

Appendix 5

Incentives

A paper by Frontier Economics

1. Price controls and incentives

- 1 What has come to be termed price cap, or RPI - X, regulation has been used in the UK since British Telecom was privatised in 1984. It has been extended to electricity and water, airports, and rail.
- 2 Price cap regulation is usually associated with high incentives for cost reduction, in contrast to rate-of-return, which has weak incentive properties. However, the UK experience of price cap regulation is that the incentive properties of regulatory regimes vary significantly, both within an industry over time, and across industries. For example, all of the following are examples of price cap regulation:
 - The first NGC price review (1992), extending to a 4-page press release, which moved the X factor from 0 to 3 per cent without returning previous efficiency gains to customers.
 - The second NGC price review in 1997, extending to four consultation documents and a final decision document, involving financial modelling, benchmarking, the derivation of a regulatory asset base and a decision rule for returning past efficiency gains to customers. This resulted in a one-off price cut of 20 per cent, followed by an annual X factor of 4 per cent.
 - The first electricity distribution price review in 1994, which developed the concept of a rate of return on a regulatory asset base, and made use of limited benchmarking, followed by the second electricity distribution price review in 1995, which re-opened the first review because of concern that the regime would encourage excess profitability.
 - The price control regime applied to the water industry, which embodied fixed price caps for five year periods, but allowed for interim price adjustments if certain unforeseen events occurred and also saw the regulator pressing companies for within-period rebates to customers when profits rose sharply.
 - The first gas price control review undertaken by Ofgas in 1992 and, on appeal, the MMC in 1993, which did not explicitly return significant past efficiency gains to customers, and which also specified a specific method for valuing and depreciating assets. The second gas review undertaken by Ofgas in 1996 and, on appeal, the MMC in 1997, which explicitly

returned significant past efficiency gains to customers through a one-off price cut, and which specified a different method for valuing and depreciating assets.

- 3 The significance of this varied history is that the phrase "price cap regulation" is inadequate to describe the different approaches that regulators have taken to their task and hence the different incentive properties of their respective regimes. Even under rate of return regulation, the price is capped to achieve regulatory objectives. In order to analyse the properties of particular regimes it is important to define the incentive power of the regime more precisely.

Why use incentives?

- 4 Incentives are typically required where an individual is interested in achieving a particular outcome, but is unable to perform directly the necessary actions himself that are required to obtain those outcomes. Shareholders in a company, for example, are interested in maximising the value of their investments. However, they rely on the management and employees of the company to perform the tasks necessary to achieve his goal. Management and employees will be keen to ensure that the firm makes profits, but will also have other objectives, such as their remuneration, the effort they have to put into the job, the opportunity to create personal empires, and so on. It is difficult for the shareholder both to monitor the behaviour of the management, and to assess whether performance and profitability are due to management behaviour, or the consequence of unforeseen events.
- 5 If shareholders wish to ensure that employees maximise profit on their behalf, they have a choice. They can meticulously scrutinise every detail of the business, or they can try to align the incentives of management and employees with their own. The latter is the only realistic option in almost all cases, and incentive schemes that allow management and employees a share of the profits are commonplace.
- 6 The regulator of a monopoly business is in a similar position. To protect customers' interests he will be keen to push prices down to the lowest possible level, while still covering the costs of the business. However, the regulator does not know whether the efficient level of costs at which he can set the lowest prices is 10 per cent or 50 per cent below the current level. The fundamental problem faced by the regulator is that of not having complete information on the efficient level of costs.

- 7 The regulator could try to obtain as much information as possible to try to obtain a better estimate of the efficient cost level. It is not clear to us, however, that such effort is always well spent. Instead, the regulator could create a set of incentives so that the firm reveals, over time, the efficient level of costs. To do this, the regulator must have a clear set of objectives, and must understand the objectives of the regulated company, in order that incentives can be credibly created that align their interests.

The company's objectives

- 8 The simplest theoretical models in economics - of firms single-mindedly pursuing profit - cannot give much guidance as to the appropriate level of incentives that a regulator should apply. If a firm is a pure profit-maximiser, then even small incentive payments should induce all possible cost reductions. Larger incentives are needed, however, because cost reductions are not "free". Sometimes cash costs are incurred - investment to replace ongoing costs or redundancy payments for staff, for example. More significantly, firms are generally not run directly by shareholders but by managers who have to be creative and work hard to make cost reductions. Economic theories of the "managerial firm" typically regard managers as pursuing a balance of shareholder objectives (profit) and personal objectives, especially the objective of avoiding "effort". This implies that larger incentives are needed to produce larger cost reductions.

The regulator's objectives

- 9 Regulators have duties defined in various Acts, covering economic issues and additional responsibilities such as social and environmental protection. Throughout this paper, we have assumed that regulators are motivated by a desire to maximise consumer welfare in the long term. This could be defined, for example, as a goal of minimising the present value of prices to customers (or, when we discuss quality, optimising the price/quality trade-off).
- 10 The key to understanding the dilemma faced by regulators in setting incentives is to understand that two types of efficiency, known as productive and allocative efficiency (see Appendix 3), can conflict. A price that is fixed forever would promote productive efficiency (because the firm would have strong incentives to reduce costs) at the expense of allocative efficiency (because prices would never fall to reflect costs). On the other hand, if the regulator simply aimed to maximise allocative efficiency by trying to match price to marginal cost at all times, then no productive efficiency gains would ever be made because the firm would have no incentive to reduce its costs.

Expectations and commitment

- 11 Network regulators deal with industries that make long term decisions. For example, electricity network assets typically last for 40 years and the main water and rail assets last even longer. This distant horizon may constrain regulators in their choice of regulatory policy because it is effectively impossible to commit themselves for such a long period of time.
- 12 This raises the issue of "commitment". By commitment, we mean that a regulator commits to an action in the future that, when that time arises, he or she would prefer not to take. It is easy, and meaningless, to commit to do things that one will want to do anyway when the time comes. Commitment only has value when it results in actions that the regulator perceives as being in his long term interests but likely to be against his immediate interest when the action is to be taken. The surprising result from game theory is that an agent can benefit by limiting his or her freedom of action.
- 13 Regulators can commit to certain actions to increase the credibility of the incentive signals they send. For example, a regulator could effectively commit to holding prices at pre-agreed levels for a pre-specified period of time and not to reduce prices the moment a company reduces its costs, in order to give companies the incentive to improve efficiency. Similarly, regulators commit not to write off the value of companies' assets arbitrarily.
- 14 Another example is commitment to a tough price control. Suppose that a regulator is concerned not to drive firms into bankruptcy. If inefficient, managerial, firms are aware of this they have little incentive to meet any tough price controls the regulator might impose. They would be aware that the regulator would re-open the price control to bail the company out, if the result of not doing so would be bankruptcy. If, however, the regulator were able to commit not to re-open the price control, the firm's managers would not have this option and could reduce costs instead.

2. Measuring incentive power and the quality of incentives

- 15 The choice of incentive power in a regulatory regime often implies a trade-off between immediate and longer-term benefits for customers. Throughout this paper, we attempt to illustrate incentive effects in two ways: through a simple measure of the power of the incentive regime and through an illustrative spreadsheet model. We discuss each in turn in this section.

Incentive power

- 16 We define the power of the incentive regime as the proportion of the present value of cost savings retained by the firm. If a firm reduces annual operating expenditure by £1 million annually, then the value of that cost saving, over the indefinite future, is £1 million divided by the discount rate ($=1/0.07$ at a 7 per cent discount rate⁸², = £14.3 million). This value would be retained as a benefit to the firm if prices were left unchanged. In this case, the power of the regime would be 100 per cent. Similarly, if the £1m cost saving were immediately passed through, in full, as price cuts then prices would be lower (by £1m per year) and customers would receive the full £14.3 million value. The power of the regime would be zero.
- 17 If the firm retained the benefits for five years and then passed it through to customers in a price cut, the firm would receive the present value of £1m annually for five years followed by nothing, the customers would receive nothing for five years, then £1m annually forever. At 7 per cent, the present values of these benefits are £4.2m for the firm and £10.1m (the remainder) for customers. The incentive power of this regime is therefore $4.2/14.3 = 29$ per cent.
- 18 For comparison, the incentive power of a perfectly competitive market is 100 per cent, but the implications for prices are quite different. The profits of a firm making a £1m annual cost saving will be £1m higher than they would otherwise have been, forever. However, this does not imply that that firm will make high profits forever because its competitors can be expected to match its cost reductions and competition will result in a general price fall to the point that "normal" profits are restored⁸³. It is also worth re-iterating the point made in the previous section that the highest-powered approach to RPI - X, giving the firm 100 per cent of any cost saving forever, provides customers with no benefits at all.

The quality of incentives

- 19 By quality of incentives, we mean incentives that do not:
- distort the timing of efficiency gains;
 - artificially encourage the use of one input over another; or
 - artificially encourage too much or too little production of a particular output.

A simple spreadsheet model

- 20 Throughout this report we illustrate our discussion, where possible, with a spreadsheet model of a hypothetical network industry. This model illustrates differences between different regulatory approaches and the impact of different variables upon the incentive properties of those approaches.
- 21 The model has the following characteristics:

We assume no **price inflation** or increases in **physical outputs** (kWh, water distributed and so on)⁸⁴.

Costs: we assume that the firm is initially in a steady-state. Annual opex is 100, annual capex is 25, asset life is 40 years. The regulatory asset base (RAB) is constant at 1000 and there is straight-line depreciation. Capital costs are calculated as depreciation plus a 7 per cent return on the mid-year average of the RAB.

Quality outputs assumed to be driven by a combination of asset value, operating expenditure and random events.

Allowed revenue set by the regulator at periodic intervals. Since volumes are assumed constant, revenue is equivalent to prices.

Economic Profit calculated as revenue minus total costs.

An **effort function**, representing the effort the firm's managers have to make to reduce costs or increase quality. Without such a function, even no incentives should produce optimal behaviour⁸⁵.

An **objective function** for the firm, consisting of a weighted average of profit and managerial effort. The weighting reflects the degree to which the firm is "managerial" or "profit-oriented".

The base case

- 22 The base case assumes a 5 year price control period. The main result is that the price cap encourages the firm to reduce costs, because it can enjoy the resulting profits for up to 5 years. However, the timing of efficiency gains is driven by the regulatory cycle - since the firm makes the greatest profits from efficiencies early in the period, it concentrates its productivity improvements in the first year.

⁸² In calculating incentive powers we always use a discount rate (for firms, the regulator and customers) of 7%. This is simply for convenience.

⁸³ We return to this point when we discuss yardstick competition in Section 3, since that regime also involves high-powered regulation without resulting in high prices to customers.

⁸⁴ Assumptions about how physical outputs will increase and how this increase is reflected in regulatory decisions can have incentive effects, but we do not deal with this issue here.

⁸⁵ See our discussion of the managerial firm, in Section 1.

Spreadsheet model - base case

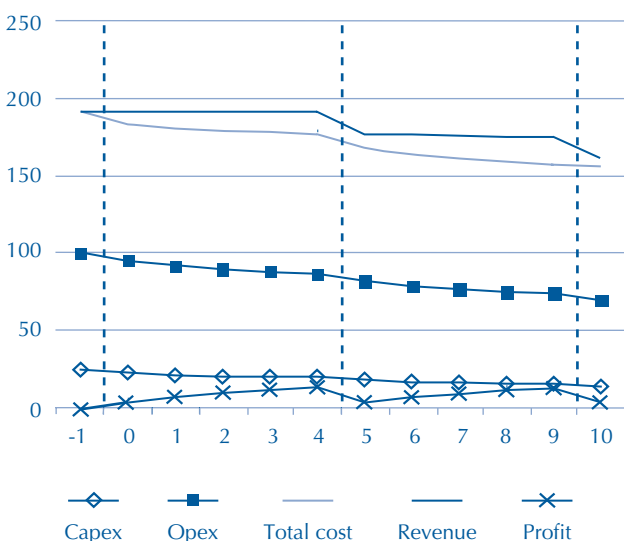
Assumptions:

The regulator sets annual revenue every five years equal to annualised costs in the last year of the previous price control;

Reducing either operating expenditure or capital expenditure requires effort⁸⁶; and

The firm optimises an objective function consisting of 50 per cent (present value of future) profit minus 50 per cent (present value of future) effort.

Results, given these assumptions:



Change in price year -1 to year 5 -7.7%

Annual average -1.3%

Change in cost year -1 to year 5 -10.3%

Annual average -1.8%

We illustrate operating and capital expenditure in detail below:

Year	-1	0	1	2	3	4	5	6	7	8	9	10
Opex	100.0	95.3	91.9	89.5	87.8	86.6	82.2	79.0	76.7	75.1	74.0	69.8
Fall from previous year		4.7	3.4	2.4	1.7	1.2	4.4	3.2	2.3	1.6	1.2	4.2
Capex	25	22.9	21.7	20.9	20.4	20.1	18.3	17.2	16.5	16.1	15.8	14.2
Fall from previous year		2.1	1.3	0.8	0.5	0.3	1.8	1.1	0.7	0.4	0.3	1.6

Costs fall as a result of incentive regulation: the firm makes profits for up to five years when costs fall. However, since it retains profits for longer for cost savings early in the period, cost savings exhibit a cyclical pattern.

3. The effects of periodic price control reviews

23 In this section we examine:

- the impact of changes to the length of the review period on incentives;
- the mechanisms available to avoid the weaker incentives associated with the regulatory timetable; and
- the use of external information as a means of reducing the trade-off between productive efficiency and customer benefits.

The effect of the periodicity of price reviews

24 The base case illustrated the possibility that if price controls are based on the prevailing level of costs in the last year of the previous price control period, then the firm has an incentive to time efficiency improvements with the regulatory cycle. Clearly, companies will receive greater benefits from cost reductions early in the period, rather than later, because they keep additional profits for five years rather than one year only. The firm retains 29 per cent of the PV of a cost reduction made at the start of year 1 of a five year price control period and only 7 per cent of the PV of a cost saving made at the start of year 5.

⁸⁶ In fact, we would expect the effort involved in reducing capital expenditure to be low - it is easy to cancel an investment. However, it may be harder to find genuine capital efficiencies, while maintaining quality performance and this is what is modelled here. We model quality performance more explicitly later.

25 This variation in incentives is likely to have two adverse effects:

- the timing of cost reductions is likely to be driven by an arbitrary regulatory timetable, rather than the firm's own assessment of its business. Presumably, this will be less efficient than a timetable driven solely by commercial and internal considerations.
- 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.

26 This is not just a theoretical possibility. The electricity distributors in England and Wales exhibited sluggish productivity growth for the first three years after privatisation, but began making extremely rapid productivity improvements after 1994 when the regulator completed the price control review. In 1998, OFGEM assessed base costs for the next price control period. Some companies registered negative productivity growth in 1997/98 - their costs increased just in time for OFGEM to use them as a basis for setting the next price control.

Solving the problem

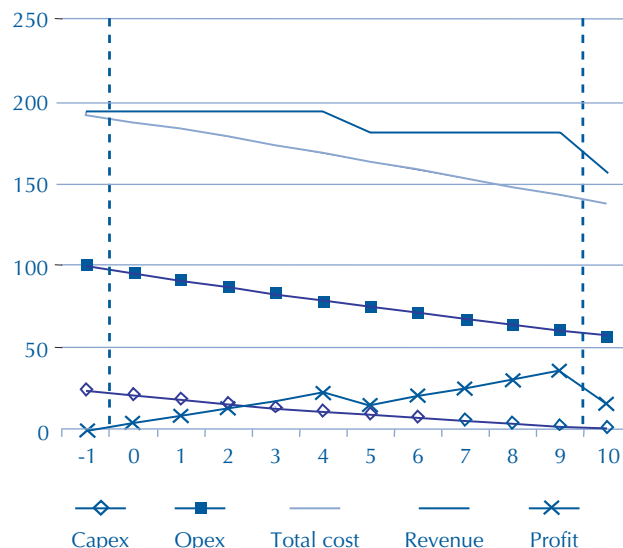
- 27 This problem can be solved by allowing firms to retain the benefits from cost savings for the same length of time regardless of when they are made. Prices could fall annually by the cost reduction achieved five years ago. For example, in 1999 OFWAT adopted a rolling incentive mechanism. The objective was to allow the company to retain efficiency savings in excess of regulatory assumptions for five years before being passed to customers. For capital expenditure the mechanism operates through adjustments to the regulatory asset base. For operating expenditure, an appropriate allowance is added to revenue requirement in the early years of the next review period.
- 28 A simple way of implementing this approach is to reduce prices by the present value (PV) of cost reductions over the previous five years. Under this approach the regulator calculates the PV of total allowed revenue and total costs over the outgoing price control period. Future revenue is then reduced by this ratio. If, for example, the PV of cost was 90 per cent of the PV of revenue, prices would fall by 10 per cent⁸⁷. This approach eliminates the problem of variations in incentives over time, as we show below:

Spreadsheet model - basing price reductions on NPV out-performance

Assumptions:

As base case, but prices re-set on basis of present value of costs over five years, not last year's annual costs

Results, given these assumptions



Change in price year -1 to year 5 -6.8%

Annual average -1.2%

Change in cost year -1 to year 5 -14.7%

Annual average -2.6%

Results have changed from the base case in two ways. Firstly, the graph of cost reduction is a straight line. Incentives are equal in all years and the firm chooses whatever level of cost reduction is appropriate for those incentives. Secondly, the power of the incentive regime has increased. Cost savings are higher but price reductions are delayed, because the effective price control period has increased (all cost savings are retained for five years).

29 There are however difficulties in implementation. This approach requires the regulator to analyse five years data, not just one, thereby potentially increasing the regulatory burden. On the other hand, the analysis of each year should be easier, incentives for gaming would be lower and gaming would be more difficult. Consequently, we suspect that this approach may be easier than regulators realise - it will not increase their workload by a factor of five.

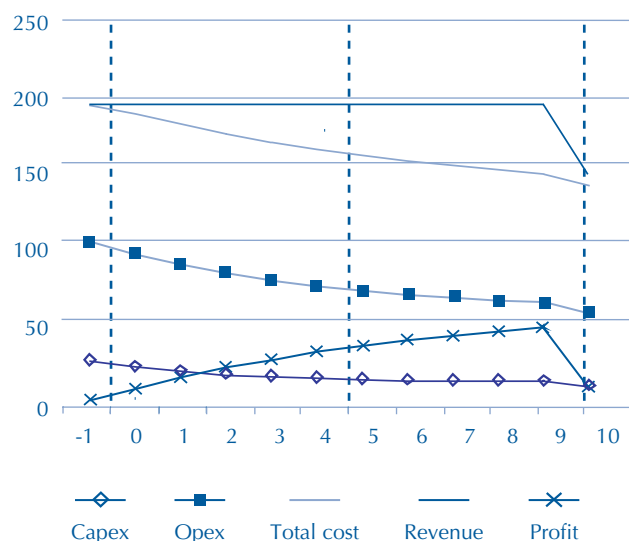
⁸⁷ This approach is identical to the rolling incentive except in the method of calculation.

Spreadsheet model - lengthening the review period

Assumptions:

As base case, with review period increased to ten years

Results, given these assumptions



Change in price year -1 to year 5 0.0%

Annual average 0.0%

Change in cost year -1 to year 5 -18.1%

Annual average -3.3%

Prices do not fall by year 5 in this example but the long-term benefits of the approach are illustrated by the increase in annual cost reduction from 1.8 per cent to 3.3 per cent in the first period. Over the 11 years to year 10, prices fall by 24 per cent, whereas in our base case they fell by only 16 per cent.

However, this delay imposes costs on customers. The present value of prices is higher in this case than the base case, because of this delay - customers were better off with a five year period. Of course, this result shows that there must always be some optimum period: too short and there are no price cuts, too long and they are delayed too long.

Incentive effects of changing the length of the period

30 The length of the price control period has a straightforward effect on the overall incentive power of the regime. Longer periods allow companies to keep the benefits of cost savings for longer (and consequently delay customers receiving those benefits as price cuts). Lengthening the review period tilts the trade-off between incentives and price cuts towards higher incentives (and therefore larger cost reductions) with

customers benefiting later. In the example, lengthening the period from five to six years would result in customers receiving 66 per cent instead of 71 per cent of the present value of a cost reduction in year 1 of the price control.

- 31 This issue has been examined on many occasions. Regulators generally consider alternative price control periods in each price review. Furthermore, different periods have been used for different activities. For example, NGC was on a four year price control cycle in the 1990s⁸⁸. However, five years is used for most network industries and airports.
- 32 The optimal period length depends on the way in which firms respond to changes in incentives. There is unlikely to be enough data to reach a definite conclusion. However, it is not obvious that the appropriate response to this practical difficulty is to maintain the period unchanged. Since privatisation, companies have become more profit-oriented and closer to the efficient cost frontier. Both developments imply that it could be appropriate to lengthen the regulatory period (either explicitly or implicitly through adopting a rolling mechanism) because increased incentives:

- are more likely to produce customer benefits if firms are more profit oriented; and
- may be necessary to promote the harder and more innovative cost reductions needed to make further improvements.

Using external information as the basis for the incentive regime

- 33 The previous section identified two problems faced by the regulator: the appropriate trade-off between current and future customer benefits, and the impact on the timing of efficiency gains. The reason that these problems exist can be traced back to the fundamental problem that the regulator does not know how low the costs of the firm could fall. The firm can reveal this information, by its actions, but will only do so if it receives additional profits for doing so.
- 34 This information problem causes the trade-off between profit-based incentives for the firm and short-term price cuts for customers. 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 while retaining the same level of incentives, or higher incentives while retaining immediate price cuts. These approaches are often called benchmarking or yardstick competition. In this paper,

⁸⁸ OFGEM briefly discuss the issue in their consultation paper on NGC's price control review published in June 2000. The reason given is the increased incentive of a five year control - but there is no discussion as to whether the period should be longer still (nor is there an equivalent discussion in price reviews for distribution, which have always used a five year period).

we will use "benchmarking" to describe the use of information from firms outside the regulatory system and "yardstick competition" for comparative analysis between firms within the same regulatory system.

Benchmarking

- 35 All regulators now use benchmarking to some extent in setting price controls. Benchmarking can be based on "top-down" comparison with similar firms or "bottom-up" analysis of specific processes. Even when direct comparators do not exist in the UK, benchmarks can be based on similarities between, for example, different network businesses or different privatised industries more generally. For example, OFGEM and ORR compared the performance of NGC and Railtrack to that of other privatised utilities⁸⁹. There has been some use of international comparisons in setting efficient cost targets. For example, OFGEM used such comparisons in its price control review for NGC and OFTEL benchmarked BT against American telecommunications companies in its last price control review.
- 36 Both top-down and bottom-up approaches have drawbacks. Top-down benchmarking relies on being able to correct for differences between the firms being compared (eg different scales of operation). International comparisons are hard because the range of differences to be corrected will be wider. Bottom-up analysis may encounter similar problems and there may be problems defining the scope of functions in different firms. If carried out in excessive detail, bottom-up benchmarking could take the form of regulatory micro-management of the firm's activities.
- 37 Benchmarking strengthens incentives by reducing the effect of the company's own costs on its own revenue. Benchmark costs are independent of the firm's own costs, so there is no reason for the firm's managers not to pursue cost reductions at the maximum possible rate. If (in the extreme case) the firm's own costs have no effect whatever upon its revenue, the incentive power of the regime is 100 per cent. The firm keeps all of the present value of any cost saving it makes. A £1m annual cost saving increases the firm's profits by £1m annually, compared to whatever they would otherwise have been.
- 38 Whether regulators are behaving efficiently or not in implementing benchmarking depends on the use that they make of the results. There are two possible benefits:

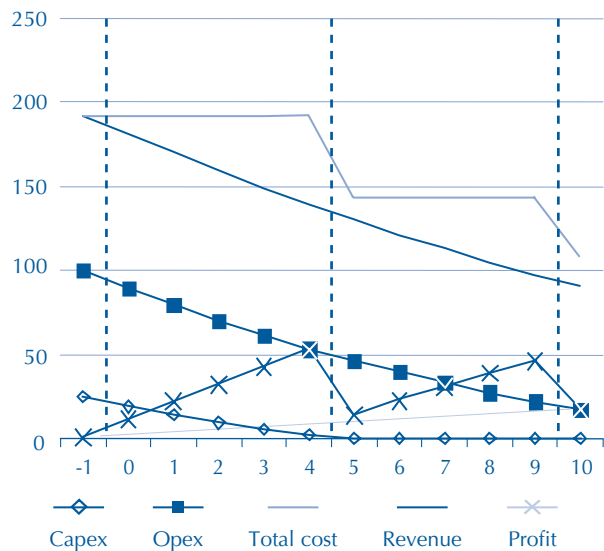
- through benchmarking, regulators gain the confidence to set revenue exogenously rather than with reference to the firm's own costs (thus realising the superior incentives described above); or

Spreadsheet model - benchmarking

Assumptions:

Allowed revenue falls by a fixed proportion at each price control review - the firm's own operating expenditure has no effect on its allowed revenue

Results, given these assumptions



Change in price year -1 to year 5 -25.0%

Annual average -4.7%

Change in cost year -1 to year 5 -32.0%

Annual average -6.2%

The powerful incentive effects of setting revenue entirely without reference to the firm's own costs are clear (and in our artificial example, the effect is so strong that capital expenditure is driven to zero by the end of the first period).

- regulators would set exogenously-determined revenue in any case but more accurate benchmarking enables them to match expected revenue more closely to expected costs (avoiding windfall gains or losses for the firm).

- 39 It is possible that benchmarking is being carried out to such a level of detail that the powerful incentives arising from the use of exogenous price-setting are being lost. Benchmarking should be seen as a way of simplifying the price control process, an alternative route to the original concept of RPI - X price reviews as a period check upon an essentially fixed price to encourage efficiency. Some of the benchmarking exercises of recent years achieve precisely the opposite - requiring the firm to account to the regulator for the way it carries out its detailed business activities⁹⁰.

⁸⁹ OFGEM and OFWAT made much more use of comparative analysis between distribution businesses for both top-down and bottom-up comparisons. We discuss this under "yardstick competition", below.

⁹⁰ For example, OFGEM's consultants identified specific cost savings that electricity distribution companies could make, and OFWAT monitor and approve capital expenditure at a very detailed level.

Yardstick competition

- 40 The most obvious and best comparators for a benchmarking study are similar businesses in the same market (yardstick competition). Under yardstick competition, the price cuts for each firm depend upon reported costs of other firms. For example, the price cut could be set equal to reported average industry cost in the last year of the previous control or (to eliminate variations in incentives) the NPV of out-performance over the previous price control period.
- 41 The greater the number of firms included in the regime, the stronger its incentive power. For example, suppose 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, 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.
- 42 Overall, the incentive power of the regime is therefore 64 per cent, rather than the 29 per cent under an RPI - X regime based on the firm's own costs. With 14 firms, on the other hand, the incentive power would be 29 per cent + 71 per cent * $\frac{13}{14}$ = 95 per cent.
- 43 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 large cost reductions. 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 per cent of the present value of the cost reduction, even though the power of the regime is 64 per cent. The trade-off 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 incentives.
- 44 The regime has these properties because the two regulated companies are in virtual competition with one another: cost reductions by one firm partially reduce the prices of another. Although prices may fall to equal costs overall, companies will still increase their profits by 64 per cent of the value of any cost reduction they make. If one reduces costs and the other firm does not, the first firm's profits will be higher by 64 per cent of the cost saving. If both firms reduce costs by the same amount, each firm's profits would have been lower if it had not reduced costs, again by 64 per cent of the cost

saving. Thus, both face an individual incentive to reduce costs below the level of revenue, even if the final effect of this is to reduce revenue precisely to match those lower costs.

- 45 This result should be familiar, because it is how competitive markets are supposed to work. In the absence of monopoly power, prices will be equal to costs in a competitive market and no firm will earn profits above the cost of capital. However, each firm is motivated to reduce costs below those of its competitors, in order to make profits above the cost of capital. If all firms respond in the same way, costs fall in all firms and competition drives the market price down to match that cost reduction. The pursuit of profit, paradoxically, leads to outcomes in which no (economic) profits are being made.

Advantages and disadvantages of yardstick competition

- 46 The advantage of the yardstick regime described above is clear: it results in powerful incentives for cost reduction and strongly mimics the operation of competitive markets. Companies are competing with each other's cost performance rather than the regulator's expectations of operating and capital expenditure. This significantly reduces the problems of "gaming" the timing of efficiency gains.
- 47 Potential disadvantages include:
- The powerful incentives for cost reduction may cause firms to ignore other regulatory objectives, such as quality. For example, capital expenditure could be cut, reducing the serviceability and security of the network. Confining the benchmark to operating costs is one solution but it distorts incentives for optimal operation, as we discuss in Section 4. The alternative is explicit quality regulation, to counter-act the pressures for cost reduction, as we discuss in Section 5.
 - There are practical difficulties in comparing companies because of, for example, the operating conditions of their franchise area or the state of the network they inherited at privatisation. This requires price differentials to be set between firms.
 - The regulator must either accept that the best-performing companies will make returns well above the cost of capital, possibly over many years, or that badly-performing companies may have to write off assets. If there is a "safety net" for poor performers, or caps on the profits achievable by firms performing consistently above the average, the incentive power of the regime is much weakened. As we noted above the incentive properties of yardstick competition are similar to those of market competition, and, in markets, there are winners and losers.

The use of yardstick competition in Britain

- 48 Obviously, yardstick competition cannot apply to single-firm industries. The water and electricity distribution industries therefore provide the main opportunities for applying yardstick competition.
- 49 OFGEM made some use of comparative analysis at the last distribution price control reviews. Controllable operating expenditure was benchmarked using top-down regression analysis (compare total controllable operating costs given the cost drivers faced by the business) and bottom-up analysis of company processes, by OFGEM's consultants. Companies that were less efficient than the two most efficient companies were penalised through price controls set assuming that their controllable operating expenditure would fall 75 per cent of the distance towards efficient levels by year 3 of the new price control. The price cut for the two most efficient companies was reduced by a "bonus" 1 per cent.
- 50 OFWAT made extensive use of yardstick competition during the last price review. Relative efficiency assessments were made for operating expenditure and capital maintenance for water and sewerage separately. The assessments were mainly based on regression models⁹¹. Separate models were estimated for different functions. For example, in water operating expenditure four models were estimated (covering: resource and treatment, distribution, power and business services). The sum of actual expenditure for each company was compared to the sum of predicted expenditure to give an overall efficiency score.
- 51 Adjustments were made to individual company scores to reflect special factors that were not included in the regression models. Allowance was also made where companies were assessed as efficient in operating expenditure and inefficient in capital maintenance (or vice versa) to reflect the fact that companies have a degree of flexibility between operating expenditure and maintenance. The company with the lowest score established the efficiency frontier. Relative inefficiency was measured as the distance from this frontier. For operating expenditure, OFWAT set price limits on the basis that 60 per cent of the gap would be closed evenly over the five years. For capital maintenance between 40 per cent and 50 per cent of the gap was assumed to be closed but this was all applied in the first year.
- 52 OFWAT also challenged capital investment costs through cost base analysis in 1993, 1994, 1998 and 1999. They asked companies to provide estimated costs for a number of illustrative projects and used this information to assess the relative inefficiency of the

proposed capital programmes. In the area of capital maintenance this work was supplemented by econometrics.

Yardstick competition - conclusions

- 53 Why have regulators not adopted yardstick competition applied to total costs, given the impressive incentive properties of the approach? One answer lies in the practical difficulties of doing so. For example, OFWAT considered the feasibility of considering total efficiency for its 1999 periodic review but concluded that there are serious practical difficulties in obtaining the necessary information, and in making comparisons between companies with very different geographic areas and inherited capital stock.
- 54 We suspect that there are two other possible answers, to which we devote the remainder of this paper:
- concerns about driving poor performing companies into bankruptcy or forcing asset write-offs; and
 - concerns about the impact of powerful incentives for cost reduction on quality provision.

4. Financial viability and incentive regulation

- 55 Regulators in the UK have generally applied high-powered regulation to operating expenditure. Increasing use of benchmarking and yardsticks applied to operating expenditure is raising the incentive power of the operating expenditure regime. However, capital costs are typically dealt with differently, and are exposed to a low-powered regime⁹². We suggest that there are two motivations for this apparently contradictory approach, namely the need to ensure financial viability, discussed in this section, and the desire to promote quality improvements, discussed in section 5.

The financial viability constraint

- 56 In the UK, regulators have a duty to enable the firm to finance its functions. This duty may lead to a reluctance on the part of regulators to challenge capital expenditure plans of companies because capital expenditure allowed by the regulator at the previous review has, in a sense, been mandated by the regulator and the firm should not be punished if it has stayed within that limit, and because the credibility of the UK regulatory commitment would be damaged by "retrospective" regulation that wrote off assets. There are three issues around this approach to financial viability, which we examine in turn:

⁹¹ Unit cost models were also used for sewerage and capital maintenance assessments

⁹² Low powered at least on the downside. OFTEL, in particular, has been willing to allow BT to retain the profits from capital efficiencies resulting from changes to network architecture.

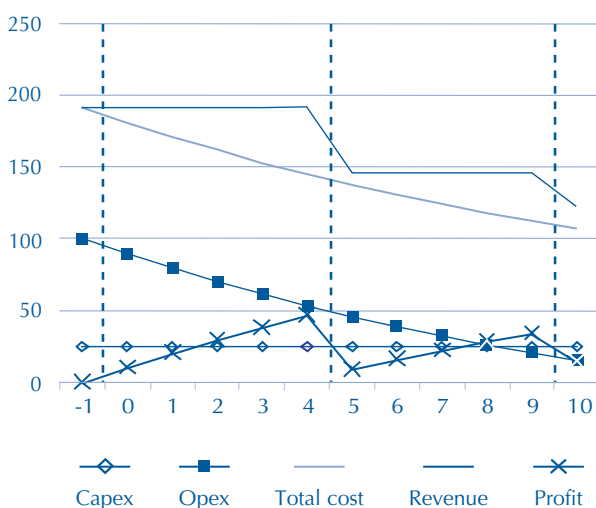
Spreadsheet model - capitalisation

We begin by illustrating the effect of benchmarking operating expenditure, assuming no change in capital expenditure is possible.

Assumptions:

Allowed revenue for operating expenditure is reset by an exogenous reduction at each price control review - the firm's own operating expenditure has no effect on its allowed revenue. Capital expenditure is assumed constant.

Results, given these assumptions



Change in price year -1 to year 5 -23.4%

Annual average -4.3%

Change in cost year -1 to year 5 -28.2%

Annual average -5.4%

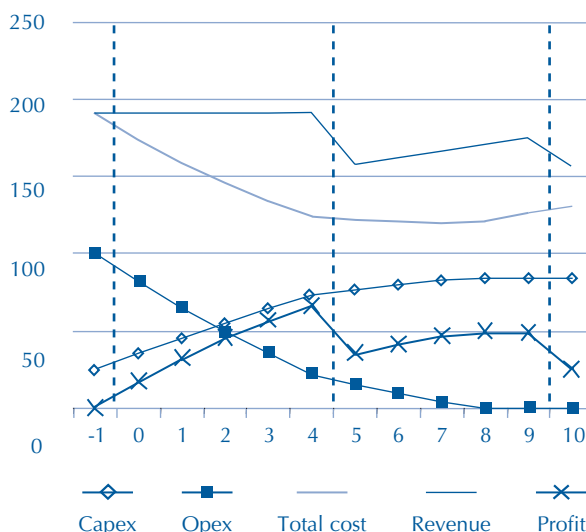
The firm makes rapid reductions in operating expenditure because of the powerful incentive properties of the benchmarking regime (see section 3).

- capitalisation of operating expenditure as a response to regulatory rules;
- increased gearing as a response to regulatory rules; and
- the role of equity markets in regulatory incentives.

Capitalisation as a response to regulatory rules

57 If regulators benchmark operating expenditure without also benchmarking capital costs, firms receive perverse incentives to substitute capital expenditure for operating expenditure. It will often be easier to replace operating expenditure with capital expenditure than actually to reduce operating expenditure. This could be because the substitution is simply an accounting change or because the operating expenditure provided services that could also be provided by investment.

Now we introduce the possibility of capitalisation. As well as reducing operating expenditure we allow the company to transfer expenditure from operating to capital expenditure.



Change in price year -1 to year 5 -17.2%

Annual average -3.1%

Change in cost year -1 to year 5 -35.8%

Annual average -7.1%

Operating expenditure falls even faster than before. However, some of this reduction is capitalisation. Capital costs are rising, as annual additions to the Regulatory Asset Base increasingly add to annual cost requirements. Total costs fall fast - over the first period faster than in the previous example. However, total cost begins to build up again by the end of period 2. Prices fall by a fixed percentage of operating expenditure at each review but the increased asset base is fully accommodated and this drives total cost up.

58 This substitution will not be in the public interest. Firstly, it protects inefficiency, forcing customers to pay higher prices for the lifetime of the capitalised costs. Secondly, if the substitution is simply an accounting change, it may increase the burden on the regulator at reviews, as the accounting changes need to be unravelled. Finally, genuine substitution of investment for operating costs may be inefficient in itself. There is an optimum mix of (for example) capital and labour so regulatory incentives favouring one expenditure category over another can only distort this mix away from the optimum. For example, companies may invest in low maintenance equipment that is more expensive, in the long term, than the more labour-intensive alternative.

Increased gearing as a response to regulatory rules

- 59 Companies, as well as regulators, can gain from making credible commitments. Increased gearing, for example, makes bankruptcy more likely given a tough regulatory settlement. Shareholders can receive a return on their investments, or not, depending on the performance of the firm, but the principal and interest on debt must be repaid.
- 60 This increased risk of bankruptcy threatens the regulator with what (the company's managers may hope will be) an unacceptable outcome. In the extreme case of a fully debt-financed company, cash-flow must be positive every year and incentive regulation, with its implicit threat of periods in which returns are below the cost of capital, cannot be applied. Consequently, such a company must be subjected to a weaker incentive regime, in which it faces positive profit incentives but no risk of losses, if the regulator is concerned to avoid bankruptcy.

Equity markets and regulatory incentives

- 61 Equity markets play an important role in ensuring that company managers themselves have an interest in responding to the profit incentives established by regulators. In order for the equity market to perform this function it is important that there is a clear link between performance and profitability. If regulators blur the distinction between these by, for example, compensating firms for losses and penalising firms with profits, then the market is unable to perform one of its basic functions. We distinguish two possible effects of capital market activity that interact with the regulatory process:
- the interaction of merger synergies and yardstick competition; and
 - take-overs and mergers as an incentive mechanism for managers.

The interaction of merger synergies and yardstick competition

- 62 In weighing up the costs and benefits of mergers in regulated industries, there are two unknowns. Firstly, the value of synergies is unknown, although the merging parties will attempt to estimate it. Secondly, mergers reduce the number of comparators available for the detailed econometric analysis of comparative costs. Whether customers gain or lose from the merger will depend upon the relative importance of these two unknowns.

The role of take-overs as an incentive mechanism for managers

- 63 We began this paper by discussing managerial, as opposed to shareholder, objectives. Profit-based regulatory incentives will only be effective if firms

genuinely pursue profit opportunities. Firms clearly differ in the way they balance shareholder and managerial objectives. A more profit-oriented firm can be expected to respond more aggressively to a profit incentive than a more managerial firm.

- 64 An increase in the degree of profit-orientation may, for example, happen after a change of management by the shareholders. This could occur through a number of routes:
- take-over by another company;
 - poor share price performance (and therefore the threat of take-over) resulting in internal management changes; and
 - direct intervention by shareholders.
- 65 Policy towards take-overs needs to take this issue into account. Synergies from take-overs can be estimated, but the potentially larger effects of cultural change are harder to quantify. Furthermore, the threat of take-over can discipline managers just as effectively as the reality. If regulators announce that mergers between existing players will no longer be allowed, they remove some of this threat.
- 66 The regulator can promote profit-orientation by creating a high-powered incentive regime that results in clear winners and losers (or clear rewards and penalties for a single regulated firm). If regulation blurs the links between performance and profitability then shareholders of a managerial firm will not see a significant difference between the performance of their shares and those in a more profit-oriented firm. If regulators step back from allowing inefficient firms to make losses, or are too quick to adjust prices to remove the profits of the most successful firms, the share price differential between good and bad performers may not prompt shareholder action. By contrast, if clear winners and losers are allowed to emerge, as will happen in a high-powered regime, poor performing firms can expect rapidly to be taken over by new owners keen to improve their performance to the level of industry leaders.

5. Quality regulation

- 67 Quality has two meanings in UK regulation - the general quality of service received by customers and, in the case of water, the investments required to meet new environmental or water quality standards set by Ministers. This section uses the general term "quality" to cover both these meanings. The section discusses:

- current practice in regulation of quality;
- incentive schemes for improved quality; and

- the importance for incentives of regulatory commitment to quality schemes and to price control regimes in general.

Current practice

68 This is an area in which regulatory policy is still developing. Historically, regulators have tended to take a very informal, discretionary approach to promoting better quality, or penalising failings. Typically, some measures of quality are "taken into account" at price control reviews but not incorporated mechanically into price-setting.

- For **electricity distribution**, **OFGEM** measure supply interruptions and the total minutes of interrupted supply by distribution companies. In the 1999 price control review, price cuts were adjusted by up to 0.5 percentage points to reflect performance on these measures against targets and a further 0.25 percentage points to reflect the number of customer complaints. More generally, however, we understand that distribution companies believe that OFGEM will take a harder line on capital underspend for companies failing to meet their targets - so these measures have a larger effect on behaviour than these penalties might suggest. OFGEM are now considering radical proposals for change in this area through its Information and Incentives project, as we discuss below.

- For **electricity transmission**, **OFGEM** now treat transmission services and transmission infrastructure provision differently. Transmission services are subject to a complex incentive regime, mostly based on sliding scale regulation. Quality provision in infrastructure is mainly covered by the requirement for adequate peak capacity. In the past, OFGEM have not provided any detailed incentive schemes for capacity, partly because NGC's basic quality performance has been very good. The two are linked (because transmission services can allow the system to operate even with local capacity constraints) and we understand that OFGEM are considering introducing more sophisticated incentives as part of its reform of transmission access arrangements.

- In setting price limits **OFWAT** made an adjustment⁹³ to reflect the overall standard of service provided to customers. Performance significantly better than the industry average led to a 0.5 per cent increase. Poor relative performance resulted in a 0.5 per cent reduction in the price limit. Particularly poor performance could attract a penalty of 1 per cent but no company fell into this category. The overall standard of service was measured as a weighted average of scores against a number of factors. These

include: the quality of the drinking water, number of pollution incidents, interruptions to supply and response to customer inquiries. Five companies received a positive adjustment and five had their price limits reduced.

- 69 These direct incentives for quality are only a small part of the story, however, since most regulators appear to regard capital expenditure as a proxy for the company's commitment to quality⁹⁴. Capital "underspend" is regarded as worrying, presumably because it may result in quality problems in the future. Direct incentives for quality provision therefore have value not just in promoting quality but in allowing the regulator directly to promote capital cost efficiencies.

Incentives for improved quality

70 The regulatory treatment of capital expenditure is therefore crucial to any discussion of quality regulation. Unless quality provision can be promoted directly, regulators will understandably be reluctant to increase incentives for cost reduction that might result in capital underspend. Any scheme for directly rewarding quality will run into two formidable difficulties:

- customers' valuations of quality are difficult to measure in a meaningful manner; and
- in most network industries, it is physically impossible to deliver different quality to customers with different preferences between quality and price.

Commitment to quality

71 Regulators' concerns over quality often reflect a concern that the network owners will take a short term view. Capital expenditure might be reduced or delayed (to obtain benefits in the current period), reducing the future safety or quality performance of the network. If network owner/operators took a longer-term view, they should undertake necessary capital expenditure today if it would enable them to avoid higher costs in the future. The regulator could set up a system of penalties and rewards for poor or exceptional quality performance and this should induce efficient behaviour even if there is a substantial lag (perhaps stretching over several price control periods) between the investment and its effect on quality measures.

72 If the concern over short-termism is valid, it is likely to result from uncertainty about the regulatory regime rather than inherent short-termism by private sector network operators. In other industries, private companies have no difficulty in making investments

⁹³ The adjustment took effect in 2000/01 and resulted in one-off, but permanent, changes in price limits.

⁹⁴ This attitude may also be related to the public perception that "cost" is a bad thing but "investment" is inherently good.

today that may only result in a payoff in the long term. Airlines, for example, invest in maintenance of their aircraft. Why are private companies prepared to make long term investments to preserve quality? In our view the answer lies in certainty about the link between investment and reward. The value of investing in maintenance is not certain - the airline will not know how profitable it will be to extend aircraft life, nor can it predict accurately how much damage an accident would cause to its business. The market does, however, provide certainty that there will be some link between quality and the value of the business.

- 73 So why are regulated network businesses assumed to be different? If they do take a shorter-term view it may reflect the different uncertainty they face. Unlike airlines, they face not an uncertain value for a definite payoff or penalty but uncertainty about whether there will be a payoff or a penalty at all. A company that does allow its network to deteriorate could hope to appeal to the regulator in the future for additional cash to bail it out - particularly since safety or quality concerns would presumably be matters of public concern at the time if an emergency programme is required. This hope would be reinforced if the company believes that the regulator would not be prepared to allow the network owners to go bankrupt or sell the business at a distress price. Similarly, a network business considering investment for long term quality benefits may have doubts about the regulator's commitment to reward such actions in the future.
- 74 Commitment to a quality regime could therefore provide a way of encouraging companies to invest efficiently where necessary without providing them with perverse incentives to inflate capital expenditure. If network companies know that the long term value of their businesses will rise if quality and safety improve, and fall if they worsen, they can take a long term view in just the same way as do companies in competitive markets.

Commitment to price control regimes

- 75 Any quality regime must be considered in the context of price regulation as a whole. The way in which companies will respond to quality incentives will depend upon how they think the costs incurred or saved as a result will be treated at the next review. Consequently, unless there is a reasonably consistent approach to setting prices, the effects of any quality regime are unknowable.

- 76 To illustrate this dependence, consider the opposite extremes of a very low-powered regime (in which all past capital expenditure is added to the RAB) and a high-powered regime in which allowed capital costs are set by an external benchmark. Under the first regime, an additional unit of capital expenditure costs the firm only the present value of the first five years (say) of the investment, since after that it is reimbursed through higher prices. Thus, the firm's long term profits fall by only 29 per cent of the cost of the investment. Under the high-powered regime, revenue is unaffected by capital expenditure and the firm therefore pays 100 per cent of the costs of any investment.
- 77 If a quality regime is added, it will have completely different effects under the two regimes. Suppose (for simplicity) that a unit of investment produces a unit of additional quality over the lifetime of the investment. Under the low-powered regime, the firm will invest whenever the unit quality payment exceeds 29 per cent of the investment cost, under the high-powered regime it will do so only when the unit quality payment exceeds 100 per cent of the investment cost. For a given quality payments regime, behaviour will differ significantly under the two price control regimes - there may be "gold-plating" under the first or insufficient quality under the second.
- 78 If the regulator is proposing a scheme covering several different firms, therefore, their responses to the regime will depend on their expectations of the approach taken at the next price control review. Unless the regulator is prepared to commit to a particular approach at the next review, the response to the incentives regime could vary wildly across the industry.
- 79 Any quality regime therefore needs to be carefully integrated into the price control regime. Regulators either need to:
- define and separate "quality-related" expenditure from general network expenditure and exclude the former from the price control review - this would create an administrative task that may be insuperable and could lead to gaming; or
 - establish a long-term price control regime at the same time as the quality regime is implemented and make a reasonably firm commitment to stick to it.
- 80 We believe that it would be a mistake to establish long term quality regimes while retaining full discretion over how to set prices at reviews.

Conclusion - keeping it simple to promote capital efficiency

- 81 In our view, complex incentives for quality improvements are likely to result in perverse outcomes, because of the considerable uncertainties regarding the costs and benefits of improved quality. If the regulator's aim is to reproduce the efficient trade-offs between price and quality produced by a competitive market, this view might appear rather defeatist. Since customers of network businesses can rarely choose their price/quality trade-off, the failure to achieve this aim seems inevitable⁹⁵. However, an effective quality regime can produce significant benefits by allowing regulators to provide incentives to reduce capital expenditure whilst not endangering quality.
- 82 Most existing regulatory regimes provide inadequate incentives for capital cost efficiency because regulators are attempting simultaneously to regulate costs and quality by setting a single variable: the firm's investment programme. OFWAT have addressed this risk by working closely with Ministers and the quality regulators to define output programmes such that once price limits are set success will be measured by delivery of these outputs not money spent. They monitor carefully every year whether outputs assumed at each review have been completed. Regulatory action follows any shortfall or clear signs of a likely shortfall. This approach provides each company with strong incentives to out perform the cost assumptions.
- 83 If the test of a quality regime is not whether it produces the "right" quality, however defined, but whether it allows high-powered incentives to reduce total costs without endangering quality provision, then such a regime can be simple. A centralised system of targets would be adequate, for example. Again, regulatory consistency and commitment are important. Regulated firms could take an appropriately long-term view of capital expenditure if they had the same level of confidence in the regulatory penalties or rewards for quality performance far into the future.
- 84 Regulators face institutional constraints on their ability to make binding commitments but more consistency and informal commitment to both price-setting and quality performance regimes over the longer term could help to remove concerns about short term, opportunistic, failure to undertake investment. This would enable a more consistent approach to operating and capital efficiency.

- 85 OFGEM's IIP represents an interesting development in this area. It derives from the regulator's clear understanding of many of the problems that we have discussed in this section and the previous one. For example, OFGEM's draft proposals for distribution price controls state that "...ways need to be found to reduce the emphasis on periodic negotiation with the regulator, to increase the emphasis on outperforming peers, to address a potential imbalance between incentives to efficiency in respect of operating and capital costs, and to give clearer incentives in respect of quality of supply."

6. Conclusions

- 86 The regulatory regimes in the UK appear to be highly successful in promoting reductions in operating expenditure and perhaps slightly less successful in promoting quality improvements and capital cost reductions. Capital cost efficiencies cannot be subject to effective incentive regimes while the size of investment alone, rather than outcomes, is seen as the main leading indicator for quality provision. Both OFGEM and OFWAT have recognised this by focussing on output measures of investment performance, as described in paragraphs 82 and 85 above.
- 87 In our view, there are two main directions in which regulatory policy needs to evolve. Firstly, it should be possible to establish simple but effective regimes to reward quality performance. The aim would not be to mimic the quality/price choice made in competitive markets (because different customers cannot choose different options) but to allow a higher-powered regime to be applied to total costs, not just operating expenditure. Yardstick competition, or increased use of benchmarks for industries with only one service provider, may be the most effective high-powered regime.
- 88 Secondly, regulators need to be more prepared to allow winners and losers to emerge. If profit-based incentives are to be effective, then shareholders need to perceive clear benefits from exerting pressure on managers to respond to those incentives. This might involve regulators allowing good performers to make returns above the cost of capital and being more prepared to allow failing firms to write off assets and be taken over.

⁹⁵ OFWAT have been active in pushing companies to offer some customers the ability to choose their price-quality trade-off (eg interruptible tariffs, reservation charges).

Glossary

The context of regulation

Better Regulation Task Force

The Better Regulation Task Force was established in September 1997 to advise the Government on action which improves the effectiveness and credibility of government regulation by ensuring that it is necessary, fair and affordable, and simple to understand and administer, taking particular account of the needs of small businesses and ordinary people. In July 2001, the Better Regulation Task Force issued a report on Economic Regulators. The Government's response was published in February 2002.

Competition Commission

The Competition Commission is an independent public body established by the Competition Act 1998 ("the Act"). The Commission has two distinct functions. The Commission's Appeal Tribunals hear appeals against decisions of the Director General of Fair Trading and the economic regulators of utilities. The Commission's reporting side investigates references made by regulators concerning, for example, the desirability of including price controls in licences.

Customer

The recipient of network services. For the network industries covered in this report there are broadly two types of customer: households and companies who are end users of the services (water and sewerage), and intermediary companies, who deliver further services to both households and other companies as end users (electricity, telecommunications).

Economic regulation

The regulation of the prices and standards of service provided by companies which hold monopolies or near monopolies over relevant types of services. The regulation is carried out by regulators who are created by Acts of Parliament and who ensure that regulated companies adhere to their licences under which they are allowed to operate.

The price review process

Anticipated efficiency

Efficiency gains made by regulated companies during the price control period which the economic regulator expected the company to achieve, after reviewing the company's operations.

Asymmetric information

A problem noted by economists in a variety of situations in which one party holds more information than another. In the context of economic regulation, this tends to mean that the regulator holds less information about the operations and costs of the regulated company than the company itself.

Benchmarking

see *Yardstick competition* below.

Capital expenditure

Expenditure incurred by regulated companies whose benefits are expected to be enjoyed for more than one accounting period. Most of the large expenditure programmes undertaken by regulated companies to maintain and upgrade their networks fall into this category. Capital expenditure is often taken to be synonymous with investment.

Efficiency

The cost incurred to produce a given level of outputs. Economists distinguish three forms of efficiency: productive efficiency (essentially that the costs of producing a given output are no higher than necessary); allocative efficiency (resources are employed in their highest value uses); and dynamic efficiency (the optimal rate of cost reduction and innovation over time).