might be required to ensure that such collusion is difficult to coordinate. The larger the number of firms, the more difficult such co-ordination becomes. Furthermore, the regulator can design the regime in such a way as to frustrate attempts at collusion. In the example where the yardstick is set on the basis of the average performance of the worst two performing companies, these two companies could be given strong incentives not to collude by having their prices set at this level less 5%. All other companies then have strong incentives to make efficiency improvements (as before) and have little to gain from colluding, while the two yardstick setting companies stand to gain significantly if they can overtake the third worst performing company. Careful design of the yardstick can help to reduce or eliminate the scope for collusion.

Annex 2

Ofwat's approach to benchmarking

Annex 2: Ofwat's approach to benchmarking

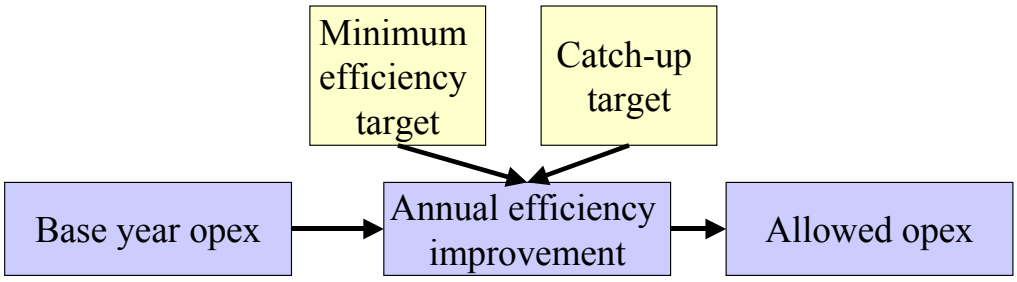
Treatment of operating expenditure

Each of the companies regulated by Ofwat is given an efficiency target for their operating expenditure. This has two components:

- a minimum efficiency target for every company regardless of their current efficiency; and
- an additional target for the less efficient companies for catching up with the most efficient ones.

Figure 6 shows the way in which these components feed into the allowed operating expenditure for the companies. The minimum efficiency target and the catch-up target together determine the annual efficiency improvement that each company must achieve on their operating expenditure. The efficiency improvement is applied to base year operating expenditure to determine the allowed operating expenditure for the company over the next price control period.

Figure 6: Ofwat's determination of allowed opex



All companies, including the most efficient, were assumed by the regulator in the 1999 price control review to be able to make a minimum efficiency saving of 1.4% per annum over 2000-05.

In addition to this minimum saving, a catch up target was derived for the less efficient companies, using an econometric model. The model explained each company's operating expenditure over the previous price control period using a number of explanatory variables. In theory, the

difference between actual and predicted expenditure will reflect inefficiency and other unexplained factors.

The output of the model was a 'frontier' company that was the most efficient company relative to its comparators. The less efficient companies were required to catch up with the frontier company. In the price control review of 1999, for example, the less efficient companies were required by the regulator to remove 60% of the gap between them and the most efficient companies over the five year price control period. These required savings were evenly profiled over the period.

Prior to these targets being set, companies were given the opportunity to explain to the regulator their efficiency performance relative to their comparators. In the 1999 price control review companies used factors such as the high labour costs in London and the surrounding area and the special water treatment costs for areas with hard water to justify their apparent inefficiency. The regulator was then able to reach a judgement as to whether to adjust that company's allowed operating expenditure in response to the issues raised by each company.

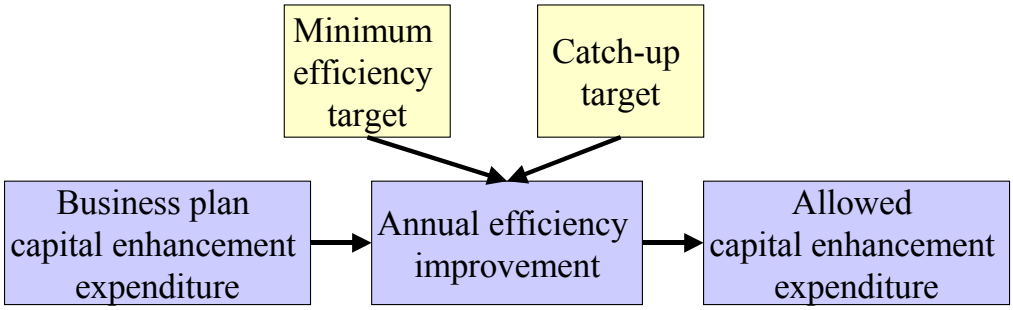
Treatment of capital enhancement expenditure

The efficiency savings that the regulator required companies to make with compared to their business plan capital enhancement expenditure in the 1999 review took the following form:

- all companies were required to increase efficiency by 2.1% per annum; and
- inefficient companies were also required to close 75% of the efficiency gap with the 'frontier' company from the first year of the control.

Figure 7 shows how these two components are combined to determine allowed capital enhancement expenditure.

Figure 7: Ofwat's determination of allowed capital enhancement expenditure



The allowed capital enhancement expenditure of the regulated companies is derived using the 'cost base'. The cost base is derived from cost estimates for each of 100 generic tasks, with each company submitting a cost for each task. Similarly, each company must also submit a cost estimates for its total capital expenditure plan over the next price control period.

The cost estimates for the capital enhancement programmes are scrutinized by the company reporters[19] who assess the company's approach to risk, consideration of alternative approaches, technological innovations and the consistency of their estimates of the cost of a generic task and that of their overall capital enhancement programmes. The regulator used the specimen project cost estimates to compare the efficiency of each company and then to set each company's efficiency target.

The efficiency target for the less efficient companies was set equal to the most efficient company in the industry in 1999. The companies were required to remove 75% of the gap between their company and the 'frontier' company in the first year of the price control[20].

[19] The company reporters are independent professionals appointed by each company with Ofwat's approval. They scrutinise the company's business and report to the Director General on the reliability and accuracy of company information and any concerns they have.

[20] The Competition Commission criticised this requirement and allowed the two small companies regulated by Ofwat to catch up over the first three years instead of over the first year.

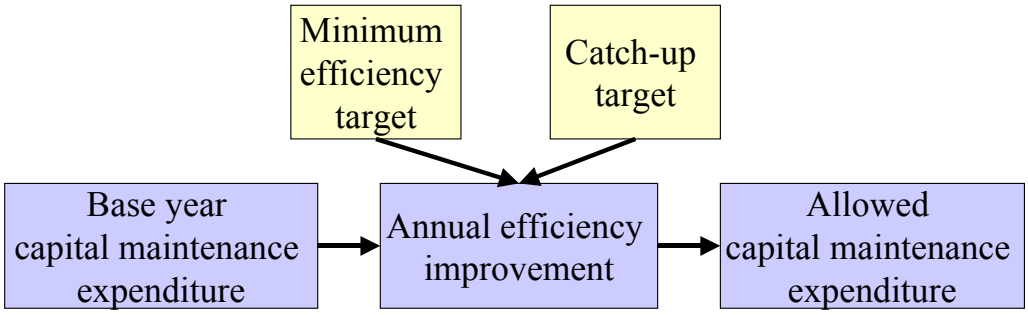
Treatment of capital maintenance expenditure

The required savings companies should make with respect to their capital maintenance expenditure, at the 1999 price review took the following form:

- a minimum efficiency saving of 1.4% per annum for all companies; and
- a catch-up efficiency target per annum for all those but the most efficient companies.

Figure 8 shows how these components determine the allowed expenditure on capital maintenance for the companies, which is very similar to the way in which allowed operating expenditure is determined.

Figure 8: Ofwat's determination of allowed capital maintenance expenditure



The catch-up efficiency target for capital maintenance was based on both an econometric model and on a comparison of capital unit costs from the cost base submissions (described above) made by companies. The two different measures capture different elements of efficiency. The cost base aims to assess the relative efficiency in procurement and implementation of capital projects. The econometric models, in addition, provide an overall indication of efficiency in carrying out the right capital maintenance activity, at the right cost, on the right assets, at the right time.

The profile of the efficiency savings was not even over the price control period. In the 1999 price control review, the regulator required the less efficient companies to catch-up 50% of the gap with the most efficient companies in the first year of the price control.

Annex 3

Implementing a capital stock approach

Annex 3: Implementing a capital stock approach

In this annex we focus on capital stock style measure of capital cost and discuss the largely mechanical details of how such an approach can be implemented. Under this approach there are a range of detailed questions that the regulator should seek to answer. We address each of these in turn.

Opening capital stock

Since the capital stock approach relies on having data for all assets that are not fully depreciated[21], a measure of current capital consumption can only be calculated if information on assets of all relevant ages is included.

A detailed calculation would require the regulator to collect data on gross annual investments by asset class (where assets have different depreciation lifetimes) for a number of years equal to the assumed asset lifetime. Armed with this data the regulator could then calculate the capital stock together with the associated annual capital consumption for any year. Clearly, this is a data intensive approach and it is quite possible that all the relevant data is simply not available.

Where such detailed historical investment data is not available, the regulator could instead make an assumption of the assets in place at a given point in time. Where very little data is available, estimates can be made based on only two of a gross asset value, a net (of depreciation) asset value or an assumed average asset life remaining. Armed with this information the regulator can infer an underlying investment profile from which to make the required calculations. The robustness of such estimates is difficult to assess since, by definition, this approach is usually adopted precisely because detailed data are not available. However, we can be sure that the investment profiles derived from this approach are consistent with the assumptions made by the regulator with regard to asset lives etc, and also with the data which can be observed. Sensitivity analysis could be conducted to assess the robustness of such estimates.

[21] We discuss approaches in which some older assets are excluded from total cost calculations in Section 3.3.3.

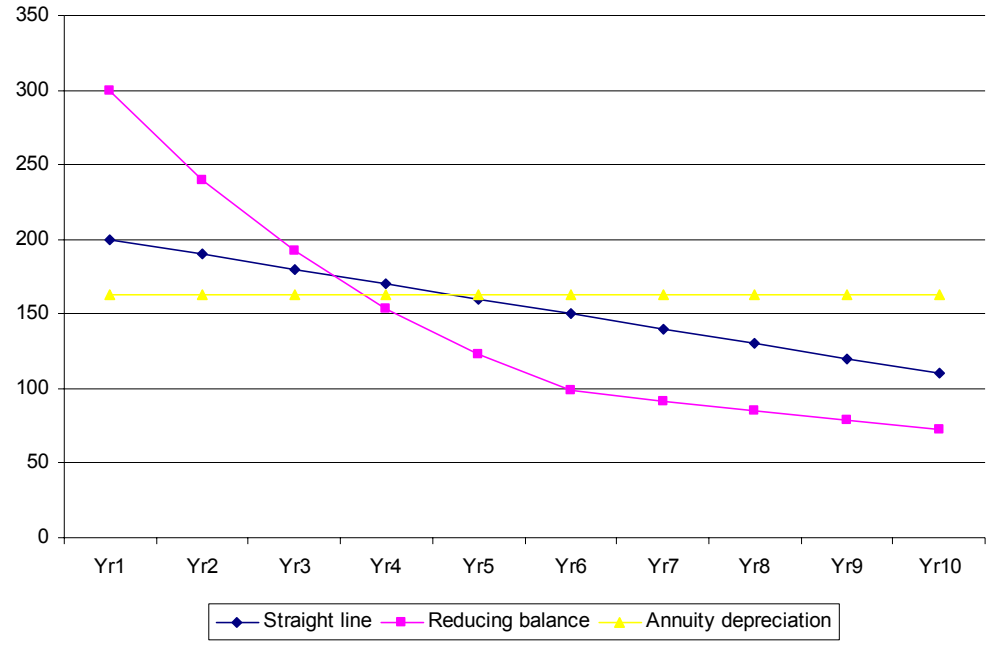
Depreciation methodology

While the resulting estimate of annual capital consumption will vary according to the choice of depreciation methodology, the choice of depreciation methodology is unlikely to substantively change the relativities between companies[22]. Given this, the selection of any reasonable depreciation methodology is likely to be acceptable.

The three most commonly used depreciation methodologies are straight-line, reducing balance and annuity. Under straight-line depreciation, an equal proportion of the gross value of the asset is written off in each year. Reducing balance depreciation is similar, but involves writing off a fixed percentage of the net value in each year (switching over to straight-line deprecation in some future year). Reducing balance therefore front end loads depreciation costs, making it appropriate for assets where repair and maintenance costs increase as the asset ages, keeping total usage costs reasonably constant over time. Finally there is annuity depreciation, where depreciation is set such that total payments to capital (depreciation plus return on net value) is kept constant in each year. This is similar in principle to an annuity, where a lump sum is returned over a number of periods through a series of constant payments. Annuity depreciation therefore loads more depreciation into the end of an assets life, compared to the alternative methodologies. These three approaches to depreciation are illustrated in Figure 9 for a single investment.

[22] Unless there are substantial differences between the investment cycles of different companies. For example, if one company had very new assets while a comparator had very old assets then a methodology which front-end loads depreciation would make the company with new assets look relatively inefficient.

Figure 9: Comparison of the annual capital consumption streams associated with different depreciation methodologies



Note: Based on a single investment of 1,000, with an assumed lifetime of 10 years and a cost of capital of 10%. Reducing balance calculations based on a write down of 20% of net value in each year.

Assumed asset lifetime

The choice of assumed asset lifetime will determine the number of different vintages of assets that must be included in asset value calculations. While a small change in assumed lifetime is unlikely to have a substantial impact on the calculated level of annual capital consumption, it is important to ensure that the assumed lifetime is broadly consistent with the actual technical lifetime. If this is not the case then the cost measures calculated and hence the efficiency analysis based on these measures will not include the appropriate set of assets, i.e. the set of all productive assets.

Break down of assets

If the regulator intends to construct a standardised asset value then having more detailed asset information available will enable the regulator to construct more accurate estimates of capital consumption. However, a highly detailed breakdown of assets implies the collection of a

considerable body of data (which might not even be available), requiring effort from both the regulator and the companies. It is the trade off between these two concerns which should govern the level of disaggregation at which asset data are collected.

A detailed breakdown of assets is important where different classes of assets have significantly different lifetimes. However, even this distinction is unlikely to be relevant unless the size of investments in these different asset types is substantive.

Assumed return on capital

Annual capital consumption includes a return on capital. We have discussed above how a capital stock can be estimated. To calculate a return on capital requires an estimate of a reasonable rate of return. Fortunately, the regulator requires such an estimate in any event, and the estimate made for other regulatory purposes is ideal for use in capital consumption calculations.

Summary of technical considerations

We have set out the calculations involved in estimating a measure of total cost. A cash cost approach could be adopted, which has the benefit of simplicity, or an arguably more realistic capital stock approach could be followed. Under a capital stock approach, the regulator would have to collect more data, identify a split of asset types make an assumption about the lifetime for each asset type and must select a depreciation methodology.