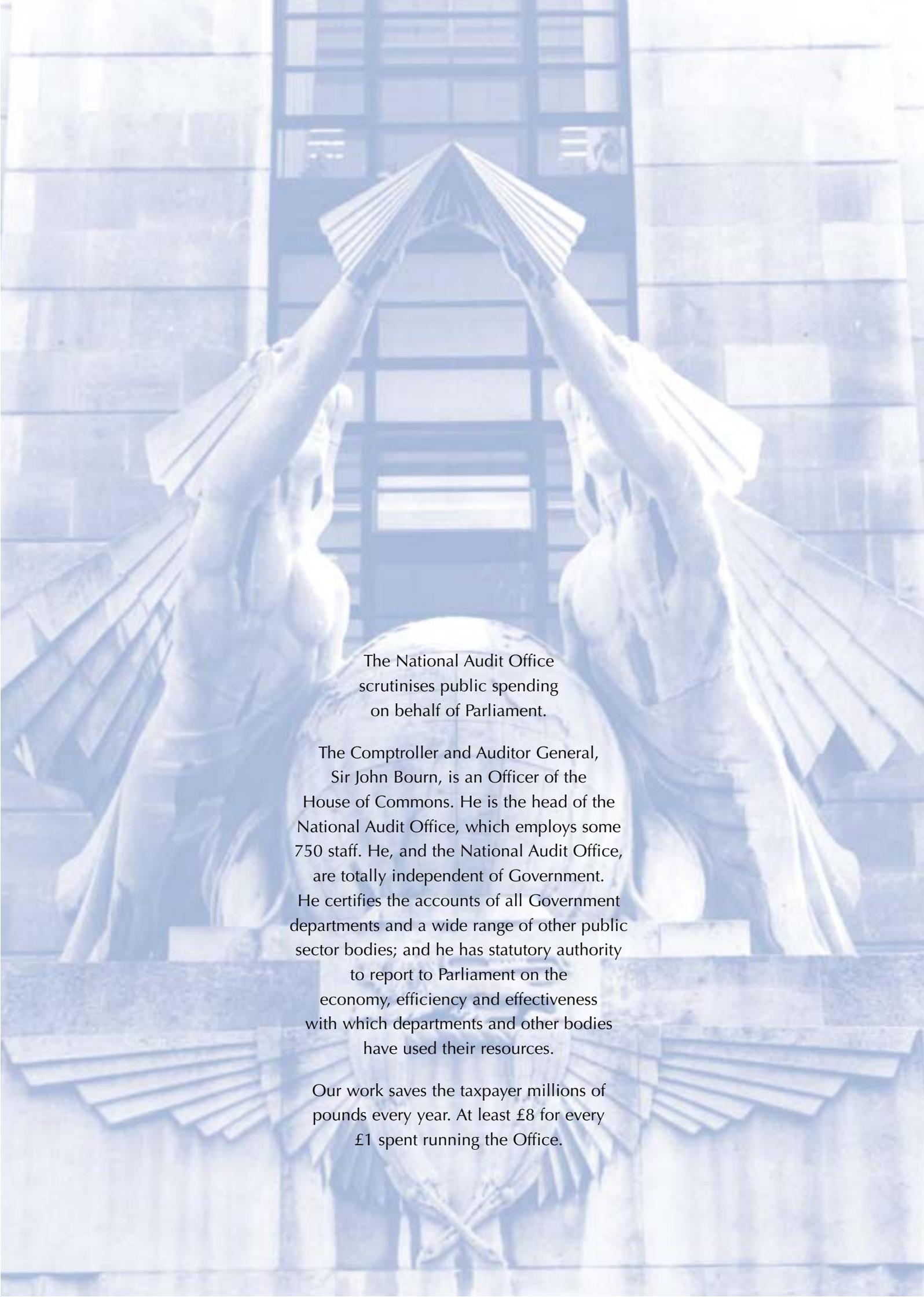


Pipes and Wires

REPORT BY THE COMPTROLLER AND AUDITOR GENERAL
HC 723 Session 2001-2002: 10 April 2002





The National Audit Office
scrutinises public spending
on behalf of Parliament.

The Comptroller and Auditor General,
Sir John Bourn, is an Officer of the
House of Commons. He is the head of the
National Audit Office, which employs some
750 staff. He, and the National Audit Office,
are totally independent of Government.
He certifies the accounts of all Government
departments and a wide range of other public
sector bodies; and he has statutory authority
to report to Parliament on the
economy, efficiency and effectiveness
with which departments and other bodies
have used their resources.

Our work saves the taxpayer millions of
pounds every year. At least £8 for every
£1 spent running the Office.

Pipes and Wires



REPORT BY THE COMPTROLLER AND AUDITOR GENERAL
HC 723 Session 2001-2002: 10 April 2002

This report has been prepared under Section 6 of the National Audit Act 1983 for presentation to the House of Commons in accordance with Section 9 of the Act.

John Bourn National Audit Office
Comptroller and Auditor General 19 March 2002

The National Audit Office study team consisted of:

John Ashcroft, Simon Banner, Steve Frost,
Ed Humpherson, Peter Langham and
Marianne O'Leary

This report can be found on the National Audit Office web site at www.nao.gov.uk

For further information about the National Audit Office please contact:

National Audit Office
Press Office
157-197 Buckingham Palace Road
Victoria
London
SW1W 9SP

Tel: 020 7798 7400

Email: enquiries@nao.gsi.gov.uk



The front cover shows construction works on the Northern Outfall Sewer, London. Courtesy of the London Metropolitan Archive, dated 1902.

Contents

Executive summary	1	Part 3	29
Part 1	13	Regulators are seeking to address the risks arising from price cap regulation	29
Pipe and wire networks contain monopoly elements that make regulation of prices and outputs necessary	13	Regulators are seeking to ensure that there is sufficient long-term investment in networks	29
Pipes and wires are an important part of the infrastructure of the United Kingdom	13	Regulators are seeking to ensure that investors are willing to provide funds for long-term investment	34
The network industries have monopoly characteristics and are regulated by independent economic regulators	15	Regulators are taking a series of steps to improve the process of price regulation while retaining its benefits	38
In regulating networks, regulators aim to balance several objectives	16		
There are concerns that the standard form of price control regulation may no longer be appropriate for UK regulation	18		
Scope of our examination	19		
Part 2	21	Appendices	
Price cap regulation has delivered substantial benefits	21	1. Methodology of the National Audit Office's examination	43
Price cap regulation should give strong incentives to increase efficiency, leading to lower prices	21	2. The statutory duties of regulators	44
Price cap regulation has delivered a variety of benefits	24	3. The theory of RPI - X price controls	45
		4. Regulatory risk	53
		5. Incentives	60
		Glossary	74



executive summary

- 1 Pipes and wire networks provide households and commerce with the essentials of modern life - electricity, gas, telecommunications, water and sewerage services (see Figure 1). The networks provide a high and reliable standard of service, but running them is a technically complex and costly undertaking, amounting to some £20 billion a year. In these networks, there is less scope for the competition that has been introduced into many other parts of the utility industries. Successive Governments have therefore established and maintained a system of economic regulation to protect consumer interests. The Office of Water Services (OFWAT), the Office of Gas and Electricity Markets (OFGEM) and the Office of Telecommunications (OFTEL) are responsible, respectively, for water and sewerage services, energy and telecommunications. In the absence of effective competition for the provision of network services, each of these regulators has introduced price controls using an output-based price-capping approach known as RPI - X, which prevents regulated companies from raising prices by more than general price inflation less a given percentage factor (X)¹.

1 The pipe and wire networks

Industry	Services	Companies owning and operating network assets	Customers
 Telecommunications	Voice and data services transmitted through a network from sender to receiver	Several companies, with British Telecommunications (BT) being the main regulated entity	Telecommunications companies offering retail services to households and businesses
 Electricity transmission	Transmission of electricity from power stations to the distribution networks	National Grid Company (England and Wales)	Other electricity companies; a few very large industrial users
 Electricity distribution	Distribution of electricity to households and business premises	12 regional electricity distribution companies (England and Wales)	Companies supplying electricity to homes and businesses
 Water and sewerage	Conveyance of clean water to homes and businesses and removal of waste water	10 water and sewerage companies and 13 water only companies in England and Wales	Consumers of water and sewerage services (both households and businesses)
 Gas network	Bulk transmission and distribution of gas from where it reaches land to customers	Transco (formerly part of British Gas)	Shippers of gas, who buy gas at the shore or other entry points and sell it to suppliers at the customer's meter

Source: National Audit Office

¹ In the water industry, the approach is technically described as RPI +/- K to reflect the heavy investment programmes that the industry has had to deliver since 1990. Throughout this report, we refer to RPI - X as a general term to describe the incentive-based regulation schemes used by regulators, including by OFWAT.

- 2 This report examines why regulators have developed the RPI - X approach (Part 1), considers how the work of regulators has benefited consumers (Part 2) and how regulators have sought to address the risks arising from the approach (Part 3)². The report focuses on price reviews for the water and electricity industries in England and Wales and telecommunications in the whole of the United Kingdom and we have sought to draw lessons of wider relevance to economic regulation³.

Main findings: the successes and potential limitations of the RPI - X process

- 3 In the absence of effective competition, regulation may be needed to protect consumers. The main challenge facing regulators is to create incentives for monopoly companies to deliver effective and efficient networks, but without creating distorted or unintended incentives, or imposing excessive burdens on regulated companies. There is evidence that the way that regulators have used RPI - X has been successful in achieving these objectives. Our analysis shows that customers have seen lower prices and higher quality of service, and regulated companies have been able to cut costs and invest in their networks, while continuing to finance their functions. While the form of RPI - X has been successful to date, limitations inherent in the approach mean that there are risks to the continued achievement of the regulators' objectives. This report considers these limitations alongside the actions that the regulators have taken to mitigate the consequent risks. **Figure 2** summarises our analysis.

2 Potential risks arising from limitations in the RPI - X approach

A The strength of incentives

Incentives to find efficiency savings may be weaker toward the end of price control periods

B Investment in networks

- i) RPI - X may distort incentives relating to investment
- ii) The regulators may make decisions on the level of investment on the basis of inadequate information

C Financing investment

- i) Regulators may allow insufficient or excessive returns to investors
- ii) Investors may perceive the regulatory regime to be uncertain

D The process of RPI - X regulation

The process of price regulation may impose excessive demands on companies

Source: National Audit Office

² Our methodology is set out in Appendix 1.

³ We have also drawn lessons from gas and railway infrastructure price reviews where appropriate. The report's conclusions focus on the inherent risks in the prevailing approach and may therefore be applicable to other regulatory contexts using a similar price-capping approach. These include the water industry in Scotland, the electricity industry in Northern Ireland and Scotland and the postal and airport industries in the United Kingdom as a whole.

The objectives of the regulators

- 4 Without some form of regulatory intervention there is a risk that companies in a monopoly or strongly dominant market position would be able to set excessive prices or to provide a lower quality of service. The duties of the regulators are set out in the specific Acts of Parliament relating to the privatisation or subsequent regulation of the industries concerned. The wording and precise ordering of the duties varies but they all require the regulators to protect the interests of consumers in respect of the availability, price and quality of service and to ensure that the regulated companies can finance their functions⁴. Since privatisation the UK regulators have adopted a common output-based approach, RPI - X, to capping the prices that pipe and wire monopoly companies can charge for delivering the service expected. RPI - X involves the regulator forming a judgement on the likely costs companies should incur to deliver expected outputs efficiently during the next five years (four in telecommunications) and setting prices to cover these costs according to a formula linked to the retail price index (RPI).

The consequences of RPI - X: incentives for companies, benefits for consumers

- 5 The strength of the RPI - X approach is that if companies can deliver the services at a lower cost than anticipated by the regulator, they keep the consequent additional profits until the regulator next reviews the price cap. These savings can then be passed on to consumers through lower prices or improved services in subsequent periods. RPI - X therefore provides strong incentives to improve efficiency for the ultimate benefit of customers, and also provides clear information to regulators on how companies can increase their efficiency over time. We found that these incentives for efficiency have been associated with substantial improvements in the efficiency of the network companies. In the periods up to the most recent price reviews the efficiency gains were of the order of 3 to 9 per cent a year. These gains followed similarly substantial gains earlier in the 1990s⁵.
- 6 The reductions in the costs of the networks have not resulted in any significant reductions in the quality of service delivered to consumers, and many measures of quality have improved. Consumers have continued to receive these essential services, and published data has shown:
- reductions in interruptions to electricity supply since 1990;
 - reductions in the number of water consumers subject to unplanned supply interruptions since 1990; and
 - the percentage of successfully completed telephone calls has been maintained at a very high level.

4 *The specific wording differs from case to case. For example, in the case of the Rail Regulator, the duty in this regard is to "act in which he considers will not render it unduly difficult...to finance any activities ...in relation to which the Regulator has functions."*

5 *National Audit Office, The Work of the Directors General of Telecommunications, Gas Supply, Water Services and Electricity Supply (HC645, 1995-96). This found that, in real terms, prices had fallen by between 10% and 44% for domestic electricity, gas and telecommunications customers, and by between 9% and 54% for business customers.*

- 7 Of the regulators, OFWAT have paid the greatest attention to promoting quality of service by network companies, by requiring them to supply each year independently validated figures against a wide range of indicators which OFWAT publish as a way of encouraging improvements in performance. These indicators have shown a generally rising trend. They have also used price reviews explicitly to improve outputs, resulting in substantial improvements in environmental and drinking water standards and in the security of water supplies (as shown for example by reductions in water leakage⁶). Ofgem have during 2001 made proposals for linking prices with specified quality measures in the electricity (and gas) distribution networks.
- 8 Regulators have sought to pass on efficiency gains to customers at their next review through lower prices or higher standards⁷. As a result of the most recent price reviews, consumers have in all cases benefited, mostly through price reductions, although OFWAT applied part of these gains to offset the costs of improving water quality. The impact on prices is set out in **Figure 3** which shows that, at the most recent price reviews, regulators introduced price cuts for customers of network companies ranging from 1.5 per cent per year in real terms (electricity transmission) to 13 per cent per year in real terms (telecommunications). In addition, regulators introduced immediate price cuts for the water (an average of 12.3 per cent in real terms) and electricity distribution (an average of 24 per cent in real terms) industries.

3 Impact on prices of the regulators' most recent reviews



Telecommunications: Following the 2001 review, BT's charges for some network services will fall by up to 13 per cent a year in real terms over the period. Services in markets that are prospectively competitive cannot increase by more than RPI + 0 per cent.



Electricity Transmission: The last electricity transmission price review resulted in caps on revenue that represent the equivalent (with stable volumes of electricity transmitted) of falls in transmission charges of 1.5 per cent each year in real terms.



Electricity Distribution: The last review cut distribution charges on average by 24 per cent in 2000-01, with further annual reductions of 3 per cent a year in real terms for each company.



Water and sewerage: In their 1999 review, OFWAT reduced average water company prices by 12.3 per cent in real terms 2000-01, and an average overall reduction of 2.1 per cent per year over the period 2000-2005.

Source: National Audit Office

⁶ The report by the National Audit Office, *Office of Water Services: Leakage and water efficiency (HC971, 1999-2000)*, found that there had been reductions in the amount of water leakage year on year from 1995.

⁷ The form of price cap can vary. In some industries, they involve limits on the prices companies can charge customers, while in others they represent caps on the revenues that a regulated company may earn.

Risks to the strength of incentives

Incentives to find efficiency savings may be weaker toward the end of price control periods

- 9 Under RPI - X, regulated companies have an incentive to achieve efficiency gains because they can keep the benefits (in terms of higher profits) for either a fixed period of time or until the regulator next reviews prices and passes benefits back to customers. This can mean that, as the next review of prices approaches, the length of time for which companies enjoy the benefits of efficiency improvements diminishes. As a result, under RPI - X the incentives to find efficiency savings may be weaker toward the end of price control periods. Regulators can respond to this potential weakening in two ways: they can make roll-over provisions, or they can attempt to anticipate this effect when making their assessment of the future level of efficiently incurred costs.

4 The regulators' response to risks to the strength of incentives

- Regulators are increasingly allowing companies to keep the benefit of efficiencies for five years regardless of when the savings are realised, although only OFWAT have made such a 'roll-over' provision relating to all forms of expenditure.
- OFTEL prefer to deal with this issue by having a glide path rather than a one-off adjustment for prices and by basing their cost forecast on average annual changes in costs, along with an assessment of the extent to which costs currently exceed a benchmark level.

Risks to investment in networks

i) The regulators may make decisions on the level of investment on the basis of inadequate information

- 10 Asset management is an important expertise for the network companies. They use their knowledge of the capability and performance of their assets to ensure that they continue to deliver the outputs - in terms of reliable provision of electricity, water and telecommunications - required. They can also use this knowledge to deliver improvements in service. Regulators need to make a judgement in their price reviews on an appropriate level of expenditure on the assets, both to maintain asset performance and to deliver enhancements in quality. While they can obtain historic information on how much maintenance and renewal has cost, this does not tell them whether that investment was sufficient, and there are significant problems for both companies and regulators with obtaining information on future needs, as follows:
- pipe and wire networks have an underlying resilience and it could take some time for inadequate or inefficient expenditure on maintaining them to be reflected in declining performance against output measures, such as numbers of interruptions;
 - links between expenditure and the quality of network performance are hard to identify; and
 - in seeking to obtain information about appropriate levels of investment, regulators may become too involved in the detail of company investment plans.

11 There is no evidence that investment has been inadequate or that the networks have deteriorated. For example, investment in the networks has been high (over £31 billion since privatisation in gas and electricity, over £50 billion in water, and similar amounts in telecommunications) and all the regulators consider that the RPI - X regime is capable of incentivising even higher levels of investment. But some regulated companies consider that the most recent periodic reviews provided for less investment than they considered necessary to prevent existing assets deteriorating, and that there may be a need for more resilient and flexible networks in future. There are also indications that the level of investment may have to rise in future to deliver the outputs the public expect. For example, the Better Regulation Task Force has reported an expectation in the electricity sector of an increasing need for investment⁸, while the Environmental Audit Committee has raised concerns about the level of investment in the water industry to manage and renew sewer and water mains⁹.

ii) RPI - X may distort incentives relating to investment

12 Price reviews enable the regulators to form a judgement about what it should cost network companies to deliver the outputs expected of them, but there is a degree of uncertainty about the relationship between cost inputs and the outputs delivered by regulated companies. Furthermore companies may not always be sure that regulators will accept that additional investment is necessary. This perceived lack of certainty creates an unintended reason for companies to defer investment. To address these concerns, regulators have developed a process, with varying degrees of formality, for logging up investments made by companies for consideration at the next price review. In the water industry, companies can also in some circumstances apply for an interim determination of price limits. Our survey of companies shows that this issue is a serious concern to them and that they believe that some longer-term certainty was needed. In the case of OFGEM and OFWAT there is a further complication arising from the differing treatment of capital and operating expenditure which may produce an unintended reason for companies to substitute capital for operating expenditure.

5 The regulators' response to investment risks

The regulators are taking a range of initiatives including:

- improving the quality of information and the incentives for long term investment. For example, OFGEM's Information and Incentives Project is intended to link electricity distribution company prices to improved measures of service performance, and OFWAT have collected similar information since 1990;
- encouraging companies to adopt a risk management approach to their network assets. For example, OFWAT's recent paper on Maintaining Serviceability and OFGEM's paper on asset risk management assessments propose frameworks for companies to assess more rigorously the investment needed to maintain their networks in a way that satisfies the regulators¹⁰; and
- focusing on the outputs required from the networks.

⁸ *Better Regulation Task Force, Economic Regulators (July 2001), paragraph 6.2. The Government's response to this report was published in February 2002.*

⁹ *Environmental Audit Committee, Water Prices and the Environment - Seventh Report, 1999-00 (HC597, 1999-00), paragraph 208.*

¹⁰ *OFWAT, MD161: Maintaining Serviceability to Customers (12 April 2000); OFGEM, Enhancing Asset Risk Management Standards in Gas and Electricity Network (8 November 2001).*

Risks to financing investment

i) Regulators may allow insufficient or excessive returns to investors

- 13** The statutory duties of regulators include a requirement to ensure that companies can finance their functions. In determining price limits for companies, they seek to meet this duty by allowing for a return on capital to reward investors. This allowance can be a large part of the costs estimated by regulators and hence of price limits. For example, the returns allowed in the water and electricity transmission industries amount to around one third of the total price paid by customers. Estimating an excessive return entails customers paying unnecessary costs, while estimating too low a return may discourage investors from providing funds to regulated companies, thus potentially making it difficult for companies to meet their obligations.
- 14** The regulators recognise that there is inevitably an element of judgement in their approach. But as the regulators have to include a precise figure in their calculations, there is always a significant risk arising from the possibility that the figure they estimate appears to observers to be either too high or too low. There have in particular been concerns expressed by some water companies that this risk has crystallised in the water industry, by allowing for too low a return in the last review. But OFWAT's view is that all companies have continued to finance their functions, that their assumptions were broadly consistent with those of other regulators and that companies dissatisfied with their price limits can require the regulators' decisions to be referred to the Competition Commission¹¹. And they point out that, since the review, some companies have successfully responded to the incentives within RPI - X to achieve more efficient financing costs by becoming predominantly debt rather than equity financed. OFWAT continue to monitor these developments to ensure that changes to a company's financial structure do not transfer risks currently borne by the company's owners to consumers.

ii) Investors may perceive the regulatory regime to be uncertain

- 15** It is inherent in the RPI - X approach that the certainty during the period after a review comes in exchange for the regulators having considerable discretion in how they determine prices and outputs at the next review. Investors are aware that changes made at reviews can substantially impact on profitability and hence their returns. This may create a perception of uncertainty in the minds of investors and hence increase the returns investors demand to finance new investment. Despite this perception of uncertainty, however, there have been few major changes in the overall RPI - X approach during the most recent price reviews. But companies in all industries told us that they had concerns about some elements of the methodology to be adopted by regulators in future. For instance, there were concerns as to whether investment undertaken during the period would be allowed in future price caps or whether changes would be made to the methodology for calculating allowed capital expenditure or returns on investment.

¹¹ In the case of OFWAT's 1999 price review, two companies required the licence amendments introducing new price limits to be referred to the Competition Commission.

6 The regulators' response to the risks to financing investment

The regulators are responding by seeking to improve the transparency and replicability of their price review work through:

- explaining more clearly to companies and investors the assumptions lying behind their calculations;
- seeking to communicate to companies and investors the methodologies they intend to use in future reviews; and
- considering, and in the case of OFWAT, committing to, the sharing of the financial models on which they base their calculations, so that companies and others can replicate their calculations.

Risks arising from the process of RPI - X regulation

The process of price regulation may impose excessive demands on companies

- 16** Even though the price review process produces substantial benefits for customers, it is not without costs for both regulators and companies. We have estimated that, on the basis of costs recorded by the regulators themselves, and responses to the survey we issued to regulated companies, the costs of the price reviews we have examined in detail for regulators amount to some £10 million (for four price reviews), and for each company a significant level of costs, which can in some instances exceed £1 million. These costs should be set against the benefits of the review process described above.
- 17** The regulated companies told us that it was not clear to them how much of the information they supplied to regulators had in fact been used. For example, a common concern across all regulated companies was that the detailed projections of future expenditure they provided were largely ignored. The regulators consider that they used all the information provided and had to spend considerable time verifying and confirming it, but that their conclusion had been to treat the projections with scepticism. This example serves to illustrate the risk that the RPI - X process imposes a large information burden on both regulators and companies. Regulators can reduce information burdens by collecting and verifying more information between reviews, for instance by using regulatory accounts provided by companies, although this may require changes in the format for some of these accounts.

7 The regulators' response to the risks arising from the process of RPI - X regulation

The regulators are:

- examining how to reduce the volume of information they request from companies;
- seeking to consult widely on their proposed price control approaches to help companies and others understand the purposes for which regulators request information;
- seeking to demonstrate how they use information they receive, through the use of clearer audit trails; and
- seeking to reduce the number of information requests and to rely to a greater extent on annual information returns and to revise the format of regulatory accounts to make them more useful (although it is inevitable that the forward-looking price review process will require some new information, principally projections for future periods).

Conclusions and recommendations

18 Through their regulation of network prices, OFGEM, OFTEL and OFWAT have been successful in ensuring that the networks are maintained and enhanced and in encouraging substantial improvements in efficiency which have been passed on to customers. The RPI - X approach does, however, have some inherent limitations (Figure 2). The regulators have already started to consider how they will conduct the next round of price reviews, and the following recommendations are aimed at helping the regulators to develop their existing practices so as to continue to mitigate the risks arising from these limitations.

A. Risks to the strength of incentives:

I **The regulators should seek to remove features of their price reviews that give companies an incentive to bias their decision making or accounting to obtain more favourable treatment.** Under the standard model of RPI - X, the length of time for which companies can benefit from out-performance of the regulatory assumptions about efficiency savings varies according to when the savings are made, which may lead companies to time their achievement of efficiencies according to a regulatory timetable (and not according to commercial or economic considerations). Similarly the differing treatment by OFGEM and OFWAT of operating and capital expenditure creates a risk that companies bias their planning, decision making or accounting to obtain a more favourable outcome. It is undesirable that the price review mechanism should risk influencing company behaviour in these ways. OFWAT already allow companies to keep all efficiency savings for five years, while OFGEM have allowed distribution companies to retain some types of efficiency saving in this way. OFTEL do not consider that there has been sufficient evidence of this weaker incentive to warrant such a change. OFGEM and OFWAT are also considering how to minimise the risks arising from different treatment of operating and capital expenditure.

B. Risks to investment in networks:

II **The regulators should consider publicly identifying the improvements in outputs and outcomes that they are willing to allow companies to invest in.** Companies are required to deliver outputs, such as the reliable delivery of water and electricity to consumers, which are explicit or implicit in government policy, legislation and the companies' licences. The companies have discretion over the inputs used to meet these outputs. But in setting price caps which enable efficient companies to finance their obligations, the regulators cannot avoid making assumptions about the outputs which are expected and the costs of delivering those outputs. To enable companies to plan and initiate investment projects effectively, regulators should provide clear guidance on developments in networks to meet changing circumstances or deliver better performance and the preferred balance between quality of service and price levels. Such statements should draw on the requirements of Government and other regulators, dialogue with regulated companies, and the preferences of the public; and they should be produced sufficiently ahead of each price review to facilitate coherent investment planning. All the regulators we examined have addressed this issue by setting out broad quality objectives, establishing clear methodologies for their assessment of company investment plans, and in some cases developing incentives to reward quality improvement. The provision of clear guidance and statements by regulators in this area could further enhance the effectiveness of regulation.



- III **The regulators should encourage network companies to develop risk management models to assess the potential impact of deterioration in asset performance on future levels of service.** While regulators obtain some measures of asset condition to support their price reviews, these do not tell the regulator what assets companies ought to replace in order to deliver the performance expected of them. The network companies are best placed to make this assessment. Such an assessment is needed to obtain a view of the investment required to maintain asset condition, especially if companies are to be able to justify the forward investment referred to in the previous recommendation by reference to outputs and outcomes. The regulators should be able to place some reliance on these models to reduce the amount of work needed during price reviews and to place the responsibility for securing the longer term condition of networks clearly with the companies themselves.

C. Risks associated with financing investment:

- IV **The cost of capital allowance should be set in a way that transparently and consistently reflects the returns investors expect from investing in the companies concerned, assuming that they are efficiently operated.** Prices and the willingness of investors to finance investment are sensitive to regulatory assumptions on cost of capital, which is an inherently unverifiable forecast, and the assumptions underlying which vary from review to review. Together, the regulators intend to commission research into the cost of capital issues across the regulated industries. The regulators should take this opportunity to develop further consistency, taking account of relevant differences between industries, which reflects research into what returns investors actually expect and the impact that heavy demand for finance for new investment may have on these returns.
- V **The regulators should present clearly the assumptions and financial models underlying their price review decisions and the extent to which these will apply at the next review.** The potentially costly perception of uncertainty in the price review process is aggravated if companies and investors do not understand precisely why regulators made their decisions and how they intend to conduct future reviews. The regulators' decisions are in practice based on the application of well established assumptions which need change little between reviews; but this has not prevented a perception of uncertainty, indicating the need for better communication with key stakeholders. To tackle the perception of uncertainty regulators should share the financial models they use to calculate price controls, and set out the principles on which future reviews will be based. OFWAT have already committed to do this.

D. Risks associated with the process of RPI - X regulation:

- VI **The regulators should specify clearly and well in advance what information they will need from companies during price reviews and gather as much of the information as is cost-justified on an annual basis.** All regulators we examined have sought to set out their information requirements clearly and in advance of their price reviews. And yet the strong perception among regulated companies is that regulators have asked for unnecessary information. This implies that regulators have not communicated clearly enough why they need the information and how they have used it. The regulators' review of regulatory accounts provides a good opportunity to even out the burden of information collection and gives the regulators more time to verify and hence rely on the information they receive. The aim should be for companies to acknowledge after the next review that they knew well in advance what information they would need to supply and why it was needed.
- VII **The regulators should publish an evaluation of their completed price reviews, and in doing so should evaluate the different types of analysis undertaken to determine whether some would not in future justify the cost to both regulators and companies.** As the regulated networks settle down after privatisation an increasing number of components of price reviews can be expected to be decided with sufficient accuracy without detailed analysis, bearing in mind that forecasts of future performance are inherently inexact in any case. By simplifying the price review process to elements of substantial importance to customers, the regulators ought in future to be able to reduce the costs of the process and concentrate on what really matters. The review conducted by OFWAT after their 1999 review, which they placed in the public domain, provides a useful precedent and the regulators' joint working groups may also be able to play a role in this evaluation.



Part 1

Pipe and wire networks contain monopoly elements that make regulation of prices and outputs necessary

- 1.1 This report is about the networks of pipes and wires that deliver electricity, gas, water and telecommunications to homes and businesses. This Part of the report explains that:
- these networks are an essential part of the economic infrastructure of the United Kingdom;
 - in the absence of effective competition, network price controls are necessary;
 - in controlling prices, regulators seek to balance a number of objectives, and use the RPI - X methodology; and
 - there has recently been increased interest in how regulators should set price controls in future.

Pipes and wires are an important part of the infrastructure of the United Kingdom

Pipes and wires provide essential services

- 1.2 The regulated industries provide basic services essential to human needs, for example water for sustenance and hygiene, and electricity and gas¹² for heating needs, as well as meeting social needs (telecommunications). Consumers and businesses demand these services because they are essential, and because there are few products or services that offer an acceptable substitute. The average household spends £22.85 a week on these services (**Figure 8**).

- 1.3 Water, energy and telecommunications services are also important for industry and commerce, as well as being important industries in their own right. In 1999, the electricity industry contributed to 1.3 per cent of GDP, and the gas industry contributed to 0.4 per cent of GDP¹³. And around 30 per cent of all water delivered is used by non-household consumers.

The network industries require significant investment in physical infrastructure

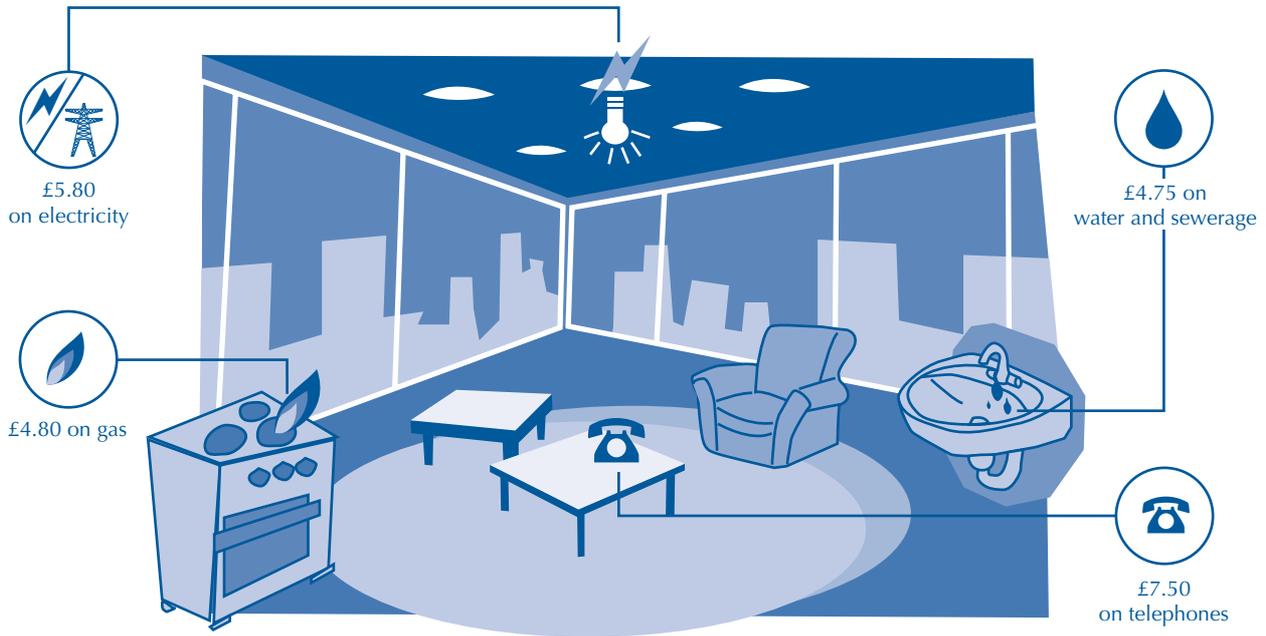
- 1.4 The electricity, telecommunications and water industries have large physical networks, as described in **Figure 9**.
- 1.5 The value of the assets in these industries is substantial, for example:
- the combined value¹⁴ of the 23 water and sewerage companies is £30 billion, although this is a somewhat artificial estimate given that some of these assets have a very long useful life and some are already more than one hundred years old;
 - the regulatory asset value of the electricity transmission network operator, National Grid Company, was established as £4.5 billion at the most recent price review; and
 - the combined assets of the 12 electricity distribution companies (in England and Wales) are valued at £12 billion.

¹² Where relevant we have taken examples from gas and railway industries as well as telecommunications, electricity and water. However, neither gas nor railway price reviews form part of the case studies around which we build our analysis.

¹³ Department of Trade and Industry, Energy Report 2000.

¹⁴ As measured by the value of regulatory assets at the start of the next control period, as recognised by OFWAT during the most recent price control review in 1999 prices.

8 Average weekly household expenditure on telephone, electricity, gas and water



Source: Family Expenditure Survey 2000, OFWAT

9 The physical infrastructure of the networks



Telecommunications: BT's fixed line telecommunications network consists of a "backbone" of wires connecting 740 local exchanges and 70 main exchanges, each of which in turn connects with lines from households and businesses in its locality. BT's network also connects to the national networks of several other companies, and in some areas the networks of cable companies connect to BT's local exchanges. There are some 34.5 million fixed telephone lines in the UK.



Electricity: Electricity is transmitted across a national network of high voltage wires owned and operated by National Grid Company. The electricity transmission network in England and Wales consists of some 14,000 kilometres of overhead electricity lines, some 600 circuit km of underground cables and some 320 sub-stations. The transmission network connects to regional (distribution) networks of relatively low voltage powerlines, through which electricity is transported to individual properties. These are owned and operated by distribution companies. The distribution networks consist of around 295,000 circuit km of overhead lines, around 465,000 circuit km of underground cable, and around 550,000 transformers in commission.



Water and sewerage: The water and sewerage network in England and Wales includes 635,000 kilometres of mains and sewers (excluding those owned by private suppliers). In addition to the pipes along which water is distributed, the water supply network includes facilities for abstraction (such as rivers, wells, springs and boreholes), treatment plants, pumping stations and storage facilities, including service reservoirs and pumping stations. The sewerage network includes underground sewers and treatment facilities.

Source: OFTEL, OFGEM, OFWAT

1.6 The physical size of the networks, combined with the associated costs of building, maintaining, operating and financing the networks, means that it is difficult to restore services if there are serious problems. For example, according to the Health and Safety Executive, to reconnect 3,000 customers safely to the gas network can take at least two weeks of work by highly-trained engineers. Because many of the pipes and wires are hard to access, maintaining or replacing them can be difficult, costly, and disruptive to others. For example, as water supply pipes tend to be underground, work to fix leaks may involve digging up roads, causing disruption and congestion costs to road users¹⁵. As an illustration of the disruption caused by interrupted supplies, an explosion at a gas plant in Melbourne, Australia in September 1998 severely affected gas customers. Gas supply was cut to all but essential services (such as hospitals) for two weeks, and the gas industry turned off and turned back on over 1.3 million customers, the largest gas system shut down and relight exercise ever undertaken. And in the UK, addressing the problems of the railway network following the derailment at Hatfield has caused considerable network-wide disruption.

The network industries have monopoly characteristics and are regulated by independent economic regulators

- 1.7 Each of the regulated industries was privatised as a monopoly, or with monopoly elements. British Telecommunications and British Gas were privatised as vertically integrated suppliers, holding a national monopoly in the provision of key services (notably network operation, and supply to domestic consumers), while facing competition in provision of some services. Water companies were also privatised as vertically integrated suppliers, with regional monopolies. The electricity industry was restructured prior to privatisation, with generation privatised as a competitive market; but transmission remained a national monopoly; and distribution and supply companies were privatised as regional monopolies (Figure 10).
- 1.8 To minimise the adverse consequences of monopoly, the privatisation of these businesses was accompanied by the creation of independent economic regulators, who, though subject to statutory duties, had discretion in how they went about the detailed regulation of their respective industries. The regulators are:

10 How the industries were privatised as monopolies or near monopolies



Telecommunications: British Telecommunications (BT) was privatised following the Telecommunications Act 1984. BT was sold in three tranches: in November 1984, November 1991 and July 1993. Although Mercury Communications was permitted to operate in competition to BT, the latter operated a near monopoly in fixed telecommunications network services, while Mercury built its network.



Electricity: The 12 electricity distribution companies in England and Wales were sold in 1990 following the Electricity Act 1989, as regional monopolies offering combined electricity supply and distribution. There are also two companies in Scotland. Following the Electricity Act 1989, electricity transmission in England and Wales was operated by a national monopoly supplier (National Grid), owned by the regional electricity companies. It was floated as an independent company, the National Grid Company (NGC) in 1995.



Water and sewerage: Following the Water Act 1989, shares in the 10 water and sewerage companies were sold to the public in November 1989. In addition, 29 privately owned companies supplied water (but not sewerage) services prior to 1989. The Water Act 1989 removed restrictions on the capital of these water-only companies. Privatisation resulted in a regional monopoly structure, with each company licensed to operate a monopoly either of water and sewerage or water supply only within their licensed area.

Source: National Audit Office

15 Our December 2000 report on OFWAT's work on leakage and water efficiency provides more detail on how the water industry addresses the leakage issue. National Audit Office, Office of Water Services: Leakage and water efficiency (HC971, 1999-2000).

- The Director General of Telecommunications who is supported by the Office of Telecommunications (OFTEL), established by the Telecommunications Act 1984. OFTEL regulate the telecommunications industry in the United Kingdom.
 - The Director General of Water Services who is supported by the Office of Water Services (OFWAT) established by the Water Act 1989. OFWAT are the economic regulator for the water industry in England and Wales.
 - The Gas and Electricity Markets Authority, supported by the Office of Gas and Electricity Markets (OFGEM), and created in 2000 by the Utilities Act 2000, from the merger of the offices of the former regulators of gas (OFGAS) and electricity (OFFER). OFGEM regulate the electricity industry in both England and Wales, which has a significant degree of separation between generation, transmission, distribution and supply and also in Scotland, where the industry structure is more integrated. OFGEM also regulate the gas industry in Great Britain.
- 1.9 The regulators are independent of direct Ministerial control, although the appointment and reappointment of regulators (whether individuals or, as in the case of OFGEM, a regulatory authority) is made by the relevant Secretary of State¹⁶, in consultation where relevant with devolved administrations. Other regulatory offices in the United Kingdom include the Office of the Rail Regulator (ORR); the Water Commissioner for Scotland; and the regulator for the electricity industry in Northern Ireland (OFREG).

Although there have been changes in these industries, incumbent companies remain dominant in provision of networks

- 1.10 Since privatisation, technological and legislative developments have permitted the development of competition in some parts of the regulated industries. The development of alternative delivery technologies has enabled the development of some competition between networks in telecommunications. In other industries, there is no competition between networks, but regulators (backed up by changes in legislation) have made it possible for competition in the supply of services delivered across one physical network. The National Audit Office has reported on how domestic consumers have benefited from the introduction of competition into gas supply, so that by changing supplier consumers could make on average savings of

£78 a year¹⁷, and electricity supply, where the average switching benefit is £45 a year¹⁸. In geographic areas without competition between telecommunications networks, it is possible for consumers to choose between suppliers when making calls, using lines owned and operated by BT.

- 1.11 Technical constraints and the cost advantages available to network operators have, however, meant that in most utility industries regulators have been constrained in opening up the provision of networks to competition. The amount of competition between networks varies but in all cases the incumbent network operators have a monopoly or dominant position as suppliers of network services (Figure 11).

In regulating networks, regulators aim to balance several objectives

- 1.12 In regulating networks that are monopolies or nearly so, regulators have to consider the interests of consumers and investors. All regulators have a statutory duty to protect the interests of consumers in respect of price and quality of service (Appendix 2). Following the Utilities Act 2000, OFGEM's primary duty is to protect the interests of consumers. The statutory duties of OFTEL and OFWAT to protect the interest of consumers are secondary duties, arising from the Telecommunications Act 1984 and the Water Industry Act 1991 respectively. Regulators must also take into account the interests of investors because all regulators have a statutory duty to ensure companies can finance their functions (Appendix 2). This means that regulators need to take a view on the preferences of customers and society for balancing outputs against prices. And they need to consider financing both current operations and long-term investment.
- 1.13 As well as balancing the interests of consumers and investors, regulators need to strike a balance between the interests of today's consumers, and the interests of consumers in future generations. If regulators keep down prices in the short term so much that companies cannot invest in the longer term maintenance of network operation and service provision, consumers in later years will have to pay more. Other duties on regulators are set out in Appendix 2. They all have statutory duties to promote the economy and efficiency of companies, and competition in their industries, and to ensure all reasonable demands for services are met.

¹⁶ *The Secretary of State for Trade and Industry for OFTEL and OFGEM and the Secretary of State for Environment, Food and Rural Affairs for OFWAT.*

¹⁷ *National Audit Office, Office of Gas Supply: Giving Customers a Choice - The Introduction of Competition into the Domestic Gas Market (HC 403, 1998-99).*

¹⁸ *National Audit Office, Office of Gas and Electricity Markets: Giving Domestic Customers A Choice of Electricity Supplier (HC 85, 2000-01).*

11 Market developments affecting network operation since privatisation



Fixed telecommunications: Technological change, and demand for new telecommunications services (for example the internet) have influenced market developments since privatisation. The Duopoly Review White Paper Competition and Choice: Telecommunications Policy for the 1990s, which was published in 1991, paved the way for other operators to enter the telecommunications market. Some operators have built networks in competition to BT, offering business and residential customers in some areas a choice between competing networks. Indirect access operators allow customers in all areas to choose between competing suppliers (even if their lines are owned and operated by BT). BT's competitors can also lease capacity at BT's local exchanges, allowing them to provide services to customers in competition to BT, but without the need to build a competing network of lines. But BT continues to be subject to price controls because OFTEL consider that BT remains dominant in the supply of certain network services.



Electricity: Since privatisation, Public Electricity Suppliers have had separate distribution and supply businesses, for which they have had to account separately. The Utilities Act 2000 required that those businesses be placed into separate companies. This process was substantially completed in October 2001 with the introduction of separate distribution and supply licences. Full supply competition was introduced in electricity by May 1999. However, monopolies remain in distribution (regional) and transmission (national), both of which are subject to price controls. OFGEM have sought to introduce competition in services ancillary to the transmission, distribution and supply of electricity, for instance by allowing developers to choose who installs connections to the distribution network and through competition in metering and meter services.



Water and sewerage: The number of companies has reduced to 23 as a result of merger activity in the 1990s. OFWAT have facilitated the introduction of competition for some users through the introduction of inset appointments, for large users and greenfield sites. The threshold for inset appointments was reduced in 2000 to 100 megalitres per year. The threat of competition has led to reduced tariffs for large users. However, most customers do not yet have a choice of supplier and water companies retain a near monopoly on supply within their areas. Consequently, charges for licensed water and sewerage services are subject to price controls.

Source: National Audit Office

To meet these objectives, the regulators use a common approach to price controls, called RPI - X

1.14 In the absence of effective competition for network services, the main tool available to regulators is the licence they issue to companies and the conditions attached to these licences. One of the key conditions seeks to protect customers from the potential abuse of monopoly power by placing limits on the prices or revenues that companies can earn. While there is no statutory requirement to set price controls, since privatisation the economic regulators have all used the licences to do so and have adopted a common methodology, RPI - X. This approach limits the prices the regulated company can charge for the services it delivers in any given year to a specified level adjusted by the subsequent movement in general economy-wide prices (as measured by the Retail Price Index), less an X value determined by the regulator. Our 1996 report on the work of the regulators showed how each of them used this approach to price control¹⁹.

1.15 The RPI - X mechanism protects customers by limiting the extent to which companies can raise their prices. The regulators set a limit on prices that covers the estimated costs of delivering the services required of companies efficiently. The RPI - X mechanism can therefore also be called output-based regulation. The approach taken by regulators recognises that companies could abuse their monopoly power by reducing the quality of service to customers, or by failing to deliver outputs expected. The extent to which the RPI - X approach is explicitly linked to expected outputs and measures of quality of service varies but all regulators monitor the quality of service provided by companies, and monitor the delivery of outputs expected by the regulator, to ensure companies do not abuse their monopoly power in this way.

1.16 Companies have the right to appeal against regulators' price determinations, under the relevant industry legislation. For example, if BT wishes to challenge the introduction of a price cap, it must object to the licence modification through which OFTEL propose to implement the price cap. If OFTEL wish to proceed with the modification, they make a reference to the Competition Commission (formerly the MMC), which investigates and reports on whether the modification would remedy or prevent an actual or potential harm to the public.

¹⁹ National Audit Office, *The Work of the Directors General of Telecommunications, Gas Supply, Water Services and Electricity Supply (HC645, 1995-96)*.

There are important differences in regulated industries, which lead to differences in the way regulators undertake price regulation

- 1.17 The number of companies subject to price cap regulation ranges from one in the case of electricity transmission (in England and Wales)²⁰ to 23 in the case of water (also in England and Wales). This affects the methodology of price control reviews, and influences the outcome of the review in terms of the levels of price controls set by the regulator. The existence of several companies in an industry enables a regulator to compare the service performance and efficiency of companies. For example, OFWAT set more demanding efficiency targets for companies that have undertaken their activities relatively less efficiently than other companies.
- 1.18 The nature of the customer²¹ for network services also varies between industries. While the water and sewerage companies supply services directly to households and non-domestic users, the customers of the other networks are not necessarily end-users:
- in telecommunications, the customers for BT's network services are the retail part of BT, and other telecommunications operators including cable and mobile operators, who need to connect to BT's network;
 - in electricity transmission, the customers of the network companies are generators, distribution companies, some suppliers and a few very large industrial size consumers; and
 - in electricity distribution, customers are companies providing retail electricity services.
- 1.19 The industries have had different investment requirements since privatisation:
- the water companies will, by 2005, have invested £50 billion since privatisation²², much of which has been to meet European Union standards on the quality of water. Some of the extra costs of these higher standards have been financed not through higher prices, but through efficiency savings achieved by regulated companies.
 - substantial investment in telecommunications has been driven by developing technology, new operators entering markets, and by expansion of capacity to meet demand for new telecommunications services including facsimile, and the Internet delivered via both narrowband and broadband wires.

- by contrast, the electricity transmission and distribution networks have not required investment on such a large scale. Changes in the location of sources of electricity and gas may, however, necessitate future strengthening of some parts of these networks in the next few years.

There are concerns that the standard form of price control regulation may no longer be appropriate for UK regulation

- 1.20 Since the most recent reviews, observers from a range of backgrounds have raised concerns about the effect of the RPI - X form of price control on long-term investment. In its July 2001 report, Economic Regulators, the Better Regulation Taskforce voiced concerns about long term investment in the regulated industries and noted that "there is a view that the financial incentives engendered by RPI - X may inhibit investment for the future"²³. The example of the railways in the aftermath of the Hatfield crash, though reflecting specific issues within the railway industry, has also raised the profile of investment and network integrity. As Railtrack undertook a major programme to identify cracks in rails, substantial disruption to rail services ensued. This demonstrated the importance of maintaining networks in good condition, to avoid the need for such emergency measures.
- 1.21 When the Environmental Audit Committee reported on the OFWAT Periodic Review, they did not report specifically on the relationship between RPI - X and investment. However, they said they were not satisfied that OFWAT's approach in the last price review to maintenance and renewal of underground assets (sewers and water mains) was an acceptable means of assessing the amount of investment water companies need to undertake²⁴. The Committee said the approach should be forward looking, and should enable companies "to adequately prepare to renew and repair the cohorts of sewers and mains which will come up for renewal/rehabilitation simultaneously as a result of historical peaks in building activity". OFWAT have told us that they have no evidence that such historical peaks in building activity have led to problems in the required rate of repairs.
- 1.22 Many companies and other respondents to our survey expressed concern about the appropriateness of price cap regulation in an environment in which investment needs to increase. For example, one company said

²⁰ There are also two transmission companies in Scotland, so that there are three transmission companies in total in Great Britain.

²¹ In this report, we use the term "consumer" when we are describing the general duty on the regulators to minimise the adverse consequences of monopoly, and the term "customer" when we are describing the specifics of the price controls for network services.

²² OFWAT, *Water and Regulation: Facts and Figures* (October 2001).

²³ Better Regulation Task Force, *Economic Regulators* (July 2001), paragraph 6.2.

²⁴ Environmental Audit Committee, *Water Prices and the Environment - 7th Report, 1999-00* (HC597, 1999-00), paragraph 208.

"there is little incentive to invest in a manner appropriate for a business with long life assets. The regime drives us to make short term decisions" while another said "although the price control leads to short-term price reductions, the methodology is not robust to deliver efficient investment or ensure the longer term integrity of the network." There was also a perception that the uncertainty associated with RPI - X made it harder and more expensive to undertake investment.

1.23 Some observers believe that the era in which price cap regulation could drive out efficiencies is coming to an end, since most regulated companies are now considered by some to be relatively efficient. This was a view identified by our survey of companies and stakeholders in regulated industries. For example, one company in the electricity industry said that the "scope for substantial savings is much less than in the past - RPI - X regulation has been successful already."

Scope of our examination

1.24 We examined four price control reviews in detail (**Figure 12**) which were completed between 1999 and 2001, and considered evidence from other price control reviews, so as to consider well in advance of the next round of price reviews:

- how well price cap, or RPI - X regulation, has worked (Part 2); and
- the risks and challenges that face regulators in implementing this approach (Part 3).

1.25 Our methodology is set out in Appendix 1. We also drew on:

- a survey we undertook of stakeholders in regulation;
- discussions, including a focus group, with regulators and regulated companies, and an expert panel;
- a paper we prepared on the principles of RPI - X regulation (Appendix 3);
- papers we commissioned from NERA and Frontier Economics respectively on the cost of capital (Appendix 4) and on incentives (Appendix 5); and
- international best practice in the audit of economic regulation²⁶.

1.26 We would like to thank all those who helped us carry out the research for this report, including the regulators, regulated companies, government Departments, consumer bodies and members of our expert panel.

12 Price controls we examined in detail

	Regulator	Control applies to	Control period	Review dates
	OFTEL	BT's Network Charge control	1 October 2001 to 30 September 2005	Commenced in May 1999, with final conclusions in February 2001
	OFGEM	NGC's electricity transmission revenue	1 April 2001 to 31 March 2006	Commenced in December 1999, with final conclusions in September 2000
	OFGEM	Electricity distribution revenue	1 April 2001 to 31 March 2005	Commenced May 1999 ²⁵ , final proposals December 1999
	OFWAT	Water and sewerage charges	1 April 2000 to 31 March 2005	Announced in October 1996, with final determinations November 1999

Source: National Audit Office

25 The distribution price control review commenced in May 1999 with OFGEM's initial consultation document and ended soon after their final proposals document in December 1999. However, this price control was part of a wider review of price controls that commenced 18 months earlier in July 1998.

26 The International Organisation of Supreme Audit Institutions (INTOSAI), *Guidelines for Best Practice for the Audit of Economic Regulation* (October 2001).



Part 2

Price cap regulation has delivered substantial benefits

- 2.1 This Part of the report describes how the RPI - X mechanism provides regulated companies with an incentive to increase efficiency. It then shows how, under the operation of this mechanism, regulated companies have found efficiency savings in response to this incentive, and how this has allowed regulators to pass efficiency savings on to customers through lower prices, and in some cases quality improvements.
- 2.2 There are weaker incentives for monopolies to find ways of operating more efficiently compared to companies in competitive markets. This weaker incentive leads to the problem of productive inefficiency - in essence, costs higher than they should be (as shown by the paper at Appendix 3). Competition by contrast provides companies with the incentive to undertake their activities more efficiently. In the absence of competition, regulators in the UK use the RPI - X form of price control to mimic the outcome in competitive markets in which companies strive to operate as efficiently as possible.
- 2.3 The process involves regulators defining the outputs companies are required to deliver, and then estimating the efficient costs of delivering those outputs. Other important elements of the process include ensuring that investors in regulated companies can earn a fair return on their investments and performing checks to ensure that each company is able to finance its activities. On this basis, regulators have established the maximum amount by which prices can change in the next price control period. This maximum amount has taken the form of the prevailing rate of inflation (measured by the Retail Price Index, or RPI), less a given percentage factor, usually known as X²⁷. Hence the price control has come to be called RPI - X. The process is illustrated in **Figure 13**.
- 2.4 Under RPI - X, regulators have estimated an efficient level of costs for the regulated companies and allowed them to recover these costs in their prices. The efficient level of costs has in some cases been estimated on the basis of comparisons between companies. **Figure 14 overleaf** provides a hypothetical example of how the regulator's estimate of the costs and returns needed by the regulated company can be reduced by incorporating an assumption about the efficiency savings a company can make.
- 2.5 For industries with several local monopolies, such as water and electricity distribution, regulators have estimated efficient costs on the basis of comparisons between the operations of each company (known as benchmarking or yardstick competition). For industries with national network operators, such as telecommunications and electricity transmission,

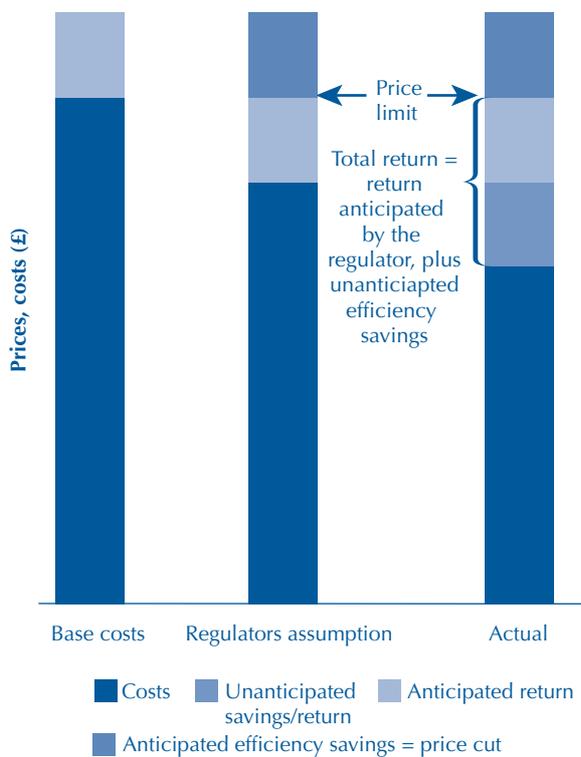
13 Illustration of the price control setting process



Source: National Audit Office

²⁷ In the water industry, the price control takes the form of $RPI \pm K$. The licences of water companies provide that in any charging year the increase in weighted average charges (ie the weighted average of the increase in charges in unmeasured water supply and in measured water supply), when expressed as a percentage, should not exceed $RPI + K$ (the charges limit).

14 A hypothetical example demonstrating the impact of anticipated and unanticipated efficiency gains

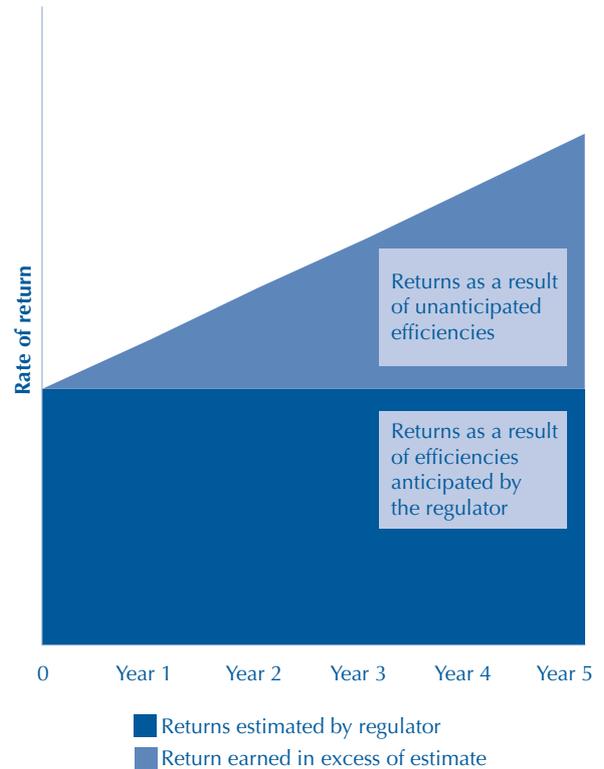


Source: National Audit Office

regulators have sought where possible to identify international comparators. For example OFTEL have benchmarked BT against American Local Exchange Carriers in its price reviews²⁸. The regulators have varied in the extent to which they analyse company expenditure into its different components and the types of modelling undertaken. Both OFWAT and OFGEM (for electricity distribution) have benchmarked operating and capital expenditure separately. The modelling this entails can only be approximate and can potentially lead to perverse incentives to alter the balance between expenditure types (considered further in Part 3). OFWAT and OFGEM have therefore assumed that companies which appear according to these analyses to be less efficient than the most efficient can, in a given period, only 'catch-up' a proportion of the efficiency needed for them to reach the 'frontier' of most efficient companies. OFTEL commissioned a benchmarking study from National Economic Research Associates on the total costs of BT's operations, which concluded that BT was close to being comparatively efficient.

2.6 Under the standard form of RPI - X, the price control sets a limit on the extent to which companies can increase prices. But while prices are fixed during the control period, the costs of delivering the outputs are not. If companies incur lower costs than assumed by the

15 The impact on company returns of unanticipated efficiencies



Source: National Audit Office

regulator, they can earn greater returns than the regulator assumed. In Figure 14, the third column shows that any unanticipated efficiency savings made by the company translate to an increase in returns to the company. The incentive to find efficiency savings results from allowing the company to keep the extra profits it earns if it makes such savings for a given period. **Figure 15** illustrates how the company's returns increase if the company makes unanticipated efficiency savings (other things being equal).

2.7 There are therefore two potential strengths of the RPI - X system:

- **it delivers strong incentives to increase efficiency:** Frontier Economics (see their paper at Appendix 5) consider the strength, or power, of an incentive regime in terms of the proportion of cost saving retained by the regulated company. They conclude that the RPI - X system gives strong incentives to achieve efficiency gains. Incentives are at their strongest, in their view, when the regulator can identify good external benchmarks to estimate an efficient level of costs²⁹. A large majority of all respondents to our survey agreed that the incentives that the regulator gives companies during the price control to improve operating efficiency are strong.

²⁸ OFWAT has also published international comparators - see report published December 2001: *The Worldwide Water Comparison 1999-2000*.

²⁹ As Frontier Economics state in their report (Frontier Economics, *Incentives* (July 2001), Appendix 5 to this report, paragraph 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."

- **it helps to solve the problem of asymmetric information between regulated company and regulator.** The regulated company may have more information than the regulator about its own costs, and the company's ability to operate more efficiently. The regulator may not know what the efficient costs of delivery could be (and in some cases the company itself may not be fully aware of its potential for increasing efficiency). By providing an incentive for the company to keep at least some of the benefits of operating more efficiently, the RPI - X mechanism reveals to the regulator the potential for the company to find future efficiency savings. And the large efficiency gains made by companies in earlier periods have encouraged regulators to set challenging targets in recent reviews.

2.8 Incentives under RPI - X are stronger if companies are allowed to keep savings for longer periods. Were price controls to be set to last indefinitely, companies would have a very strong incentive to make efficiency savings, because they would keep all the benefit of further savings they make. But in this case customers would not share in these benefits. By contrast were price controls to be reset every year, companies would have little incentive to make efficiency savings, because unanticipated savings would be immediately taken away by regulators (as price reductions to customers)³⁰. To provide a balance between the need to provide incentives for efficiency, and the need to pass the benefits of savings to customers, the UK regulators typically set price controls for five years (except for OFTEL, who have adopted a four year period).

2.9 There is, however, a risk that incentives to find efficiency savings are weaker toward the end of price control periods, because companies keep the benefit of these savings for less time than the benefits of efficiency savings made earlier in the price control period. The majority of companies responding to our survey on the OFGEM distribution and transmission price controls considered that incentives to improve operating efficiency weakened toward the end of the price control period. One company commented that "without some form of 'rolling operating expenditure' methodology, the incentives are weaker towards the end of the period."

2.10 In recent reviews, regulators have therefore strengthened the incentive for companies to find efficiency savings later in the price control period, by introducing a "rolling" retention mechanism that allows companies to keep savings for a set period, regardless of when (within the price control period) the efficiencies

arise. For example, OFWAT have introduced a rolling retention mechanism through which efficiency savings in excess of regulatory assumptions are retained by companies for 5 years before being passed to customers³¹. Most water companies who responded to our survey welcomed this mechanism. And OFGEM's electricity distribution price control introduced a rolling mechanism for capital expenditure to allow companies which spent less on capital items than expected at the time of the last review to keep the full benefit of this under-spend³². Of the electricity distribution companies who commented on this in our survey, all regarded it favourably³³. OFTEL by contrast have sought to address this issue by anticipating more accurately likely efficiency savings delivered by companies.

Under price cap regulation, regulators can pass efficiency gains on to customers in a variety of ways

2.11 Under price cap regulation, there is scope for companies to increase their profits through making efficiency savings. As noted in Appendix 3, these profits can appear excessive to customers, and the regulatory regime and regulated companies may be criticised as a result. But the "excess" returns need only last until the regulator next resets prices or revenues, when the efficiency savings made by the company (which resulted in "excess" returns) are passed to the customer. At each price review, regulators can also ensure that prices reflect future anticipated efficiencies that companies can be reasonably expected to make. Regulators can pass such efficiency gains back to customers in several ways:

- requiring immediate price cuts, such that the company's rate of return is reduced to the cost of capital immediately. Sometimes this requires a one-off adjustment to the level of prices, called a P₀ adjustment;
- making phased price reductions through a "glidepath" mechanism, such that the rate of return is reduced to the cost of capital by the end of the price control period;
- requiring companies to deliver a high level of quality for the same level of prices; or
- a combination of these methods, for example an immediate price cut passing a proportion of past efficiency gains back to customers, accompanied with further phased reductions in prices over time.

³⁰ Frontier Economics, *Incentives* (July 2001), Appendix 5 to this report, Section 2.

³¹ OFWAT, *Future water and sewerage charges 2000-05, Final Determinations* (November 1999), paragraph 6.3.

³² OFGEM, *Distribution Price Control Review, Final Proposals* (December 1999), paragraph 6.12.

³³ Four companies mentioned the rolling incentive mechanism for capital expenditure, out of a total of 10 responses.

2.12 The glidepath approach to phasing price reductions may provide stronger incentives for companies to find efficiency savings, but the immediate benefits passed to customers are smaller than when an immediate, or P_0 , adjustment, is made (Figure 16). The Committee of Public Accounts noted in 1997 that there were differences in approach adopted by regulators where industries make profits which are in excess of the amounts considered an appropriate level for the remuneration of capital³⁴. These differences in approach persist. For example, OFTEL do not employ immediate adjustments when it sets price controls for BT, because they believe that incentives to find efficiency savings would be harmed. In their price review in 1994, OFWAT also adopted a 10 year glidepath approach. However, in their 1999 price review, OFWAT moved a P_0 adjustment for water and sewerage charges in line with the views of the Committee of Public Accounts and the Monopolies and Mergers Commission³⁵ so that customers benefited quickly from the efficiency savings achieved by companies from 1994 to 1999. Similarly, OFGEM have also used a P_0 adjustment for electricity distribution charges.

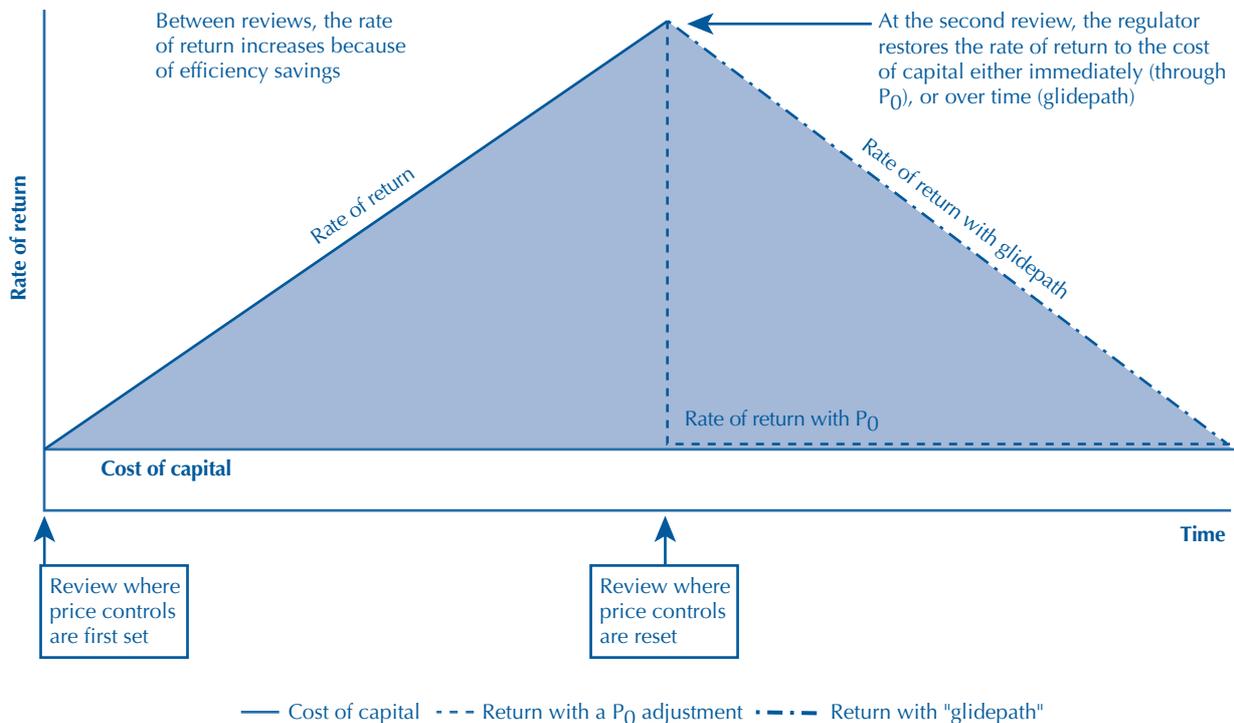
2.13 As output-based regulation sets prices for specified or implicit outputs, regulators can also pass on efficiency gains to customers through improvements in the quality of service. Efficiency savings allow companies to deliver the same outputs at a lower price, or to deliver more

outputs (either in quality or quantity) for the same price. If companies make efficiency savings, regulators can impose a higher level of quality or investment on regulated companies, to be delivered at the same price. Quality in turn has two elements: short term quality of service; and maintaining the condition and performance of the core pipe and wire assets in the longer term. In practice regulators only choose to pass on efficiency savings through improved service rather than lower prices where they have identified a clear need for improvement. The risks facing regulators as they seek to create incentives to improve the condition and performance of these assets is discussed in Part 3.

Price cap regulation has delivered a variety of benefits

2.14 As indicated below, there is clear evidence of widespread efficiency gains during recent price control periods by regulated companies across all the industries we looked at, and no evidence that efficiencies have been achieved at the expense of reduced reliability in the provision to customers of essential services. The efficiency gains have been passed on to customers through better services or lower prices, or both. This evidence supported the view that RPI - X has strong incentives to increase efficiency, and can enable prices to fall without detriment to quality of service.

16 The differences between a P_0 adjustment and the glidepath approach



Source: National Audit Office

34 Committee of Public Accounts, *The Work of the Directors General of Telecommunications, Gas Supply, Water Services and Electricity Supply - Sixteenth Report 1996-97 (HC 89 1996/97)*, paragraph 76.

35 Monopolies and Mergers Commission, *Portsmouth Water PLC: A report on the determination of adjustment factors and infrastructure charges for Portsmouth Water PLC (15th June 1995)*, paragraphs 2.58 and 2.59. A similar point was made in the Commission's determination for South West Water, published at the same time. The Monopolies and Mergers Commission was the predecessor of the Competition Commission.

Price cap regulation has been associated with efficiency gains in each industry

2.15 In all of the regulated industries we looked at, companies have found ways of operating more efficiently. They have either reduced their costs during recent price control periods, or, in the case of the water industry, where costs have increased to deliver improvements in quality, companies have incurred expenditure more efficiently (Figure 17).

Service reliability has also been maintained or improved

2.16 The reductions in the costs of the networks have been accompanied by increased or maintained reliability in terms of reducing interruptions to the provision of essential services, across all the industries, as:

- interruptions in the supply of electricity have fallen since 1990 as a result of improved performance in the electricity transmission and distribution systems (Figures 18 and 19);
 - the number of water consumers subject to unplanned supply interruptions has fallen since 1990 (Figure 20); and
 - the percentage of successfully completed telephone calls has been maintained at a very high level (Figure 21).
- 2.17 There are many other ways in which the quality of service delivered to households and businesses can be measured. OFWAT have paid particular attention to promoting quality of service by network companies, by requiring them to supply each year independently validated figures against a wide range of indicators which OFWAT publish as a way of encouraging improvements in performance (Figure 22). These indicators have shown a generally rising trend. A number of respondents to our survey on OFWAT's water and sewerage charge control indicated that the publication of league tables by the regulator acted as an incentive for companies to maintain and improve service performance in order to maintain their reputation.

17 Efficiencies achieved and projected in regulated industries



In **telecommunications**, BT Network achieved a weighted average rate of reduction in real unit costs of 9.4 per cent up to 1999/2000, reflecting both regulatory incentives and advances in technology. In its most recent review, OFTEL assumed BT Network could make an underlying real unit cost reduction of 3.27 per cent per annum in the four year period October 2001 to September 2005, the same underlying rate as achieved in the four-year period to 1999/2000. The actual reduction in real unit costs up to 1999/2000 includes the effect of volume growth and real input price changes whereas the underlying rate of reduction in real unit costs does not.



In **electricity transmission**, National Grid Company has reduced controllable operating costs by 50 per cent since 1990.



In **electricity distribution**, each company achieved efficiency savings to varying degrees. Overall operating costs of distribution businesses reduced by around 25 per cent in the period 1994-95 to 1997-98.

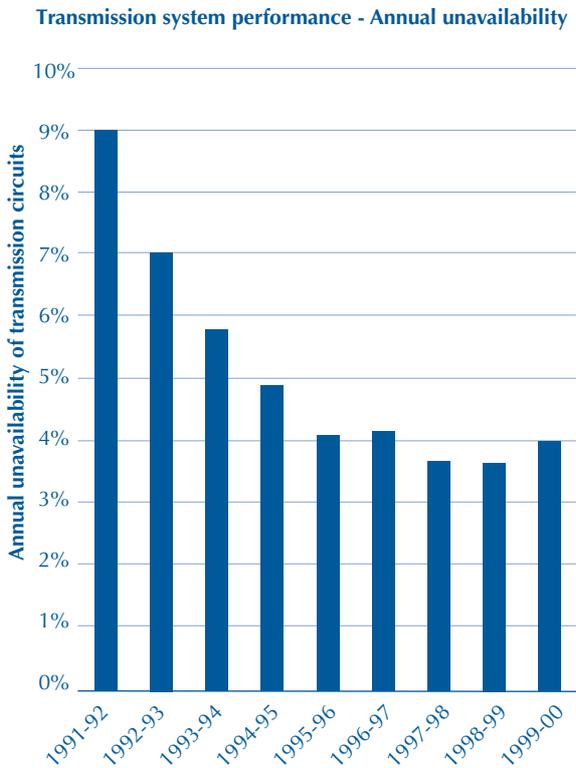


Water companies have achieved substantial reductions in unit costs since 1990, with companies outperforming OFWAT's operating expenditure projections by 6 per cent between 1989-94, and by 9 per cent between 1994-99. OFWAT have been able to make extensive use of yardstick competition, including the use of econometric models, to set anticipated efficiency gains for water companies³⁶. OFWAT estimated efficiency savings in base operating expenditure (the costs of delivering a fixed service) ranging from 3 to 37 per cent for individual companies, in aggregate amounting to some £590 million in 1998-99 (compared to 1995-96). OFWAT also estimate efficiency savings of up to 30 per cent in quality enhancement programmes, and savings of up to 15 per cent in capital maintenance expenditure.

Source: OFTEL, OFGEM, OFWAT

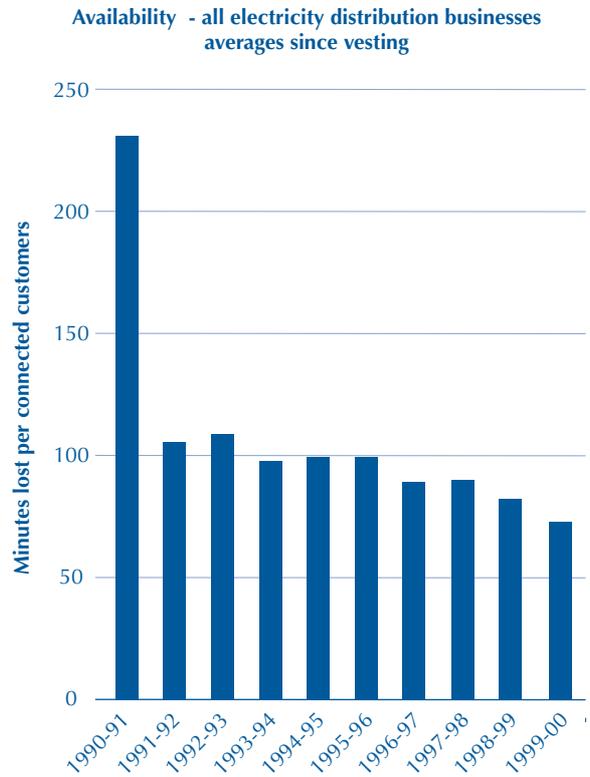
³⁶ These econometric models have featured as a case study in the Performance and Innovation Unit's report on modelling in government, *Adding it Up: Improving Analysis and Modelling in Central Government* (January 2000).

18 Electricity transmission - unavailability (percentage), 1991-2000



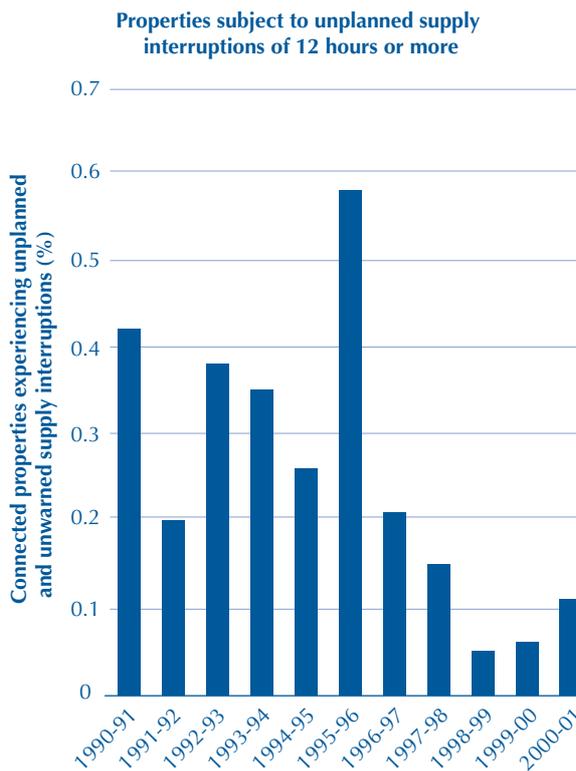
Source: OFGEM

19 Electricity distribution - unavailability (minutes lost), 1990-2000



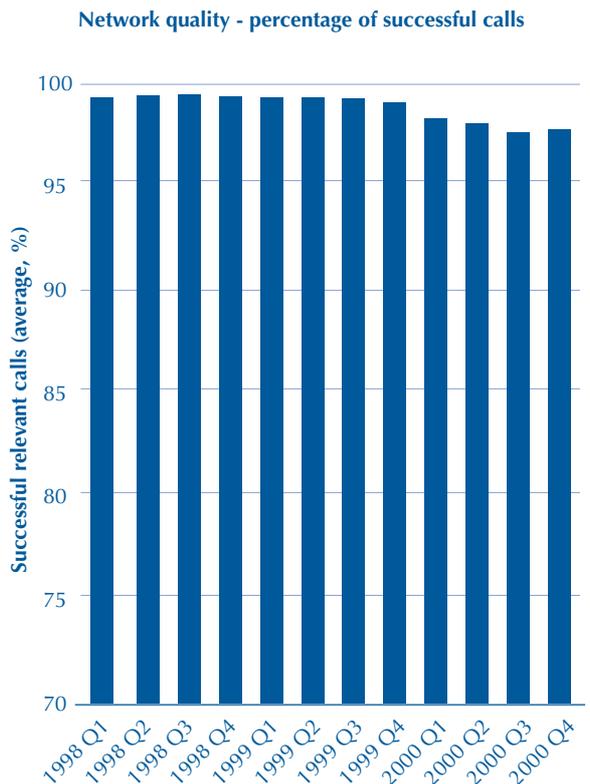
Source: OFGEM

20 Properties subject to unplanned water supply interruptions of 12 hours or more, 1990-2001



Source: OFWAT

21 Telecommunications - Network quality - successful relevant calls, 1998-2000



Source: OFTEL

2.18 OFGEM and OFTEL also collect information on quality of service, which shows that companies have improved their performance, but they have not gone as far as OFWAT in making the results for individual companies publicly available. Since their last review, however, OFGEM have developed an Incentives and Information Project designed to link efficiency distribution company performance against three key measures of service³⁷. In doing so, they have identified inconsistencies in the way companies report performance, which are being eliminated in the new reporting arrangements being required. OFGEM intend to incorporate the Project into the next price review. In telecommunications, operators' retail performances are directly compared in a publication entitled Comparable Performance Indicators. This publication, which is publicly available, includes comparisons of operators' performances in terms of faults reported and time taken to repair them.

2.19 Regulators have also sought to create, or are considering, incentives for improved quality and reliability of service. OFGEM have considered including price incentives for the National Grid Company to strengthen capacity in their future electricity transmission price reviews. In

telecommunications, BT has an incentive to increase the capacity of its network since not only its network business but also its retail business can benefit, as it enables more traffic to be conveyed at a high grade of service.

2.20 OFWAT have most explicitly linked improvements in efficiency to improvements in quality of service. These improvements have been used to offset the investment OFWAT have considered necessary to achieve improved drinking water and environmental standards required by European Union legislation. In addition, at the last price control review OFWAT introduced a mechanism whereby better performing companies (relative to companies as a whole) are rewarded through an upward adjustment to the prices they are allowed to charge in the subsequent price control period. In their 1999 price review, 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 was judged to fall into this category. Five companies received a positive adjustment and five had their price limits reduced.

22 Measured quality of service



Telecommunications: Quality of service by the network operator is not perceived to be a problem in fixed line telecoms. OFTEL do not specify standards or outputs for BT Network to attain, instead they monitor service performance to customers of BT Network, using measures agreed between BT and OFTEL, and reported annually by BT. This monitoring has shown a high standard of quality of service, with the percentage of successfully connected calls in the fourth quarter of 2000 standing at 97.5 per cent (Figure 21).



Electricity transmission: Electricity transmission is associated with high reliability and quality, with no transmission-related voltage or frequency excursions, though OFGEM have incentivised measures relating to meeting demand for use of the system. OFGEM believe NGC's customers have generally benefited from a high quality of supply, for example there were no transmission related voltage or frequency excursions in 1998/99 and the total annual unavailability of transmission circuits fell from 9 per cent in 1991/92 to 4 per cent in 1999/00 (Figure 18).



Electricity distribution: OFGEM measure a range of aspects of quality of supply, including the average number of supply minutes lost per customer, and the number of interruptions per 100 customers. At the last electricity distribution review, OFGEM considered that quality measures had improved. In terms of measured quality of service, the weighted average number of supply interruptions per 100 customers fell from 112.6 in 1990/91 to 81.4 in 1999/00 (Figure 19), and the weighted average number of minutes lost per connected customer fell from 227.4 in 1990/91 to 70.8 in 1999/00.



Water: Service performance has shown a steady improvement across the range of levels of service and environmental indicators during the last price control period and beyond. OFWAT use a wide range of information to assess the service performance of companies, including customer service, and water and sewerage services, and they publish indicators of service performance in annual reports. In addition, the Drinking Water Inspectorate reports on drinking water quality, and OFWAT and the Environment Agency reports on environmental performance. The most recent OFWAT report³⁸ indicates improved service performance for the industry as a whole across most indicators and a huge investment programme to meet quality targets. For example, in addition to reductions in the number of properties subject to unplanned supply interruptions (Figure 20), properties at risk of low pressure fell from 1.85 per cent in 1990/91 to 0.11 per cent in 2000/01. And properties subject to sewer flooding fell from 0.05 per cent in 1992/93 to 0.03 per cent in 2000/01.

Source: National Audit Office

37 Covering interruptions and responses to reports of interruptions.

38 OFWAT, Revised levels of service for the water industry in England & Wales 2000-2001 (September 2001).

Regulators have been able to pass on efficiency gains through reduced prices

2.21 In the most recent price control reviews we examined, regulators passed efficiency savings on to customers through reductions in future prices. In water and electricity distribution, the regulators combined immediate price, or P_0 , reductions with other methods of passing benefits to customers. In water, OFWAT accompanied this P_0 cut for customers with an increase in allowed investment in water quality programmes, while OFGEM combined the P_0 reduction with further

price reductions over time. In the most recent electricity transmission price review and in telecoms, the regulators passed efficiency savings on to customers through phased reductions in prices over the period without making use of P_0 reductions. The evidence for each case study is set out in **Figure 23**. This evidence is consistent with the large price reductions described in our 1996 report on this subject. This found that, in real terms, prices had fallen by between 10 per cent and 44 per cent for domestic electricity, gas and telecommunications customers, and by between 9 per cent and 54 per cent for business customers³⁹.

23 Price reductions in each industry



In **telecommunications**, charges for some services will fall by 13 per cent per year in real terms as a result of the price control, while services in markets that are prospectively competitive cannot increase by more than RPI+0%. As an illustration of the effect of the controls, BT's network revenues for 2000-01 were 7.4 per cent lower than if, in the absence of price controls, they had increased charges in line with the RPI index.



The last **electricity transmission** price review resulted in transmission charges falling by 1.5 per cent each year from 2002/3 in real terms. This is ultimately passed on to final consumers in the form of lower bills. As transmission charges in total only make up 5 per cent, on average, of the final consumer's bill, the impact of this is limited.



The most recent **electricity distribution** price review cut distribution charges on average by 24 per cent in real terms. Distribution charges make up over a quarter of the final customer's bill on average, and the review therefore lowered the average electricity bill of £251 excluding VAT, in 1999, by 5 per cent. The extent of the price reductions for final consumers varies by individual company and will depend in future on the extent to which electricity supply companies pass on distribution reductions to final consumers.



The latest OFWAT review of **water and sewerage** charges reverses the trend of rising prices since privatisation. Until April 2000, water customers faced increasing prices, reflecting a very large quality programme. In its 1999-2000 review, OFWAT decided to introduce a P_0 adjustment, reducing average water company prices by 13 per cent in 2000-01. OFWAT reduced the average household bill by £35 (in real terms) between 1999-2000 and 2004-05, as a result of past efficiencies and out-performance. And OFWAT's assumptions about future efficiency savings allowed them to reduce the average household bill by a further £25 (in real terms) over the same period. In addition, six water companies passed on rebates to customers totalling some £275.9 million between 1995-96 and 1999-2000, as a result of efficiency savings made during the period, while in the same period companies deferred price rises for an additional benefit to customers of around £54 million⁴⁰.

Source: OFTEL, OFGEM, OFWAT

³⁹ National Audit Office, *The Work of the Directors General of Telecommunications, Gas Supply, Water Services and Electricity Supply (HC645, 1995-96)*.

⁴⁰ All figures for OFWAT are in 1999 prices.

Part 3

Regulators are seeking to address the risks arising from price cap regulation

3.1 This Part of the report considers how regulators are seeking to address the main long-term risks arising from the limitations of price cap regulation. In particular, it sets out:

- how regulators are addressing the risk under price cap regulation that incentives to maintain and enhance the pipe and wire networks may be distorted;
- how regulators are addressing the risk that investors may not be willing to provide funds for investment; and
- how regulators are addressing the risk that the process of price regulation imposes significant demands on companies.

Regulators are seeking to ensure that there is sufficient long-term investment in networks

3.2 The regulated companies in the pipe and wire industries are in essence asset-owning businesses⁴¹. The pipe and wire network assets they own produce outputs - in the form of water, electricity, gas and telecommunications delivered to homes and businesses across the UK. They maintain and enhance the capacity of these networks to deliver these outputs through expenditure - principally capital expenditure, but also operating expenditure. Regulators aim to create incentives for companies to ensure that the pipe and wire networks continue to deliver the required outputs. The main method for creating these incentives is the RPI - X mechanism, and this section focuses on the incentives within RPI - X.

3.3 In essence, RPI - X provides a form of long-term contract through which companies are rewarded for delivering specified outputs and are given incentives to improve the value for money they provide, with periodic break-points so that changes in circumstances can be taken into account. Although RPI - X is mainly to be found in the regulation of utilities, **Figure 24** gives an example of how London Underground has approached similar challenges through the establishment of a contract for delivering electricity outputs. Their approach has many features in common with the approach adopted by the regulators, for instance it provides similar incentives for improved efficiency, while seeking to provide both parties with enough certainty to encourage longer-term investment.

24 London Underground Limited's output-based contract for electricity supply⁴²

London Underground Ltd (LUL) has over 270 stations and over 400 kilometres of track. It has traditionally supplied most of its own electric power, in the past using its own two generating stations, and has the largest non-utility electricity network in the UK. In 1998, following a competitive process, LUL signed a thirty-year contract with Seeboard Powerlink (a consortium consisting of the electricity distribution company Seeboard, BICC (now Balfour Beatty) and Asea Brown Boveri, hereafter the Contractor) for the operation, maintenance, repair and renewal of its electricity distribution network. LUL chose a long duration for the contract to ensure proper long-term provision of service, and to secure lower costs and less uncertainty than repeated short-term contracts would provide. The Contractor is responsible for designing and implementing the future investment programme in accordance with LUL's specification of the required outputs, backed by a comprehensive survey of asset condition at the time of contract signature. The contract is worth over £1 billion, and involves over £100 million⁴³ capital investment during the first five years. While the Contractor has to report regularly on financial and operational performance, the price is largely fixed at the outset. Although the contract does not include the five yearly reviews that are a standard feature of the RPI - X approach, there are provisions to vary or review the contract for changes in prices and other circumstances.

⁴¹ Some companies have been considering separating the asset-owning and asset-operating elements of their business operations.

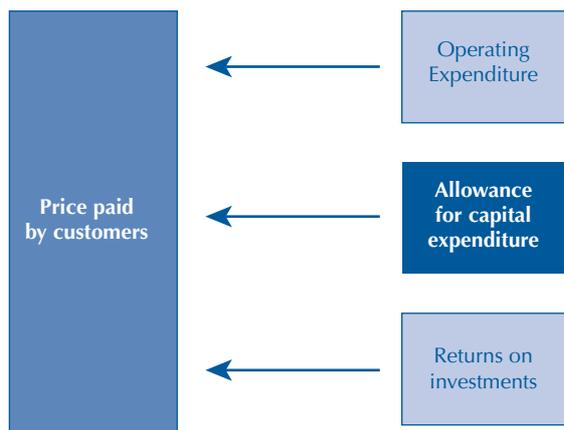
⁴² This example is taken from a paper by Professor Stephen C Littlechild: *Competitive Bidding for a Long-term Electricity Distribution Contract*, Judge Institute of Management Studies (4 June 2001).

⁴³ In 1998 prices.

There is a risk that price cap regulation provides distorted incentives for companies to undertake investment

3.4 Regulators typically include an allowance for capital expenditure in their assessment of the maximum prices regulated companies can charge. **Figure 25** provides a generic model of how regulators tend to include capital expenditure under the RPI - X form of price control.

25 Capital expenditure within RPI - X (generic model)



NOTES

1. "Price paid by customers" relates to two distinct forms of price caps. Some price caps take the form of caps on the overall revenue that the regulated firm can raise from the regulated business; while others take the form of capping unit prices.
2. The figure is generic and the approaches adopted by individual regulators may be slightly different. For example, for OFTEL the projected price paid by customers in the last year of the price control just covers the sum of operating expenditure, including depreciation, and return on investment (cost of capital).

Source: National Audit Office

3.5 But there is a risk that the incentives to maintain and renew assets under RPI - X are distorted. The Frontier Economics report (Appendix 5) identifies three potential ways in which the standard RPI - X approach to investment may provide distorted or unintended incentives:

- **risk of an unintended incentive for companies to defer investment.** There may be an incentive on companies to incur expenditure more slowly than the regulator has assumed, since deferring expenditure will raise returns in early years of the review period. The link between input of capital expenditure and output - in terms of changes in the performance of the assets - is much less immediate for capital expenditure than it is for operating expenditure, so companies can defer capital expenditure more easily. Furthermore, uncertainty about the regulator's approach to capital expenditure in future price reviews may mean that companies are reluctant to commit to long-term investments. Regulators have developed the principle of logging up investments made by companies for consideration at the next price review to address this risk, although with varying degrees of formality.
- **risk of weaker incentives to achieve efficiencies in capital costs than in operating costs.** Under the RPI - X approach, capital expenditure has tended to be treated separately from operating expenditure, although both contribute to the performance of network assets (paragraph 2.5). In practice, benchmarking of capital expenditure has tended to be less demanding than that of operating expenditure because it is difficult to identify external benchmarks and because regulators may be unwilling to risk reductions in the quality of network performance by setting challenging targets for reductions in capital costs⁴⁴. The incentives to achieve efficiencies in capital costs may as a result be weaker, since companies can, by incurring capital costs, increase their allowed revenue during the next price control period. Frontier Economics note that the risk of weaker incentives arises from using a single variable - the firm's investment programme - to regulate simultaneously costs and quality outputs; and
- **risk of unintended incentives to substitute capital costs for operating costs.** If regulators benchmark operating expenditure without also benchmarking capital costs, firms may perceive an unintended incentive to substitute capital expenditure for operating expenditure. This substitution could take two forms: firstly, bias in projecting future expenditure (in business planning), and secondly, bias in the accounting treatment of actual expenditure. As Frontier note, this substitution will not be in the public interest, since there is an optimum mix of capital and labour and favouring one expenditure category over another can only distort this mix.

⁴⁴ As noted by Frontier Economics in Appendix 5 to this report, there are potential benefits in treating capital and operating expenditure together, by setting a single target for allowed expenditure, and both OFGEM and OFWAT have considered adopting this approach. There are, however, significant practical difficulties in doing so, and in their most recent price reviews, regulators have maintained the separate approach.

- 3.6 As part of our survey we asked respondents about the strength of incentives under price cap regulation to achieve efficiency in capital expenditure compared to operating expenditure. The ratings given by the single company industries (electricity transmission and telecommunications) did not vary between these incentives. However, companies in the electricity distribution and water industries rated the incentives to achieve efficiencies in capital expenditure as slightly less strong than the incentives to improve operating efficiency. Half the respondents in electricity distribution and a third of the respondents in water gave a lower rating to the strength of incentives to achieve capital efficiencies.
- 3.7 OFTEL seek to avoid potential perverse incentives between operating and capital costs by benchmarking the total costs incurred in delivering the outputs delivered (an approach known as total factor productivity). At the last review OFWAT and OFGEM considered using such an approach for the water and electricity distribution industries but did not consider that the approaches they tried produced sufficiently reliable results to justify placing much reliance on it. They both intend to re-consider the interaction of incentives between operating and capital expenditure.

There is a risk that regulators make decisions on the level of investment on the basis of inadequate information

- 3.8 Although regulators set an allowance for capital expenditure through the price control process, they do not have the same detailed knowledge as the regulated companies of the condition of the assets. Furthermore, it is hard to assess the condition of underground assets, such as water mains, and the design life of some network assets can be very long (at least 40 years for many wire networks and far more for water mains).
- 3.9 Regulators can obtain (and in OFWAT's case have analysed) historic figures on how much maintenance and renewal has cost the companies. But this gives an inadequate guide to how much it will cost to deliver the required outputs in future, and there are in general a series of limitations to the information available to regulators for estimating the expenditure companies need to incur to maintain and enhance outputs:

- **pipe and wire networks have an underlying resilience.** United Utilities, who, as a multi-utility involved in electricity distribution, water and telecommunications, manage networks of both pipes and wires, told us that networks were characterised by an underlying resilience. This means that it could take some time for inadequate or inefficient expenditure on maintaining and enhancing them to be reflected in declining quality of outputs. And some electricity distribution companies told us that it can be difficult to know how robust the distribution network will be in the face of adverse weather conditions that may arise only once every 20 years.
- **links between capital expenditure and quality of network performance are hard to identify.** The inputs - in terms of money and time - into any network investment project are usually easy to predict. But, as noted by the Competition Commission⁴⁵, the impacts of the project on network performance, in terms of longevity of asset or capacity of network, are harder to predict, especially for the regulator who operates at one remove from day-to-day operations. Our report Ensuring that Railtrack Maintain and Renew the Railway Network brought out how, for railways, linking investment input to quality outputs is not always clear⁴⁶. ORR subsequently addressed these issues in their price review, completed in October 2000, which sought to create clearer links between prices and outputs.
- **it is hard to assess how much customers are prepared to pay for improvements in network performance.** Customers pay for investment in networks through their bills for water, electricity and telecommunications. The resilience of these networks, and their ability to cope with surges in demand, has a public benefit but also involves costs, which are borne by customers. Regulators therefore have to make a judgement on the value that customers place on resilience, for instance using customer surveys, so as to determine whether investment expenditure is justified. But, though regulators undertake surveys of customer preferences, customers' valuations of qualitative measures, such as network resilience, are difficult to measure in a meaningful manner.

⁴⁵ As the Competition Commission have noted in the context of water, "the relationship between service delivery performance indicators and the condition of the assets is not always clear. For example, a satisfactory trend may be the result of other factors, such as pressure reduction or improved operating procedures, masking or distorting an underlying deterioration in the system." Competition Commission, *Mid Kent Water plc: A report on the references under sections 12 and 14 of the Water Industry Act 1991 (September 2000)*, paragraph 6.33.

⁴⁶ National Audit Office, *Ensuring that Railtrack maintain and renew the railway network (HC397 Session 1999-2000)*, paragraph 3.26: "...although it is desirable that performance indicators should measure the performance of the network, for example in terms of train delays, the complexity of the network and the variety of the assets making it up mean that this performance cannot always be immediately related to the level and quality of maintenance and renewal activity".

3.10 In considering investment issues, regulators need to be wary of the risks both of over-allowance for investment, which may raise prices unnecessarily, and of deferring investment, which may lead to problems with network performance. This in turn creates the further risk that regulators become too concerned with the details of investment plans, effectively taking the regulated company's decisions for them. In so doing, they may take away the primary responsibility for the condition of pipe and wire networks from regulated companies and weaken the incentives on companies to manage investment efficiently themselves. The alternative approach is to set clear output based targets for companies and leave discretion on how to achieve those targets for companies, although in the absence of competitive pressure on companies, regulators may be obliged to consider the reasonableness of the costs incurred in delivering those outputs.

3.11 According to our survey, a majority of the electricity distribution companies and water companies considered that the regulators should set as a priority creating incentives to maintain and develop the condition of the network beyond the current price control period. One area emphasised by companies in their responses was the importance of information on asset condition and the long-term condition of the network. For example, one electricity company told us that "It is not clear that incentives are sufficient to ensure that companies invest in their networks for the longer term. The way in which investment will be rewarded in the next price control review is not defined" while a company in the water industry concurred: "What is needed, however, is a more substantial reform of the framework for price-setting so that the long-term is at the heart of the process."

Regulators are seeking to improve the information they use to make decisions on investment where appropriate

3.12 There is as yet no conclusive evidence to demonstrate that the pipe and wire networks are deteriorating. But some regulated companies consider that the most recent periodic reviews provided for less investment than they considered necessary to prevent existing assets

deteriorating, and some observers have suggested that the level of investment may have to rise in future to deliver the outputs the public expect. For example, a recent report by the Performance and Innovation Unit has suggested that electricity networks will have to cope with substantial changes in the pattern of energy supply and may need greater flexibility and resilience than has been demanded over the last 10 years⁴⁷. Against this background, some observers told us that the need in the future may well be for "fatter", more resilient (and possibly more expensive) networks. For example, some electricity distribution companies told us that they perceive a potential increase in demands for investment to enable greater use of smaller electricity generating units (known as embedded generation), an issue which OFGEM already have under active consideration⁴⁸, and the Environmental Audit Committee has also raised concerns about the level of investment in the water industry⁴⁹, although OFWAT consider that there is no evidence to suggest there is a problem.

3.13 Each of the regulators is conscious of the potential limitations of RPI - X and has considered carefully how to address the issues around information and investment. This is in line with international best practice identified by INTOSAI⁵⁰. Regulators have focussed on four areas:

- improving information on asset condition and network performance;
- ensuring that companies' investment plans are appropriate;
- creating incentives for companies to undertake investment in network performance; and
- developing a risk-focussed approach to considering the capacity and resilience of network assets.

3.14 **Figure 26** shows the approach taken by each regulator. It shows how OFTEL have been able to rely on market pressures to incentivise investment to a much greater extent than the other regulators. And all regulators are continuing to develop their thinking in this area, through consultations with companies on how to improve information and incentives in the area of network investment.

47 Performance and Innovation Unit, *The Energy Review* (February 2002).

48 OFGEM, *Embedded generation: price controls, incentives, and connection charging: A preliminary consultation document* (September 2001).

49 Environmental Audit Committee, *Water Prices and the Environment - Seventh Report, 1999-00* (HC597, 1999-00), paragraph 208.

50 INTOSAI, *Guidelines on Best Practice for the Audit of Economic Regulation* (October 2001), guideline 19.

26 Regulatory approaches to information, incentives and investment

OFTEL: Several features of the telecommunications industry result in a different regulatory approach to network quality and integrity, compared to the other industries.

In telecommunications, technological developments happen more quickly; there is a degree of competition between networks; and network failure has less catastrophic (though still important) implications for customers and society. Further, the network operator, BT, has a direct financial interest in the quality of the network as a result of operating both network and retail businesses, and the existence of competition to its retail business. And BT told us that its reputation for good service levels, even in the less competitive parts of their network, is a vital form of competitive response. These factors point toward a stronger incentive for BT to invest in its network, compared to other industries, and accordingly OFTEL pay less attention to BT's investment than other regulators in their respective industries. OFTEL's approach is to monitor network quality measures, partly to gain assurance on network quality, and also to ensure that BT's network business does not discriminate in the quality of service it provides between BT's retail business and other operators. Information gathering is directed toward monitoring network quality. OFTEL have not identified problems with network quality, although BT told us that it was aware that if under-investment caused any significant quality problems, OFTEL were able to step in with formal controls. OFTEL intend to continue with their current approach.



OFGEM Electricity Transmission: 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.



OFGEM Electricity Distribution: OFGEM's Information and Incentives Project (IIP) represents a promising development. It derives from OFGEM's approach to the risks discussed in this report⁵¹. It concentrates on firstly improving the information collected and secondly developing an incentive scheme linking financial payments to quality of service. OFGEM are also planning to ensure that future comparisons of performance take account of legitimate differences between companies, identifying broadly two types of difference where it may be appropriate to make adjustments for differences across companies:

inherited differences - differences inherited at the time of privatisation;

inherent differences - differences that relate to the area in which a company is licensed to distribute electricity and may include topographic factors.

On risk management models, OFGEM have recently issued a paper on asset risk assessments which proposes frameworks for companies to assess more rigorously the investment needed to maintain their networks in a way that satisfies regulators⁵².



OFWAT: OFWAT take a close interest in company investment plans and the performance of company networks. They challenge capital investment costs systematically by the cost base analysis they undertake, through which companies provide estimated costs for illustrative projects. OFWAT use this information to assess an "efficiency frontier" for water companies.

In 2000, they issued a paper on maintaining the serviceability of water networks⁵³, which requires companies to undertake economic appraisals of how their capital maintenance and investment plans will maintain and enhance serviceability to customers. It also recommends that companies undertake a risk analysis of probability of loss of serviceability to customers. For example, Yorkshire Water is adopting such an approach to its investment plans, through which it defines the economic levels of service for a range of service-quality indicators based on customer priorities, and focuses investment in areas providing maximum service quality benefits per pound spent.

OFWAT seek to provide an incentive for companies to improve overall performance. Their means of providing incentives is to make an adjustment to reflect the overall standard of service provided to customers, as described in Part 2 paragraph 2.19 of this report.



Source: National Audit Office

⁵¹ For example, OFGEM have, in considering future distribution price controls, stated that "in particular, 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." (Quoted in *Frontier Economics, Incentives* (July 2001), Appendix 5 to this report, paragraph 85).

⁵² OFGEM, *Enhancing Asset Risk Management Standards in Gas and Electricity Networks* (8 November 2001).

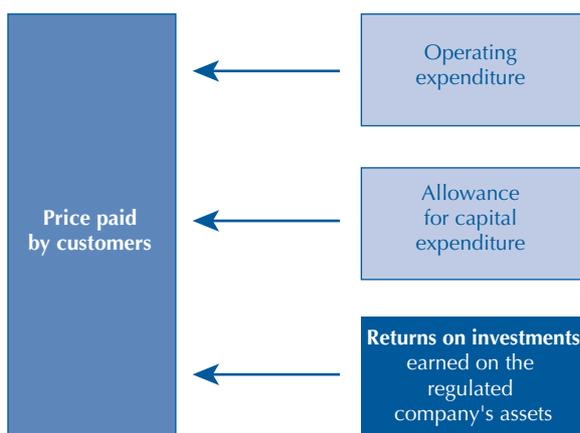
⁵³ OFWAT, MD161: *Maintaining Serviceability to Customers* (12 April 2000).

Regulators are seeking to ensure that investors are willing to provide funds for long-term investment

Under price cap regulation, there is a risk that regulators allow insufficient or excessive returns to investors

3.15 The returns on investment allowed by regulators within the price cap formula is one of the key determinants of levels of investment. Companies require finance, provided by investors in the form of debt and equity, in order to undertake investment. Investors in turn require the prospect of adequate returns, commensurate with the risk of investing, to induce them to provide this finance. Regulators typically allow for these returns by estimating what they consider to be a reasonable return on the company's assets (known as the company's Regulatory Asset Base or Regulatory Capital Value) and including this return in the overall price cap that they set. **Figure 27** shows how the regulators' allowed returns on investment form a part of the price that regulated companies can charge their customers. Given the size of the asset bases in these industries, this allowed return can form a significant part of the final price paid by customers - up to a third in the case of water and electricity distribution.

27 Returns on investment and the price paid by customers (generic model)



For notes, see Figure 25.

Source: National Audit Office

3.16 Regulators are confronted with two complementary risks in setting the allowed returns on investment. If returns allowed by regulators are above the level investors require, the investors can earn excess profits, and customers have to pay higher bills. But if returns are below the required level, companies may encounter difficulties in financing their functions. Companies may respond by seeking to achieve lower financing costs, altering their financing structure (for example, increasing debt) or reducing the level of investment. These potential responses in part reflect the incentives within RPI - X for companies to meet and beat the regulators' assumptions on an efficient level of financing costs, in the same way as for operating and capital costs.

3.17 To address this risk, regulators use a rigorous approach to estimating reasonable returns, using a set of standard calculations known as the Capital Asset Pricing Model. These calculations are based on assumptions about the returns investors require and the way the companies are financed, including:

- **the risk-free rate:** the rate which investors would require to invest in a risk-free asset. This is typically estimated on the basis of the returns investors require from government gilt-edged securities.
- **the equity premium:** this is the additional return that investors typically require to invest in risky assets, such as a portfolio of shares traded on the stock market.
- **the relationship between company returns and returns to the market as a whole:** the returns earned by an individual company are related to the returns earned by the market as a whole to a greater or lesser extent. The closeness of this relationship is a factor in estimating the returns investors require. The report we commissioned from National Economic Research Associates (NERA), at Appendix 4, explains further about how the riskiness of a company is estimated under the Capital Asset Pricing Model.
- **the financing structure of the company:** this includes assumptions about the proportions of debt and equity in the company's financing structure in the future, and about the cost of debt. Since debt issued by a company is regarded by the market as more risky than government debt, investors expect a premium for holding company debt.

3.18 All regulators apply this model, though OFGEM and OFWAT cross-checked their results using an alternative model, known as the Dividend Growth Model, while OFTEL examined the possibility of using another alternative known as real options modelling. The merit of regulators applying a standard model is that their calculations should be relatively transparent and easy for observers, such as regulated companies and investors, to replicate.

3.19 We examined the assumptions made by regulators in their most recent price reviews, and the rates of return they estimated on the basis of these assumptions. We found a broad consistency in regulatory approaches and assumptions, as illustrated by **Figure 28**. The most significant differences arise in the estimation of the relationship between the company's returns and those to the market as a whole. This is what we would expect, given that this relationship will inevitably vary from industry to industry.

3.20 By setting allowed returns in this way, regulators are able to provide some reassurance to investors that they will earn a reasonable return on any funds they provide to regulated companies. They also provide an incentive to companies to achieve the most efficient financing arrangements, in much the same way that setting allowed expenditure provides an incentive to increase efficiency (see Part 2). Companies can adjust their financing arrangements in a variety of ways, including increasing the ratio of debt to equity in their balance

sheet. For example, in the water industry, some companies, notably Glas Cymru, have sought to move towards a financing structure dominated by debt⁵⁴. OFWAT continue to monitor these development to ensure that changes to company financial structure do not transfer risks currently borne by the company's owners to consumers.

3.21 Estimating returns is inherently imprecise. The formula the regulators use typically produces a range, and the values for each of its components, such as equity risk premium and the balance of debt and equity in a company's balance sheet, change constantly as a result of market activity. It would be impossible for regulators to anticipate perfectly the movements of markets in the future and it is unreasonable to expect them to achieve complete accuracy in this calculation. But in order to calculate the price cap, regulators must choose a specific value within the estimated range at a specific point in time.

28 How regulators have set returns on investment in their most recent price reviews



OFTEL: In their 2001 network price review, OFTEL estimated a weighted average rate of return on investments of 13.5 per cent (before tax but including inflation) for BT's regulated businesses. Key assumptions include a risk-free rate (including inflation) of 5.1 per cent, a financial structure of 30% debt, and a beta of 1.29. This is a much higher beta than estimated by other regulators, which implies that BT's returns are more volatile than those to the market as a whole. This reflects the higher degree of competition and uncertainty faced by BT plc as a whole and OFTEL's judgement that BT's regulated businesses were not to any significant extent less volatile than BT as a whole.



OFGEM Electricity Transmission: In their 2000 price review, OFGEM assumed a weighted average rate of return on investments of 6.25 per cent (before tax and in real terms) for the National Grid Company, using the Capital Asset Pricing Model and corroborated using the Dividend Growth Model. Key assumptions included a risk-free rate, based on current market returns for index-linked gilts, of 2.5 to 2.75 per cent, a financial structure made up in equal proportions of 60 to 70 per cent debt, and a beta factor of 1.0. OFGEM noted that this beta factor appeared generous in comparison to the principal publicly available estimate from the London Business School of 0.56.



OFGEM Electricity Distribution: In their 1999 price review, OFGEM assumed a weighted average rate of return on investments of 6.5 per cent (before tax and in real terms). Key assumptions included a risk-free rate of 2.5 per cent, a financial structure made up in equal proportions of debt and equity, and a beta factor of 1.0, implying that the returns to electricity companies are closely correlated to returns to the market as a whole.



OFWAT: In their 1999 price review, OFWAT estimated a weighted average rate of return on investments of 4.75 per cent (post-tax and in real terms), using the Capital Asset Pricing Model. Key assumptions included a risk-free rate, based on current market returns for index-linked gilts, of 2.5 to 3.0 per cent, a financial structure made up in equal proportions of debt and equity, and a beta factor (used to measure the relationship between stock market returns and the returns to the company) of 0.7 to 0.8. The beta factor was lower than that chosen by other regulators, reflecting OFWAT's view that the water companies operated in a relatively stable and lower risk environment compared to the UK stock market as a whole. Other key adjustments included a premium for the smaller companies in the water industry, amounting to an additional 0.75 per cent on the post-tax cost of capital, and an adjustment for the costs of embedded debt owed by companies.

Source: OFTEL, OFGEM, OFWAT

⁵⁴ Glas Cymru, a company limited by guarantee, acquired Welsh Water in 2001, and is now funded largely with bonds, alongside financial reserves. Other water companies moving to a financing structure in which debt predominates (often described as the "thin equity model") include Mid Kent Water and Portsmouth Water.

- 3.22 Since the calculation is a judgement at a certain point in time, rather than a mechanistic exercise, there is inevitably scope to question the figures set by regulators. This is particularly the case where observers perceive that regulators have set too low or too high a level of returns. Our survey showed that there is some concern over the cost of capital allowed by regulators. According to the results of our survey, however, most regulated companies considered that their most recent price control had enabled them to continue to finance their activities.
- 3.23 The exception was the water industry, where a majority of water companies expressed concern over this issue. One water company commented "it is arguable whether the returns allow companies to finance their functions in the longer term. This is evidenced by the reaction of the markets to the review - with companies being valued at a significant discount to their Regulatory Asset Value - evidence that equity investors do not believe that the returns allowed are satisfactory." Since the 1999 periodic review, however, Thames Water has been sold at a substantial premium to its quoted share price, suggesting to OFWAT that not all investors think the cost of capital was too low. OFWAT consider that it is too soon in the regulatory cycle to judge whether the cost of capital they allowed was appropriate or not.
- 3.26 On regulatory system uncertainty, NERA's review of relevant literature produced the conclusion that the UK system of price cap regulation created greater uncertainty than the principal alternatives. They noted, however, the UK system has two very significant benefits: first, that the uncertainty is borne by the companies and their shareholders, through the reserves these companies build up over time, rather than by customers; and second, that, as noted in Part 2, price cap regulation is associated with strong incentives on companies to reduce costs by increasing efficiency.
- 3.27 On regulatory intervention uncertainty, NERA concluded that the empirical evidence is ambiguous. There is some evidence that interventions by UK regulators and government affect the rates of return demanded by investors, but in some cases these interventions appear to lower the required returns, rather than raise them. NERA quote evidence on BT which suggests that regulatory announcements on enhancing competition in the telecommunications sector tend to increase the level of uncertainty implied by market prices, while regulatory announcements that result in price decreases for BT tend to reduce implied uncertainty, perhaps because lower prices may act as a deterrent for new entrants. The evidence quoted by NERA implies that ascribing regulatory intervention uncertainty to UK regulators is not straightforward.

There is also a risk that the regulatory regime is perceived as uncertain by investors

- 3.24 Regulators typically estimate returns as part of the five-yearly review of prices. Between reviews, capital market estimates of a reasonable level of returns for a regulated company change constantly. These estimates are dependent on investor perception of the certainty or uncertainty of the environment in which regulated businesses operate. A greater perception of uncertainty tends to increase the required returns on both debt and equity funding. The actual cost at which regulated companies can obtain finance, and to some extent the availability of finance, is therefore linked to investor perception of the uncertainty of the regulated company's environment.
- 3.25 We asked NERA to examine the evidence for regulatory uncertainty in the UK regulatory environment. They distinguished two elements of uncertainty:
- **regulatory system uncertainty:** this is the uncertainty arising from the design of the regulatory system as a whole. In the UK, regulatory system risk might arise from the design of price-cap regulation under RPI - X.
 - **regulatory intervention uncertainty:** this is the uncertainty associated with actions taken by regulators in response to unexpected events.
- 3.28 One important aspect of investor perception of regulatory uncertainty is their view of the future direction of the regulatory regime, with regulatory strategies on capital expenditure being of particular concern to investors. Investors may be uncertain about whether or not regulators will incorporate current capital expenditure within the company's regulated assets at a future price review (although the process of "logging up" expenditure for inclusion in the next price review may provide some comfort). If not, the company may be unable to provide a return to investors on this element of their assets. Investors may therefore perceive the regulatory regime as uncertain and hence raise the required return from their investments. This increase in the required returns is often known as the "regulatory risk premium".
- 3.29 The predictability of methodology, both on calculating investor returns and through a long-term framework for incentivising investment, are crucial areas for regulatory attention. In our survey, virtually all the regulated companies considered that reducing uncertainty about the regulator's approach to controlling prices in the long term was an area that their regulator needed to prioritise. One telecommunications company commented "we believe this will be a major factor in allowing long term investment and stability in the industry".

Regulators are seeking to minimise these risks

3.30 Regulators recognise the risks associated with estimating the cost of capital and with investor perceptions of uncertainty. They are seeking to minimise these risks by:

- communicating their future methodologies for price controls well in advance. All regulators have also developed regular programmes of briefings for the City;
- recognising the importance of explaining fully to the investment community the financing assumptions that they use. For example, in December 2001 OFWAT said they would publish their assessment of future regulatory capital values for water companies in England and Wales⁵⁵. Regulators are also considering the case for sharing with regulated companies the financial model they use to set the allowed returns and the overall price cap, with OFWAT committing to do so;
- reviewing the impact of their price cap proposals on the ability of regulated companies to finance their functions, consistent with the duty on each of the regulators to ensure that efficiently operated companies can finance their activities. In their most recent price reviews, each of the regulators aimed to ensure that efficient companies could maintain a robust credit rating (known as investment grade credit rating). And each regulator tested the financeability of their overall price control proposals by ascertaining, through sensitivity analysis, whether an efficient company's financial robustness would be maintained under a variety of scenarios on their assumptions. **Figure 29** provides one illustration of how OFGEM approached this issue in the most recent transmission price control. OFTEL and OFWAT adopt similar approaches.

3.31 In taking these steps, regulators are seeking to provide clarity to the investment community on their regulatory strategies. If regulators can commit to given strategies and methodologies, they can increase the certainty of the regulatory environment. Regulatory commitment may as a result lower the costs to companies of raising finance. As noted by Frontier Economics (Appendix 5), regulatory commitment, in the form of stating in advance how future price controls will be carried out, may also increase the credibility of the incentives regulators put in place.

3.32 It is not possible, however, for regulators to offer absolute certainty over future methodology, for two reasons, which mean that the key ingredient in the price control regime should be predictability, not absolute certainty:

- regulatory priorities change as new issues emerge, for example greater public concern over the integrity of network assets, or a greater emphasis within government on lowering prices. This means that regulators need to retain some flexibility to respond to changing economic and political circumstances.
- regulatory intervention to reduce rates of return is inherent in the logic of RPI - X. This is because RPI - X first seeks to allow companies to retain efficiencies for up to five years, with a concomitant increase in returns, and then subsequently reduces returns to a reasonable level through regulatory interventions such as immediate price cuts or price cuts over time. Regulators would not, under the logic of RPI - X, be able to commit to a totally non-interventionist strategy.

29 OFGEM's review of the financeability of their price proposals⁵⁶

OFGEM have used a series of indicators to ensure that their proposals for the price control of the National Grid Company ensured that the company remained financially robust. These indicators take the form of ratios of various financial measures to interest payable on debt. Through a financial model, OFGEM analyse the impact of a series of different scenarios on these ratios. If in any scenario the ratio falls below the minimum level shown below, this would indicate to OFGEM that their proposals might cause a degree of difficulty for the company in financing its operations. The ratios therefore act as a test on the company's financeability.

Ratio of earnings before interest and tax to debt interest due	Minimum 1.5 times
Ratio of earnings before interest, tax, dividends and amortisation to debt interest due	Minimum 2.25 times

OFGEM use these and other tests to ensure that efficiently operated companies can finance their functions after the implementation of price reviews (but their duty does not extend to ensuring that inefficiently financed companies can finance their functions).

55 OFWAT, MD173: *Format and Timetable for Publishing Future Regulatory Capital Values* (17 December 2001).

56 OFGEM, *The transmission price control review of the National Grid Company from 2001 - Final Proposals* (September 2000), Table 5.5

Regulators are taking a series of steps to improve the process of price regulation while retaining its benefits

3.33 The Government's Better Regulation Task Force has established five principles of good regulation (Figure 30). In the context of economic regulation⁵⁷ they translate into targeting action to achieve intended goals, ensuring that the extent of regulation is proportionate to those goals and acting in a consistent and predictable manner so as to reduce uncertainty among regulated companies and their investors. And the transparency principle requires that the case for regulation be clearly made, its purpose clearly communicated and that it should be informed by proper consultation. We considered three aspects of how the regulators are seeking to address the risks to good regulation arising from the RPI - X process:

- the costs of the process;
- whether the information requested was necessary; and
- the steps taken by regulators to improve the process.

30 The Better Regulation Task Force's principles of good regulation

Transparency
Accountability
Proportionality
Consistency
Targeting

The Government established the Better Regulation Task Force in September 1997 as an independent body that advises Government on action which improves the effectiveness of Government regulation, taking particular account of the needs of small businesses and ordinary people.

Source: Better Regulation Task Force, Principles of Good Regulation re-issued 2000.

To undertake price cap regulation, regulators request significant volumes of information from companies

3.34 Regulators require a significant volume of information to set an appropriate price cap, including information on:

- the efficient level of costs;
- financing costs;
- future investment needs; and
- customer's preferred price/quality trade off.

3.35 Regulators obtain information from companies in two main ways: through regular returns from companies in a standard format, and from periodic information requests that are made during the price control setting process. The information requests can be sizeable: for example the last price review by OFWAT required companies to make eleven separate submissions over nearly a three year period (although four of these submissions related to the water quality programme). One water company estimated that the penultimate submission on the water quality programme comprised over 800 individual data tables, each table having some 125 potential data cells of which they estimated some 75 per cent had to be completed, although OFWAT have pointed out that this is in the context of a request for extra allowed investment of over £1 billion over five years.

3.36 The price review process can therefore result in substantial information processing costs for regulators and companies. These costs are likely to vary according to:

- the number of companies in the regulated industry (there are 23 regulated water companies, 14 electricity distribution companies and only one in the case of electricity transmission and telecommunications);
- the scope of the price control within each industry (the water price reviews cover both the water and sewerage industries including abstraction, treatment, distribution and retail, and collection and treatment of sewerage, while the electricity and telecommunications price reviews cover only the network elements of the respective industries);
- the liaison with other regulatory agencies (for example, OFWAT liase with the Drinking Water Inspectorate and the Environment Agency); and
- the extent of any investment programmes proposed for the industry.

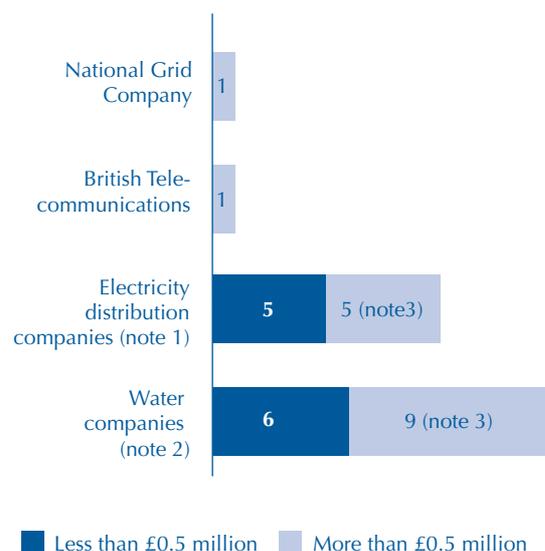
3.37 As part of our survey, we asked companies to estimate the costs incurred in supplying information to the regulator for the price setting process and in responding to the regulator's associated consultation documents. We also asked the regulators to estimate the costs they had incurred during the last price review. The responses to our survey showed that the costs related to the price reviews conducted by OFWAT were significantly larger than those of other regulators, reflecting the larger number of companies and the greater scope of the price review, as noted in paragraph 3.36 above. The costs are set out in **Figures 31** and **32**.

Regulators make use of this information in setting price controls, but there is a risk that regulated companies do not understand how the information has been used

3.38 The regulators told us that most of the information they requested was used in the price review process. For example:

- **OFWAT:** our survey showed that, in the view of some companies, OFWAT had ignored their submissions on capital maintenance. OFWAT requested projections of capital expenditure for 2000 to 2005. OFWAT, however, said that they found that the projections did not provide an economic justification for increases in capital expenditure, and that even the best submissions lacked a thorough economic analysis of the options. To address this perceived problem, OFWAT issued guidance to water companies on how they should present the economic case for capital maintenance in future⁵⁸ and have initiated a series of studies around this issue.
- **OFGEM:** A number of the electricity distribution companies commented that the projections requested by OFGEM had not been used in setting the price control, and that data relating to only one year (1997/98) was used in determining the efficient level of costs for the price control. OFGEM told us that all data they requested had been used. For example, information provided by companies for the financial year 1997/98 was used as a baseline year for a regression analysis which was in turn used to establish an efficient frontier for operating costs for the years of the price control (2000-2005). The forward projections were used by OFGEM's consultants to corroborate the results from the regression analysis by modelling the efficient level of costs for a hypothetical electricity distribution business on the cost frontier.

31 Staff costs incurred by regulated companies at the last price review



NOTES

1. Based on the responses of the 10 electricity distribution companies that responded to the NAO survey.
2. Based on the responses of the 15 of the 24 water companies that responded to the NAO survey.
3. Five of the nine water companies estimated their staff costs at more than £1 million (in one case as high as £6 million), and two of the five electricity distribution companies estimated their staff costs to amount to more than £1 million.

Source: National Audit Office

32 Regulators costs at the last price review

Regulators	£m
OFWAT	7.0
OFGEM (electricity distribution)	2.5
OFGEM (electricity transmission)	0.8
OFTEL	0.3

NOTE

1. Regulators costs include staff costs and consultancy costs.

Source: National Audit Office

■ **OFTEL:** BT commented that OFTEL initially requested 1998/99 figures as the base data for their financial model. Subsequently OFTEL updated the base year to 1999/00 making 1998/99 data redundant. OFTEL informed us that, even though they requested data for two years (for 1998/99 and 1999/00), both had been necessary. They had requested the 1998/99 data to initiate their financial modelling process. Once the 1999/00 data was available, OFTEL said they were able to easily update their pre-prepared model.

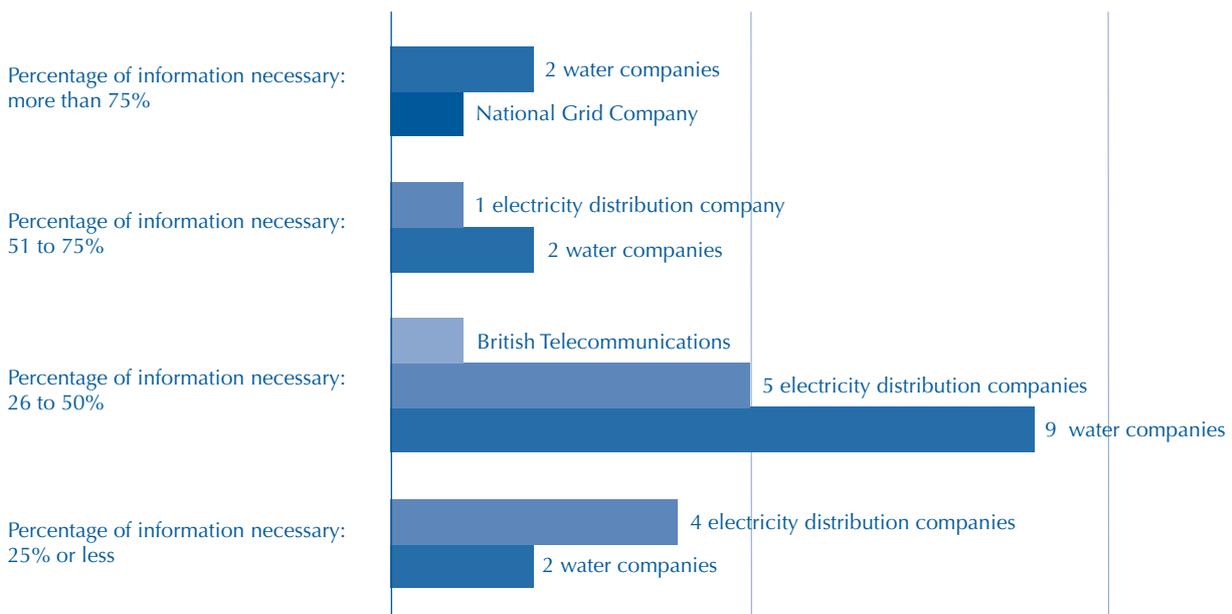
3.39 Nevertheless, there is a clear concern among companies that the amount of information they are required to provide by the regulator is more than is strictly necessary for the purpose of setting prices, as shown in **Figure 33**. Especially in the water and electricity distribution industries, companies perceive that regulators are asking for large amounts of information and that only some of it is being used. And a majority of the regulated companies that responded to the water and electricity distribution survey questionnaires considered that reducing the cost of the price review process should be a priority for the regulator. BT also considered that reducing the cost of the process should be a priority for OFTEL, and they pointed out the complexity and sheer size of the information they are required to provide, with the number of supplementary schedules to their regulatory accounts increasing from 15 in 1998 to 70 in 2000, although not all of these schedules relate to the network charge control.

3.40 However this was not a view shared by the National Grid Company plc, the single company in the electricity transmission industry. National Grid considered that the amount of information they had supplied to the regulator that had been used fell into the category 75 to 100 per cent. This difference may arise because it is easier for a regulator to maintain a dialogue on the needs and uses of regulatory information requests with one company than with several, given the practical constraints on how far a regulator can communicate the detail of how they have used the information.

There is also a risk that information requests may increase over time

3.41 In addition to the risks of imposing significant costs on companies through the price control process, and of requesting information that companies may not perceive as being necessary, regulators face a further risk - that the volume of information requested increases over time. In seeking to address problems of long term incentives and information on asset condition covered earlier in Part 3, regulators risk increasing the demands on companies for information, for example by requesting detailed breakdowns of investment plans or analyses of asset condition. There may also be a pressure on regulators to obtain ever more information to justify their discretionary judgements in the face of criticism from a range of stakeholders.

33 Company views on whether information requested was necessary



NOTE

The figure shows the responses of British Telecommunications, National Grid Company and the 10 electricity distribution companies and the 15 water companies that responded to the NAO survey.

Source: National Audit Office

3.42 It is therefore important that regulators review the burden of their existing and any new information requirements on companies, and seek more fully to explain and justify the amount and level of detail in the information that they request.

Regulators are taking steps to improve the process while retaining its benefits

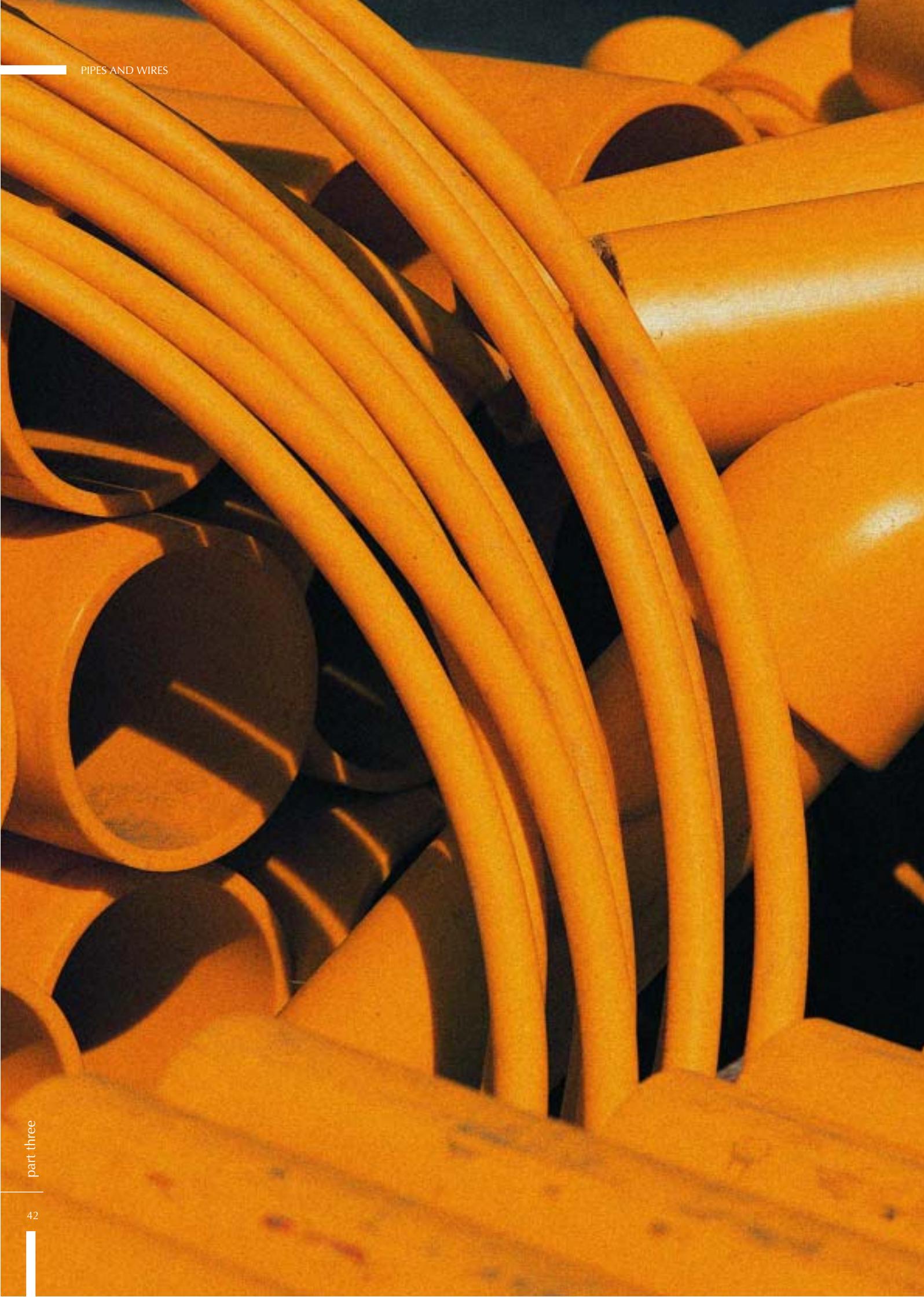
3.43 Regulators are taking a number of steps to improve the process of price regulation:

- all the regulators we examined are considering how to minimise the volume of information they request from companies. For example, in the review of BT's retail price cap that OFTEL is currently undertaking, it has applied a materiality test to data requests and any simplifications that result and are unlikely to affect the result of modelling have been adopted. And OFWAT reviewed the information they collected in their June Return in 2000 and implemented resulting changes in 2001.
- regulators seek to consult widely on their proposed price control approaches, and have been refining and improving their consultation processes in recent years. Doing so should help companies and others understand the purposes for which regulators request information. Our survey indicated that in general the majority of respondents considered that the consultation documents were easy to understand and it was clear what questions were being asked (although a majority of water and electricity distribution companies considered that regulators had not listened to their views during the last price review).

- regulators are seeking to demonstrate how they use information they receive. For example, OFGEM provided the companies with an audit trail to show how they had arrived at the final figures for the price control. One company commented that in their opinion "the issuing of audit trails to companies was a considerable improvement on previous reviews in understanding the mechanical calculation of the price control proposals."

- regulators are seeking to reduce the number of information requests and to rely to a greater extent on annual information returns.

3.44 The regulators are also seeking to introduce more consistency in their methodologies. In July 2000, regulators issued a statement covering their formal joint work on a range of cross-industry issues. The statement was published by seven regulators including OFGEM, OFTEL and OFWAT, and set the agenda for future cross-sector work to ensure consistent approaches to common issues and to share expertise and good practice. As part of this, the inter-regulator regulatory accounts working group published a final proposals paper in April 2001 and each regulator is now engaged in consultation and finalisation of proposals on regulatory accounts. This initiative shows that regulators are aware of the criticisms of the process and are seeking to address them as far as possible⁵⁹. Other regulators could also adopt OFWAT's practice of undertaking a formal evaluation of the price control process once it is complete, and placing the conclusions in the public domain.



Appendix 1

Methodology of the National Audit Office's examination

The key elements of our study methodology are set out below.

Consulting stakeholders

At the outset, we held a focus group of regulators and regulated companies to identify issues for the study to address. In the course of the study we held discussions with regulators and regulated companies.

Benchmarking and analysis

We examined and compared the process and results for price reviews of the electricity transmission network and the fixed line telephone network in the UK, and for the electricity distribution and water networks in England and Wales. This was done mainly through an examination of documents prepared by the economic regulators, and other published information. In addition, we used the guidelines on the audit of economic regulation prepared by the International Organisation of Supreme Audit Institutions (INTOSAI).

Stakeholder survey

The National Audit Office conducted a survey of stakeholders in the electricity, telecoms and water industries to ascertain their views on a number of issues including: the strength of incentives in the price control; the price review process; views on the regulators' information requirements, and associated costs incurred by the regulated companies; actions or incentives of the regulator other than those in the price control, and views on areas which the regulator needs to prioritise.

The questionnaire was emailed to stakeholders in the relevant sectors including: all regulated companies, trade bodies and other industry companies; industry consumer bodies; sector specialist City analysts.

The number of survey responses received is summarised by industry and category in Figure A.

A pro-forma of the questionnaire that was sent to stakeholders is available on our website at www.nao.gov.uk.

A Responses to the National Audit Office's survey of stakeholders

	Electricity distribution	Electricity transmission	Telecoms	Water	Totals
Regulated companies	10	1	2	15	28
Other companies	0	3	11	1	15
Trade bodies	0	0	2	3	5
Consumer bodies	3	1	4	9	17
Sector analysts	3	3	1	7	14
Totals	16	8	20	35	79

Economic advice

We commissioned a paper on incentives from Frontier Economics and a paper on cost of capital from National Economic Research Associates.

Expert Panel

We invited experts in regulation across the various industries we examined to sit on an expert panel to provide advice and guidance during the study and to test and validate the emerging findings. Membership of the panel comprised:

- **Richard Budd** - British Telecommunications
- **John Hughes** - Rail Passenger Council
- **Professor Stephen Littlechild** - former Electricity Regulator, now an independent consultant
- **Iain Taylor** - Centrica
- **Tim Tutton** - National Grid Company
- **Peter Vass** - Centre for the Study of Regulated Industries, Bath University
- **Professor Catherine Waddams** - Centre for Competition and Regulation, University of East Anglia
- **Robert Weeden** - Water UK
- **Bob Westlake** - Western Power Distribution

Appendix 2

The statutory duties of regulators

	 OFTEL	 OFGEM	 OFWAT	 OFGEM
Consumer interests	Promote the interests of consumers, purchasers and other users of telecommunication services	Protect the interests of consumers in relation to electricity conveyed by distribution systems	Act in a manner best calculated to ensure that the interests of every person who is a customer or potential customer of a company are protected as respects the fixing and recovery of water and drainage charges, and other terms and quality of services	Protect the interests of consumers in relation to gas conveyed through pipes
Financing activities	Secure that providers of telecommunication services are able to finance those services	Secure that licence holders are able to finance the activities which are the subject of obligations imposed by or under (the Act)	Act in a manner that the Director considers is best calculated to ensure that companies can finance the proper carrying out of the functions of water undertakers	Secure that licence holders are able to finance the activities which are the subject of obligations imposed by or under (the Act)
Effective competition	Maintain and promote effective competition between persons engaged in commercial activities connected with telecommunications	Promoting effective competition between persons engaged in, or in commercial activities connected with, the generation, transmission, distribution or supply of electricity	Act in a manner best calculated to facilitate effective competition between persons holding or seeking appointments	Promoting effective competition between persons engaged in, or in commercial activities connected with, the shipping, transportation or supply of gas so conveyed
Efficiency	Promote efficiency and economy on the part of persons (engaged in commercial activities connected with telecommunications)	Promote efficiency and economy on the part of persons authorised by licences or exemptions to transmit, distribute or supply electricity and the efficient use of electricity conveyed by distribution systems	Act in a manner best calculated to promote economy and efficiency on the part of any such company in the carrying out of the functions of a relevant undertaker	Promote efficiency and economy on the part of persons authorised by licences or exemptions to carry on any activity, and the efficient use of gas conveyed through pipes
Universal supply/coverage	Secure the provision throughout the United Kingdom of telecommunication services which satisfy all reasonable demands	Secure that all reasonable demands for electricity are met	Act in a manner best calculated to ensure that the functions of a water undertaker and of a sewerage undertaker are properly carried out as respects every area of England and Wales	Secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met

Appendix 3

Regulating monopoly - the theory of RPI - X price controls

Simon Banner, Regulatory Economist,
National Audit Office

Introduction - what is RPI - X?

"RPI - X" is a means of controlling the extent to which companies with monopoly power raise their prices. The RPI - X control prevents regulated companies from increasing their prices or revenue by more than general price inflation (as measured by the Retail Price Index, or RPI), less an X value determined by the regulator, over a specified period. The control protects consumers, by preventing companies with monopoly power from abusing that power through price increases.

Why are price controls necessary?

What is monopoly power?

Monopoly power is the ability to restrict output and to set prices in excess of the costs of production for more than a short period of time, or to behave in other ways which would be impossible under competitive pressure.

Monopoly power exists because of a lack of competitive pressure. If competition existed, other firms could freely enter the market, causing market supply to increase, and forcing the market price down to cost-reflective levels. But in markets where monopoly power exists, barriers to entry prevent new firms from entering the market.

Why is regulation of monopoly power needed?

Customers need protection to prevent companies from abusing their monopoly power, for example by persistently setting prices above the levels that would prevail in competitive markets. Customers cannot take their business elsewhere in response to price rises, because there is only one producer or service provider. This is of particular importance in relation to the provision of essential services such as water and energy, where there are no effective substitutes for the product or service⁶⁰.

The lack of competitive pressure also means monopolies create adverse consequences in quality of service, and in innovation to develop new goods and services. And customers cannot take their business elsewhere if quality falls, because there is only one producer or service provider.

In addition, monopoly power produces two efficiency problems:

- Resources are not allocated efficiently, because a company with monopoly power can set price above the cost of supply; and
- Companies with monopoly power do not produce efficiently, because there is no incentive for companies to minimise their costs (for a given output level).

The allocative efficiency problem

For society, the level of output produced in competitive markets is optimal. At this output level, each company charges a price equal to marginal cost⁶¹. This is also the optimal output for producers, because they maximise profits at this output level⁶². The competitive market also produces the optimal outcome for consumers, because the marginal benefit they receive from consumption of the last unit equals the marginal cost (the price of the last unit).

Monopoly producers are able to set a price above marginal cost, and restrict output. If they do so, resources are allocated inefficiently, because society would be better off at higher output levels. Consumers' welfare is reduced, because prices are in excess of costs⁶³. Some of this reduction is transferred to the producer, while the remainder is a welfare loss to society⁶⁴.

The productive efficiency problem

In competitive markets, companies have incentives to find ways of operating more efficiently, through reducing their costs of production. Relatively inefficient companies will lose market share to more efficient competitors. But a monopoly company has less of an incentive to look for ways of producing more efficiently because of the absence of competitive pressure. It tends to have a higher cost of production at each possible level of output, compared to the

⁶⁰ INTOSAI, *Guidelines on Best Practice for the Audit of Economic Regulation, Guideline 15*: "where suppliers have a monopoly or are dominant, one of the methods for protecting consumers against abuse is to limit the prices that such suppliers may charge".

⁶¹ Marginal cost is the change in total costs resulting from a unit change in output.

⁶² Because price equals marginal cost, and in competitive markets price equals marginal revenue, marginal revenue equals marginal cost, which is the profit maximising output level.

⁶³ In practice pricing at marginal cost may not be feasible for companies with monopoly power, if doing so meant that they could not cover their total costs. However, consumers would still need protection against arbitrary price increases.

⁶⁴ In theory, the producer can appropriate all of the reduction in consumer welfare (with no welfare loss to society) if it can perfectly price discriminate.

costs that would prevail if it faced competitive pressure. Consumers' welfare is reduced, because costs (on which prices are ultimately based) are higher than they would be under competition.

Why is the RPI - X form of control employed?

Rate of return regulation

The US has a longer history of regulation of private ownership in the utility industries than the UK. In the US, the traditional form of regulation is for the regulator to allow the regulated company to earn a "fair" rate of return on capital. This is known as rate-of-return regulation, and aims to prevent companies from exploiting their monopoly power to earn "excess profits"⁶⁵.

There are several disadvantages with rate-of-return regulation:

- Allowing companies to earn a given rate of return, regardless of its cost level. Therefore the company has little incentive to find efficiency savings, because reductions in costs would lead to reductions in prices. Prices may be cost-reflective, but costs are higher than they should be;
- There are limited incentives to innovate, because firms can only earn the rate of return on investment projects. Riskier projects may be rejected because the rate of return the company can offer is restricted; and
- Under rate-of-return regulation, a company has an incentive to expand its capital base, because the rate of return set by the regulator applies to the company's asset base. Therefore, the more capital a company employs, the larger the return it earns. The company will employ more capital, and less labour, than the optimal capital-labour mix that minimises costs. This is known as the Averch-Johnson effect⁶⁶.

Why was RPI - X introduced in the UK?

The RPI - X form of control was introduced in the UK for the first privatised monopoly, BT, in 1984. It was designed to try to avoid some of the problems associated with rate-of-return regulation. The RPI - X method was recommended by Professor Stephen Littlechild in a report commissioned by the Government, and published in February 1983⁶⁷.

In which markets are prices controlled by RPI - X?

Since the introduction of RPI - X to telecommunications, this form of control has been extended to control the prices of monopoly suppliers in electricity, gas, water, and rail, as they were privatised. Most recently, an RPI - X control was introduced for Consignia, and for the National Air Traffic Control service (NATS). As the use of RPI - X controls widened, there were variations on the general theme, for example:

- Ofgas allowed British Gas to pass through some input costs outside the control of the company to consumers, the rationale being that it was impossible for British Gas to find efficiency savings in these costs. Other regulators have followed the Ofgas approach to pass through certain costs or cost changes.
- Prior to water privatisation, in 1989, the Government introduced an RPI +/- K control, a form of RPI - X control, but allowing for the fact that new quality obligations on companies would result in rising real terms price increases (up to 2000), unlike in other industries.
- More recently, OFGEM have, through the information and incentives project, introduced variations in allowed revenue reflecting changes in performance, and have also introduced broader incentive schemes for system operator functions undertaken by NGC and Transco.

Monopoly power in the regulated industries derives from sunk costs and economies of scale⁶⁸, and from the structure of the industries before privatisation, when the industries were operated as monopolies in order to meet certain political objectives. Some industries (telecoms and gas) were privatised whole as monopolies, while others (electricity, rail) were restructured into component parts, but each industry retained some monopolistic parts.

Who sets price controls?

When the regulated industries were privatised, it was generally the Government that set initial price controls in the industry immediately prior to privatisation⁶⁹. After each privatisation, the industry regulator has undertaken each review of price controls (e.g. OFWAT set price controls in the water industry).

When are price controls set?

The regulator's process of setting the "X" in RPI - X needs to be completed some time before the next price control period is due to begin, to allow for the possibility that the regulated company will exercise its right to appeal against the

⁶⁵ See Beesley and Littlechild (1989) for a summary of how US regulators set rate-of-return controls.

⁶⁶ Averch and Johnson (1962).

⁶⁷ Littlechild (1983).

⁶⁸ If economies of scale are large enough, the industry is said to constitute a natural monopoly, where supply costs are lower under monopoly than under competition. Such industries create a different set of cost and price issues for regulators which are outside the scope of this paper, but the potential for abuse of monopoly power may still justify the use of price controls.

⁶⁹ The exception was Railtrack, where the Rail Regulator set the control on access charges starting April 1995, and privatisation occurred in May 1996.

regulator's decision. With the exception of regulated airports, for which there is an automatic reference to the Competition Commission every five years, companies have the right to appeal against regulators' price determinations, under the relevant industry legislation (e.g. BT's right is under the Telecommunications Act 1984). The Competition Commission (formerly the MMC) examine these appeals. The latest appeals against a regulator's decision were made in February 2000 by Mid Kent Water and Sutton & East Surrey Water against OFWAT's determination for 2000-2005.

Normally, the Competition Commission are allowed 6 months to form an opinion, and the regulator usually allows a period of around two months for the regulated company to decide whether to appeal or not. So as a rule of thumb, the price control review needs to be completed at least nine months before the price control is due to start.

How long are price controls set for?

In some cases, regulators assess whether the regulated company faces competition for the service it provides, before resetting price controls. If competition has developed sufficiently, it is better to remove controls. Retaining price controls too long may deter potential entrants from entering the market. But removing price controls too soon means consumers are unprotected in the face of monopoly power. In markets where competition is developing but an incumbent firm still holds some monopoly power, UK regulators have set price controls for as little as one year, with a further review at the end of that period to assess whether competition has developed sufficiently to remove controls altogether. For example, in 2001, OFTEL extended BT's retail price controls for one year because OFTEL believed that competition was increasing but was not at that stage sufficient in itself to constrain BT's pricing behaviour.

As competition develops in "supply" markets, the RPI - X form of control is being gradually removed from incumbents in these markets. In February 2002, OFGEM published initial proposals for removing the remaining supply price controls in the domestic gas and electricity markets from April 2002.

It is accepted that the need for a form of price or rate-of-return control or other long-term regulation is likely to be needed in parts of the networks of regulated industries due to barriers of entry to these markets. In these cases, regulators set RPI - X controls for a fixed period, typically five years in the UK (four years for BT's network charges).

Regulatory objectives in setting price controls

When setting price controls, regulators aim to balance the (sometimes competing) interests of two groups. Firstly, regulators seek to protect the interests of customers, by:

- setting limits on the degree to which companies can exploit their monopoly power through price increases (to facilitate greater allocative efficiency);
- encouraging firms to reduce their costs (to facilitate greater productive efficiency); and
- ensuring that companies do not "chisel" on quality, or make short-term efficiency savings at the expense of the long-term quality and condition of the network.

But the industries subject to price controls provide (to varying degrees) essential services. Regulators must ensure that companies maintain the condition of their networks and develop the capacity to meet demand. To do this, companies need to undertake considerable investment. Companies need to be able to attract investors and lenders, in order to raise the substantial amounts needed to fund the investment.

Investment takes place over the long term. Once assets are in place, they are "sunk". If regulators reduce prices too far when setting controls, they may make it impossible for investors to achieve a return on, and a return of, their investments. This will deter potential investors in the regulated company, and make it difficult for that company to raise finance to fund investment.

So regulators seek to protect the interests of investors, by:

- ensuring that companies are funded for the efficiently incurred costs of delivering the output required by the regulator; and
- ensuring that investors earn a fair rate of return on their investments, and in doing so ensure that price controls do not undermine the ability of companies to finance their activities.

How are price controls set?

Price controls are broadly set by:

- Deciding what outputs the company will deliver;
- Assessing how much these outputs will cost;
- Assessing the extent to which outputs can be delivered more efficiently;
- Determining a "fair" rate of return for investors; and
- Setting a level of X that equates the predicted rate of return with the company's estimated cost of capital; while
- Ensuring that the final determination is financeable, by reference to credit ratings, financial ratios etc.

How does RPI - X provide efficiency incentives?

How RPI - X provides companies with an incentive to find efficiency savings

Price controls prevent companies from raising prices in order to increase returns on capital. But during a price control period, a company is free to vary its costs, and can increase returns on capital if it reduces costs by more than the regulator anticipated at the start of the period. The incentive to find efficiency savings arises from the opportunity for the company to keep any unanticipated efficiency savings made during the period.

In **Figure A**, the regulator sets a price limit of £100m from year 1 (1996), on the basis that the company can deliver the required outputs for costs of £90m, plus an allowance for return on capital to investors of £10m (say, as a result of a cost of capital of 10 per cent multiplied by a regulatory capital value of £100m).

The company cannot increase its return on capital by raising prices, but it can do so by reducing costs. Any unanticipated efficiency savings translate to an increase in the return on capital. In **Figure A**, the company makes an additional efficiency saving of £2m in each year of the period. By year 5 of the price control (2000), the company incurs costs of £80m, £10m lower than the regulator anticipated the company would incur. This £10m saving is added to the £10m return allowed by the regulator, resulting in a return of £20m, and a rate of return of 20 per cent.

The possibility of earning a higher rate of return, through making greater than anticipated efficiency savings, provides the company with its incentive to find efficiency savings. **Figure B** shows how the unanticipated efficiency saving translates directly into a higher rate of return over the period, such that the company earns 20 per cent return on capital in year 5 (2000), compared to its cost of capital of 10 per cent.

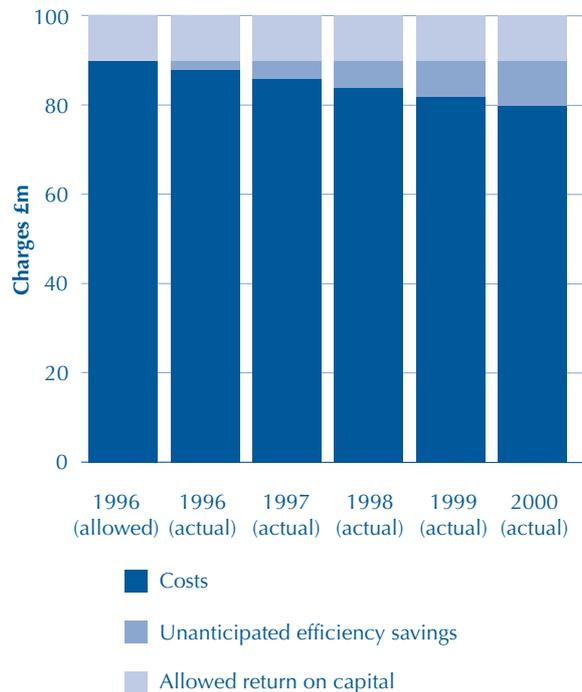
How does the regulator pass benefits to customers?

RPI - X benefits the customer in the following ways:

- It protects the customer by limiting the ability of the company to abuse its monopoly power by raising prices.
- It provides the company with an incentive to reduce costs by finding efficiency savings, which the regulator can subsequently pass on to customers by way of price cuts.

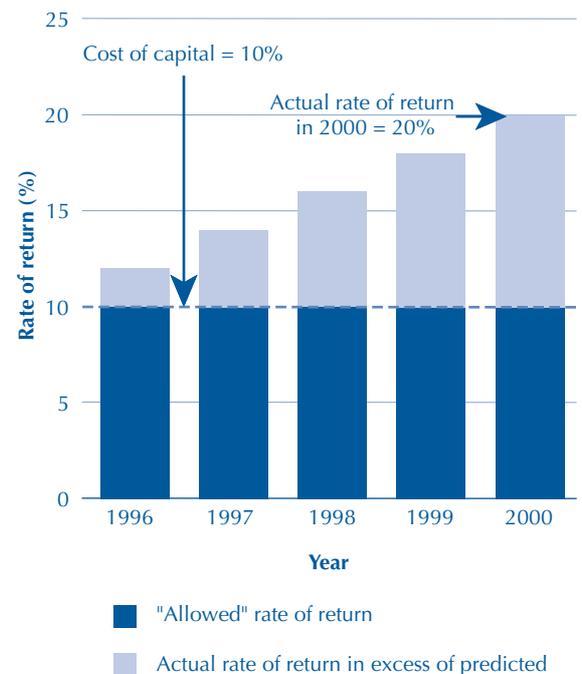
While RPI - X provides the company with an incentive to find efficiency savings, the greater these are, the higher the rate of return becomes in relation to the cost of capital (**Figure B**). At price control reviews, regulators seek to eliminate excess returns earned by the company - this means that the rate of

A How the incentive to find efficiency savings works



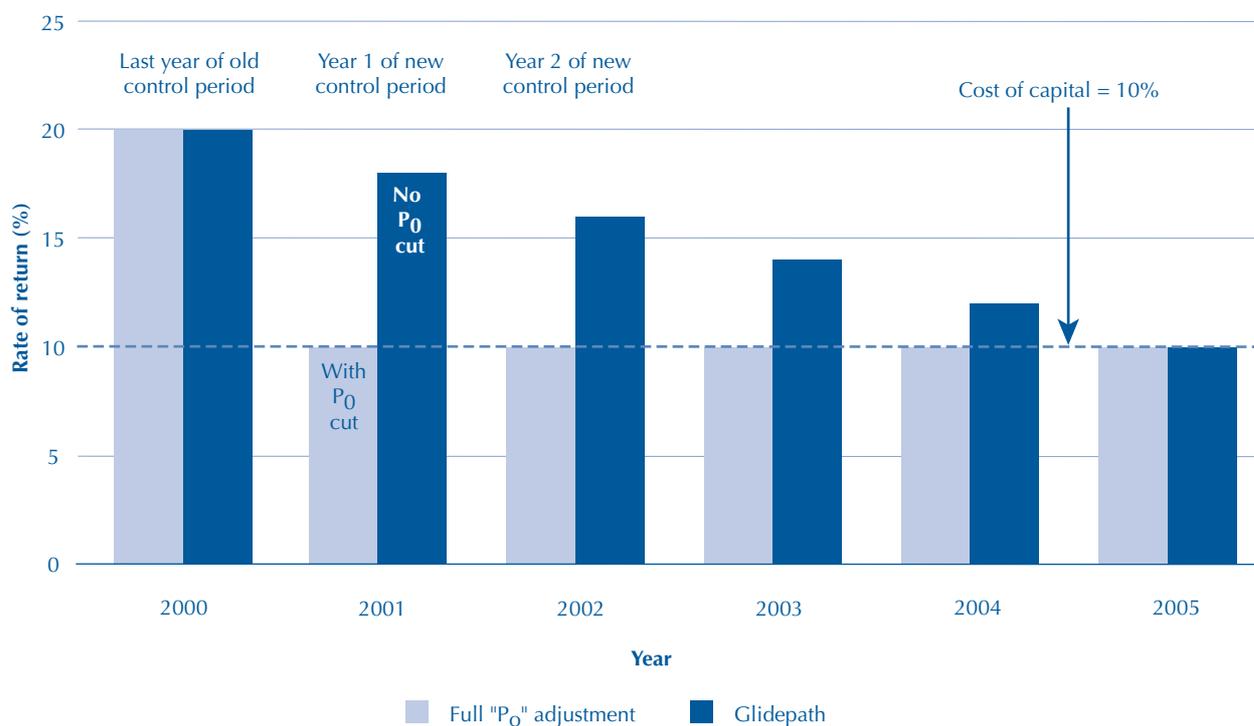
Source: National Audit Office

B Change in the rate of return following unanticipated efficiency savings



Source: National Audit Office

C Options for restoring the rate of return to the cost of capital



Source: National Audit Office

return must be restored to the cost of capital, which is the return required by investors that just compensates them for the risk of their investment.

The regulator then has to decide the best way to pass the benefit of the unanticipated efficiency savings on to consumers.

Figure C shows that the regulated company in our example above has made unanticipated efficiency savings in the previous price control period (the 5 years to 2000) and is earning a rate of return of 20 per cent, compared to its cost of capital of 10 per cent. The regulator's aim is to restore the company's rate of return to the cost of capital. This requires a reduction in the rate of return of 10 per cent (assuming the estimate of the cost of capital has not changed).

The regulator then chooses a price profile, which reduces the rate of return to the cost of capital during the period. This is what the regulator does when he chooses the level of X to go into the RPI - X formula. In the example above, there are a variety of options available to the regulator:

- requiring immediate price cuts, such that the company's rate of return is reduced to the cost of capital immediately. Sometimes this requires a one-off adjustment to the level of prices, called a P₀ adjustment;

- making phased price reductions through a "glidepath" mechanism, such that the rate of return is reduced to the cost of capital by the end of the price control period;
- a combination of these methods, for example an immediate price cut passing a proportion of past efficiency gains back to customers, accompanied with further phased reductions in prices over time.

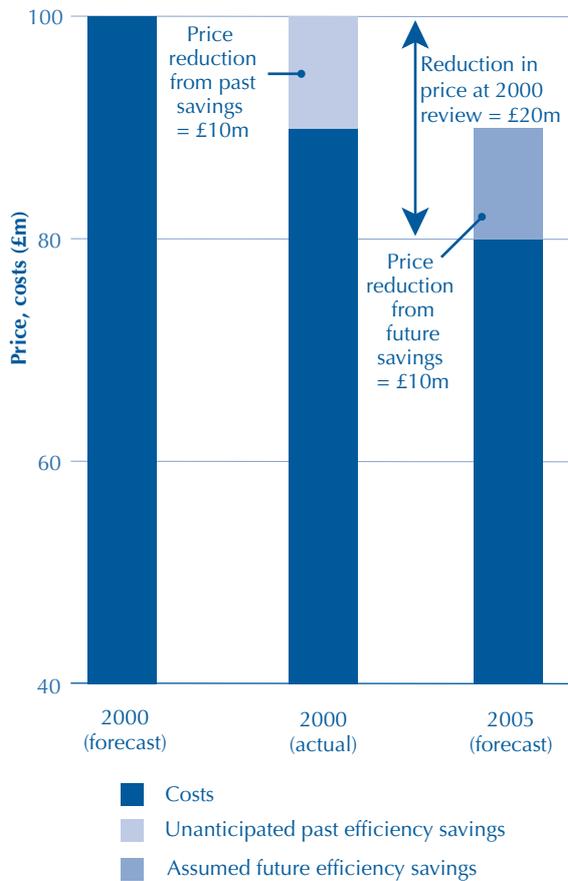
Reducing prices by assuming future efficiency savings

The regulator can also pass benefits to consumers by making assumptions about the efficiency savings that companies can make in the next control period.

In the illustrative example, the company has incurred costs in 2000 of £80m. The regulator can reduce future prices by £10m compared to the original price limit, because of the £10m efficiency saving made by the company in the previous price control period. The company has revealed that it can operate at a lower cost level. The regulator can reduce future prices further, for example by assuming that the company can reduce costs by a further £10m by 2005. Combining the two parts of the price reduction produces a price forecast of £80m in 2005. Figure D shows the breakdown of the benefit passed to the customer in price reductions⁷⁰.

⁷⁰ For clarity, the figure combines costs and the return allowed by the regulator.

D Breakdown of the benefits passed to customers



Source: National Audit Office

Difference between "X" and assumed future efficiency savings

The level of "X" in RPI - X is not the same as the level of future efficiency savings assumed by the regulator, for a number of reasons:

- "X" applies to either revenue or prices. It does not apply directly to costs.
- Any past unanticipated efficiency savings in the previous period will result in X being greater than assumed future efficiency savings. Similarly, unanticipated losses may necessitate an adjustment to X.
- X and assumed future efficiency savings will also diverge if quality requirements change. For this reason, OFWAT calls their controls RPI +/- K, to reflect that real price increases are possible, if the upward effect of new quality requirements on prices outweighs the downward effect of assumed future efficiency savings.

- The regulator may choose different levels of X in different years, for example to change the profile of prices to reflect customer preferences, or following consideration of financial ratios by the regulator. OFWAT concluded that water customers had stated a preference for initial price cuts, followed by real terms price increases, rather than relatively stable prices over the period.
- Vickers and Yarrow (1988) demonstrated that X needs to be greater than assumed efficiency savings, in industries where there are increasing economies of scale, and demand is expected to increase over the price control period.

OFTEL's network charge control for BT demonstrates the difference between X and assumed efficiency savings. In calculating the network charge control, OFTEL assumed a real unit cost reduction of 3.27 per cent per annum⁷¹ over the price control period, but imposed caps on the baskets of non-competitive services varying between RPI - 7.5 per cent and RPI - 13 per cent (so "X" in RPI - X is between those figures)⁷².

And OFWAT elected to pass efficiency savings on to customers immediately through a P0 adjustment, reducing year 1 (2001-02) average charges by 12.3 per cent. Over the whole period, average charges fall by 2.1 per cent (the average "K" in RPI+K is - 2.1 per cent for the period). But OFWAT assumed future efficiency savings of 7 - 22 per cent in operating expenditure, 3 - 15 per cent in capital maintenance expenditure and 7 - 24 per cent in capital enhancement expenditure. Assumed efficiency savings are larger than price reductions, because of additional quality requirements in the period⁷³.

Comparing RPI - X and rate-of-return

"Mimicking" the competitive outcome

Unlike rate-of-return regulation, the RPI - X mechanism aims to "mimic" the outcome in competitive markets, whereby a producer that innovates to become more efficient temporarily benefits through supernormal profits, before those profits are competed away as other producers respond by becoming more efficient, and new producers enter the market. And competitive pressure forces companies to reveal their most efficient operating level, but this is absent if a company has a monopoly. RPI - X mimics competition by providing companies with an incentive to reveal the efficiencies they could attain, the incentive being the right to keep some of the benefits of the efficiency savings they make.

⁷¹ Before volume growth and real input price changes.

⁷² OFTEL, *Proposals for Network Charge and Retail Price Controls from 2001 (February 2001)*, paragraphs. 3.43 and 4.25.

⁷³ OFWAT, *Future water and sewerage charges 2000-05 (November 1999)*, Tables 1, 6.

RPI - X and efficiency

The most powerful incentive scheme would be a one-off RPI - X that lasts forever, allowing the firm to keep 100 per cent of all unanticipated efficiency savings. This would provide very strong incentives to improve productive efficiency (although such a regime might lack credibility since all benefits of efficiency savings would accrue to the company). However, in the long term prices and costs could diverge widely.

Under RPI - X, controls are reset every 5 years. Between reviews, the firm benefits from unanticipated efficiency savings, promoting productive efficiency. While prices and costs diverge between reviews, at each price review prices can be reset to converge on normal economic costs, so that prices are once again cost-reflective. However, the mere act of resetting controls reduces the power of the incentive for the company to find efficiency savings.

Is RPI - X really different to rate-of-return regulation?

Vickers and Yarrow (1988) considered the RPI - X form of control to be not as different from rate-of-return regulation as first appearances may suggest. As employed in the UK, RPI - X controls require an estimate of the rate of return of a regulated company, just as rate-of-return regulation does. They consider the key difference to be timing, with longer periods between RPI - X reviews.

But Beesley and Littlechild (1989) argued that "there are significant differences between the two systems, which give RPI - X a potential advantage with respect to incentives and efficiency". In summary, they say these are:

- RPI - X embodies an exogenously determined risk period between appraisals of prices;
- RPI - X is more forward looking, with forecasts of what productivity improvements can be achieved and what future demands will be, and is set on the basis of predicted cash flows. Whereas rate-of-return tends to be based on historic costs and demands;
- Regulators have more degrees of freedom in setting X than are available in rate-of-return regulation, because RPI - X reviews cover the whole regulatory framework; and
- The UK regulator has more discretion and less need to reveal the basis for decisions than does his or her US counterpart.

Beesley and Littlechild argue that there is greater scope for bargaining in RPI - X, and that the regulator may be able to use the additional bargaining power to achieve better results under RPI - X than would be possible under rate-of-return regulation.

Impact of RPI - X controls on stakeholders

Impact on customers

RPI - X price controls offer the prospect of considerable benefits to customers in the short term, because they provide an incentive for companies to find efficiency savings, which regulators can then pass on to customers through lower prices. And because short-term quality of service is generally measurable, it should be evident if companies respond to price controls by reducing quality of service ("chiselling"), rather than finding efficiency savings.

The emphasis of RPI - X is on providing companies with incentives to find efficiency savings. But it is important that short-term efficiency savings should not be achieved at the expense of the long-term condition and serviceability of networks providing essential services. Otherwise, current customers benefit at the expense of future customers, who will have to pay in order to make up any shortfall.

To assess whether this is happening, both companies and regulators need good information on the condition and serviceability of assets, and the relationship of these with the service provided to customers.

Impact on investors

In the short term, RPI - X appears attractive to investors, because it allows companies the opportunity to make returns in excess of the cost of capital, for up to five years (in a 5 year control period). This would not be possible under rate-of-return regulation.

In the longer term, there is a contrast between the medium-term nature of RPI - X price control periods (generally 5 years), and the long-term nature of the regulated industries, where assets can last for hundreds of years if properly maintained (e.g. railway bridges, underground sewers). The decisions taken by regulators regarding the rate of return they allow investors to earn, have an impact on the funds companies are able to attract for investment. In turn, this has an impact on the investment that the company undertakes. Distortion of investment decisions may lead to "dynamic inefficiency", where regulated companies do not minimise costs in the long run.

Under RPI - X, the company's cost of capital is fixed for five years, whereas under rate-of-return, the rate of return allowed to investors (reflecting the cost of capital) is annually revised in the light of developments.

Impact on regulators

Balancing interests of consumers and investors: RPI - X price controls allow regulators to meet their objectives of protecting consumers, and promoting efficiency. But regulators are required to allow a normal rate of return for an efficient company, and they are not allowed to introduce P₀ adjustments (passing benefits to consumers immediately) that make it impossible for companies to finance their activities. It is also important for the regulator to ensure that efficiency improvements are not made at the expense of quality of service.

Efficiency and asymmetric information: Under rate-of-return regulation, while regulators can demand information from regulated companies, this only provides information on current costs, not on what costs could be reduced to. RPI - X provides companies with an incentive to find efficiency savings, thereby revealing (at least partly) what efficiency savings it is possible to achieve. This goes some way to solving the problem of asymmetric information between regulator and regulated.

"Excess" returns: One problem for regulators arising from the way RPI - X works is the likelihood that (for limited periods) companies will make returns in excess of the cost of capital. The regulator fixes prices, but firms can increase profits by reducing costs by more than expected, which will result in higher than anticipated profits. These unanticipated profits can appear excessive to consumers, and the regulatory regime and regulated companies may be discredited as a result. But the "excess" returns reflect improved efficiency,

and only last until the regulator next resets prices, when some of the efficiency savings made by the company (which resulted in "excess" returns) are passed to the consumer. This is to an extent a presentational problem for companies and regulators, rather than a fundamental problem of the RPI - X system.

Regulators can counter the problem by introducing profit sharing (where profits above a specified level are shared between company and customers). Alternatively, they can introduce error-correction mechanisms, where material profits or losses arising from factors outside the control of management are passed on to customers automatically. However, both options may have negative impacts on incentives to find efficiency savings, and therefore they are not a common feature of RPI - X schemes in practice.

Administrative burden of price controls: The perceived advantages to RPI - X compared to rate-of-return regulation are chiefly greater incentives for efficiency, and a reduction in bureaucracy, with reviews (usually) every 5 years to reset RPI - X price controls, compared to annual reviews under rate-of-return regulation. INTOSAI guidelines on best practice for the audit of economic regulation point out the risk that "an effective price control regime ... can be complex and costly"⁷⁴.

It is undoubtedly the case that the process of setting RPI - X controls is now very complicated in some industries. In its 2000 reports on the 2 water companies, the Competition Commission suggested OFWAT might wish to consider ways of simplifying the process⁷⁵.

Bibliography to Appendix 3

- | | |
|--|---|
| Averch H. and Johnson L. (1962) | <i>Behaviour of the Firm under Regulatory Constraint</i> , American Economic Review 52: 1052-1069. |
| Baldwin R. and Cave M.(1999) | <i>Understanding Regulation</i> , chapter 17. |
| Beesley, M.E. and Littlechild, S.C. (1989) | <i>The regulation of privatised monopolies in the United Kingdom</i> , in Beesley (ed.), <i>Privatisation, Regulation and Deregulation</i> , 1989, chapter 4. |
| Clifton M. (1997) | <i>RPI - X and Benefit Sharing</i> , NERA Topic 19. |
| Helm D. (2001) | <i>Utilities Journal</i> , OXERA (February). |
| INTOSAI (2001) | <i>Guidelines of Best Practice for the Audit of Economic Regulation</i> . |
| Littlechild S.C. (1983) | <i>Regulation of British Telecommunications' Profitability</i> , London: Department of Industry. |
| Mayer C. (2001) | <i>Water: the 1999 price review</i> , in Robinson C. (ed.), <i>Regulating Utilities</i> , chapter 1. |
| Vickers J. and Yarrow G. (1988) | <i>Privatisation: An Economic Analysis</i> . |
| Viehoff I. (1995) | <i>Evaluating RPI - X</i> , NERA Topic 17. |
| Williamson B. (1997) | <i>Incentives and Commitment in RPI - X Regulation</i> , NERA Topic 20. |
| Williamson B. (2001) | <i>UK "Incentive" Regulation: International Best Practice</i> , in <i>Regulatory Review 2000/01</i> , CRI, chapter 15. |

⁷⁴ INTOSAI, *Guidelines on Best Practice for the Audit of Economic Regulation (October 2001)*, guideline 15.

⁷⁵ Competition Commission, *Mid Kent Water plc (August 2000)*, para 2.211.

Appendix 4

Report for the National Audit Office by NERA on regulatory risk

1. Introduction

This report for the National Audit Office (NAO) surveys existing literature on "regulatory risk". The report distinguishes between two types of regulatory risk. The first type of regulatory risk, which we refer to as "regulatory system risk", is related to the form of regulation (e.g. price-cap, rate of return). A second notion of regulatory risk that we refer to as "regulatory intervention risk", concerns the risk associated with particular "events" or action by the regulator.

2. Measuring risk: CAPM and APT

This section discusses the basic principles of asset-pricing models, the Capital Asset Pricing Model (CAPM), and the less widely used Arbitrage Pricing Theory (APT), both of which have been used to estimate the impact of regulatory risk on the cost of capital of regulated utilities in the UK.

2.1 Capital Asset Pricing Model

The standard Capital Asset Pricing Model (CAPM) determines required post corporate tax returns for investment in the equity capital of a firm as:

$$E[r] = E(rf) + \beta(E[rm] - E(rf))$$

Where $E(rf)$ is the current risk-free rate of return; beta (equity beta) is the covariance between returns on the risky asset and the market portfolio, divided by the variance of the market portfolio; and $E[rm]$ is the expected rate of return for the market.

A key tenet of the CAPM is that an investor diversifies his or her stock holdings by combining risky securities into a portfolio. The effect of this diversification is to eliminate risks known as specific risks (also known as non-systematic risks). Specific risks arise from all those events that are unique to a particular share and have nothing to do with general market or economic factors. Because specific risks are not related, CAPM holds that an investor holding a diversified portfolio does not need a premium to reward this type of risk.

Complete diversification of risk is not possible since securities all move together to a certain extent, a result of the influence of economy wide factors such as interest rates, inflation, and macro economic demand. The risks that cannot be eliminated through diversification are described as "market" risks (or "systematic" risks).

A further key assumption of the standard CAPM model is that investors are risk averse and base their portfolio decisions only on the first two moments of the distribution of possible returns, the expected return and the variance of return, implying that returns are symmetrically distributed. This is important in the context of regulatory risk, an issue we will return to.

In studies that examine and attempt to quantify the importance of regulatory risk on the cost of capital, the CAPM has been widely used. In some studies, described below, the impact of regulatory system risk is measured by examining the difference in the measured beta coefficients across regulatory systems. Correspondingly, the impact of regulatory intervention risk is measured by examining the change in the measured beta coefficient pre and post regulatory announcements. Other studies use amended versions of the CAPM to include dummy variables as a way of identifying the effect of regulatory events at specific points in time.

2.2 Arbitrage Pricing Model (APT)

The arbitrage pricing model (APT) is an alternative asset pricing model to the CAPM developed originally by Ross (1976, 1977). The APT expresses required rates of return as a function of a number of economic factors (eg. oil price shocks, inflation etc), each of which has its own risk premium.

The APT is used occasionally to measure the importance of regulatory system or regulatory intervention risk but has not been used to date by UK regulators as a primary tool for estimating the cost of capital for UK utilities. Cooper and Currie (1999) argue in a paper that assesses the cost of capital for the UK water sector that APT models might be the appropriate type of models to estimate the impact of regulatory risk *"...there may well be other systematic sources of regulatory risk that are related to APT factors. For instance, regulators often do not set returns correctly relative to interest rates. This error is a source of risk that will be related to the level of interest rates. As such it is almost certainly a source of risk that affects returns in the APT model and should be included in any assessment of the impact of the cost of capital"*.

Whilst there is strong evidence that the APT gives a more complete description of risk than the CAPM, a key problem with the APT in practice is that the theory does not state what factors and how many should be included in the model specification. Practical applications of the APT to estimate the cost of equity for utilities, whilst limited, have produced no consensus on the key variables that should be included in the

model specification. A recent study by Goldenberg and Ashok (2001) which applies the APT to US utilities is found to produce significantly different estimates depending on the number of factors specified and the set of firm factors analysed.

Since the APT is more contentious and rarely used in the UK as a tool for measuring the cost of capital, our review places less emphasis on the results of studies that estimate the importance of regulatory risk using an APT framework by comparison with studies that use a CAPM framework.

3. Regulatory System Risk

This section examines the relationship between the regulatory system and the cost of capital.

3.1 Regulated v Competitive Markets

It is widely accepted that the design of regulatory systems can impact on the degree of market risk to which a firm is exposed.

Papers on regulatory risk by Peltzman (1976, 2001) propose that regulation provides a "buffering" effect on a firm's profits by limiting both upside and downside earnings variability. Peltzman argues that this buffering effect occurs as a result of regulatory price reviews that aim to ensure that total costs are recovered through the price limits that are set. By contrast, Peltzman argues that companies operating in competitive markets face more volatile cashflows that occur as a result of such factors as stranded costs, classic externalities and increased demand volatilities. In the context of electricity deregulation in the US, Peltzman (2001) argues that increased demand volatility will occur under competitive conditions as companies will be forced to set prices in accordance with marginal cost which will lead to greater price variability and hence greater profit variability. A related argument often made in UK regulation is that because continuity of service is so important, regulators will not want regulated companies to become bankrupt, except where this is necessary to emphasise the responsibility borne by the firm's managers, and so will buffer returns on the downside.

Some recent empirical papers have supported Peltzman's earlier observation of a buffering effect of regulation on profits, and a reduction in the cost of capital (Binder and Norton, (1999) Nwaeze (2000)). For example, Nwaeze examined the US electricity sector over time, as the determinants of earnings changed from a rate of return regulatory regime to arrangements involving more competitive markets. Nwaeze found that pro-competition reforms in the US electric power industry corresponded to increased earnings volatility and risk, consistent with phasing out the "buffering" effect of regulation.

It has also been argued, however, that there are a number of reasons why Peltzman's theory on the "buffering" effects of regulation may not hold but, rather, that regulation can actually increase a company's cost of capital relative to that which would be observed under competitive conditions.

First, the issue of "regulatory lag" is considered important in considering the effect of regulation on a firm's systematic riskiness (see Armstrong et al. (1999), Morin (1994)). Regulatory lag refers to the period between price or rate case reviews which in the UK is generally a period of 5 years. Through efficiency gains, utilities can realise greater rates of return than those anticipated and hence earn greater returns than would be earned under competitive conditions. Correspondingly, should costs be higher than was originally assumed, then the utility will earn less than the cost of capital until prices are realigned.

Second, it has been argued that regulation can increase the degree of market risk to which a utility is exposed as a result of imperfect indexation mechanisms that are used to adjust prices at regulatory review periods. Williamson (2000) argues in the context of the water and electricity price reviews in 1999 and 2000 respectively that the regulators' use of price caps which are adjusted to changes in the retail price movements but not input prices may mean that "(U)tilities with regulated output prices are more exposed than their counterparts in competitive markets, since companies in competitive markets can and do adjust their output prices in response to changes in input prices".

Third, regulators operate without full information about the regulated firm, and must therefore estimate the relevant parameters used to set prices such as efficient operating and capital costs, and the cost of capital. A complicating factor in UK regulation is that forward looking prices are set on the basis of observed operating costs for previous accounting year as current data is not available. Such imperfect information will lead to more volatile returns relative to companies operating in competitive markets where prices would be expected to realign continuously to cost changes⁷⁶.

Fourth, there is the issue of the fairness and predictability of the price review process itself. In his textbook on regulatory finance, Morin (1994) argues that "regulatory risk generally refers to the quality and consistency of regulation applied to a given regulated utility...regulation can compound the business risk premium if it is unpredictable in reacting to rate hike requests both in terms of the time lag of its response and its magnitude". With regard to UK regulation, there have been many suggestions that inconsistencies in the actions of regulators at price reviews since privatisation may lead to increases in the cost of capital (Helm, (1995), Bishop, Kay and Mayer (1995), Cooper and Currie (1999)).

⁷⁶ Ergas et al (2001) show that even when the average regulatory error is zero, the concavity of the firm's profit function means that there is a net loss of profit as a result of imperfect regulation.

Overall, whilst the conventional wisdom may say that price regulation reduces the market risk to which a utility is exposed, recent literature on regulatory risk exposes such factors as regulatory lag, imperfect price adjustment mechanisms, imperfect information and inconsistency that it is argued can actually increase the cost of capital for regulated utilities above that which would be observed in competitive conditions.

3.2 Differences between Regulatory Systems: Price-cap and Rate of return Regulation

This section looks at the key features of price cap and rate of return (or cost of service) regulation that can impact on regulatory risk as a result of the factors suggested above that include buffering of profits, regulatory lag, indexation mechanisms, informational asymmetries and predictability and consistency.

The key feature of price-cap regulation is that a fair rate of return on the capital base is set ex ante, on the basis of the regulator's perception of efficiency savings and input prices over the control period. Because companies are allowed to retain efficiency gains in the form of higher profits if they beat the regulatory price-cap, a company has the incentive to bear down on costs. However, the desirable incentive properties of the price-cap have a cost in terms of the risk to which the company is exposed. Under pure price cap regulation, outperformance or underperformance of the regulatory cost targets and/or demand changes including those which the company has no control will impact directly into profits. Where expected earnings volatilities cannot be diversified they will require compensation from investors through an increased cost of capital.

By contrast, "pure" rate-of-return (cost of service) regulation sets a nominal price to ensure a fair rate of return on a company's capital base. The key difference is that, where RPI - X regulation sets a price-cap to ensure a fair rate of return on the basis of ex ante expectations, rate of return regulation ensures a fair rate of return ex post. In theory, this means that a company can pass through all genuine additional costs to consumers in the form of higher prices, to ensure that a fair rate of return is gained. Under this system, if the price review process was continuous, the company's earnings volatility would be zero and the rate of return on its asset base would be constant.

In practice, pure forms of price cap or rate of return regulation do not exist. Price cap regulation requires periodic price reviews, and often is often implemented to allow for prior pass through of certain cost items deemed to be beyond the control of the company. Providing such cost pass through provisions are implemented in an symmetric manner this will reduce the exposure of the utility to risk. Rate of return

regulation in practice, does not allow for instantaneous cost pass through of all costs, and capital expenditures in particular are generally subjected to prudency tests, so ex post full recovery is not guaranteed⁷⁷.

A study examining the relationship between regulatory structure and risk was undertaken by Alexander et al. (1996). They classify regulatory regimes according to the strength of cost-efficiency incentives: RPI - X and revenue-cap regimes involve high powered incentives, rate of return regulation is low-powered, while European discretionary regimes are classified as intermediate. Estimating betas for a wide range of utilities worldwide, the study presents cross-country averages for the three types of regime by sector, and, a single average figure by regulatory regime (see Table 1 and Table 2).

Both the sectoral averages and the overall regime estimates show a clear trend: high-powered incentives appear to be related to higher systematic risk, while low powered incentives imply low systematic risk.

The results of Alexander, Mayer and Weeds (1996) are in line with other research at that time by Gandolfi, Jenkinson and Mayer (1996) and more recently by Alexander et al. (2000) that found a similar relationship between the regulatory regime and beta risk in the transport sector. The results seemed to confirm the hypothesis that companies under RPI - X regulation (as practiced in the UK) are viewed by the markets as being exposed to higher levels of systematic risk in comparison with those under rate-of-return regulation (as practiced in the US), and that the cost of capital for those companies was therefore likely to be higher.

Table 1 - Average Asset Beta Values by Regulatory Regime and Sector

Incentives	Electricity	Gas	Energy	Water	Telecoms
High-powered	0.57	0.84	-	0.67	0.77
Intermediate	0.41	0.57	0.64	0.46	0.70
Low-powered	0.35	0.20	0.25	0.29	0.47

Source: Alexander et al, 1996

Table 2 - Average Asset Beta Values Across Regulatory Regimes

Incentives	Average Beta
High-powered	0.71
Intermediate	0.60
Low-powered	0.31

Source: Alexander et al, 1996

⁷⁷ For example, since the mid-1970's the ex-post rates of return achieved by a number of US utilities have been eroded as a result of inflation coupled with a regulatory lag in adjusting nominal prices, and by regulatory decisions to disqualify some assets from the rate base on the grounds that they were not "used and useful".

However, as Alexander, Mayer and Weeds (1996) noted in their report:

"...the observed difference may be due to any number of alternative factors and cannot be said to prove the existence of higher regulatory risk in the UK"

Additional factors that could cause changes in betas as well as the regulatory regime include: the political environment, the operating environments, variations in the level of competition, market risks, geographical composition and non-utility activities. The alternative regulatory systems may not be the sole cause, therefore, of the difference in the asset betas.

Research which looks to update the 1996 analysis of Alexander et al., and investigate why the relative riskiness of companies in different regulatory regimes may have changed, is not apparent and would be useful⁷⁸.

3.3 Regulatory Risk and Political Risk

The regulator and the regulatory regime are, in turn, influenced by political change. In the UK, utility regulators have been empowered independently by statute at the time of privatisation, arguably minimising direct political direction of their decisions. There remains, however, the fact of their ultimate control by Parliament and the potential for influence from Departments and Ministers of State. This may introduce the factor of political risk: that is, that the regulator's guiding statements, instructions or stance will shift to alter the systematic relationship of returns in the utility with those in the market as a whole.

Some research has examined the behaviour of utility shares with regulatory and political uncertainty. Antoniou and Pescotto (1997) suggest that there is evidence of political risk in the statistical significance of dummy variables standing in for the association of the 1987 and 1992 UK General Elections with the beta of *British Telecommunication plc's* (BT) equity⁷⁹. Francis, Grout and Zalewska-Mitura (2000) show that betas for regulated utility stocks fell during the period of 1 January 1998 to 12 August 1999, which they attributed to political and regulatory uncertainty over government proposals for a move towards profit sharing regulation in the UK.

4. Regulatory Intervention Risk

4.1 Introduction

This section presents empirical work that has examined the relationship between regulatory behaviour or events and the regulated firms' price volatility and cost of capital.

4.2 Regulatory Conduct and Cost of Capital

The existing literature on regulatory risk and cost of capital effectively focuses on two broad issues: (i) the impact of discretionary, unpredictable actions of a regulator on share price volatility; and (ii) the effects of the price review process on cost of capital.

4.2.1 Predictability of Regulatory Behaviour

There are number of papers examining whether the use of a regulator's discretionary power, in the form of unpredicted regulatory interventions, increases the volatility of a regulated company's returns and cost of capital.

Robinson and Taylor (1998a) examine the intervention of the then Director General of Electricity Supply, on March 7 1995, who unexpectedly announced a re-visiting of the price review process that had been concluded in the previous August, and which was intended to come into effect in April 1995 for a five year period⁸⁰. In particular, the authors examine whether the intervention increased the volatility of stock prices for the twelve regional electricity companies (RECs), by examining the companies' share price variances before and after the event.

Robinson and Taylor discover that for eight of the twelve RECs, there is a marked impulse increase in share price volatility after 7 March 1995, and this increased volatility displayed some "persistence".

Robinson and Taylor (1998b), in a separate study, use the same methodology to examine regulatory risk in UK electricity distribution industry for a wider set of regulatory "events". For two thirds of the 58 regulatory events they examined, the authors found evidence for an increase in the firm's variance of returns, and a significant degree of persistence in the period following.

It is necessary to point out that neither study tests for the effects of a change in systematic risk. Both studies highlight the impact of regulatory events on share price volatility. Of particular importance is the study of the unexpected intervention in 1995 described above, which suggests that events increasing perceptions of unpredictability of a regulatory regime can increase volatility of returns. These unanticipated events could have implications for a company's cost of capital. The authors conclude that if the standard deviation of an individual asset's returns affects its cost of capital, such as some APT modelling has found, then regulatory intervention would have impacted upon a company's cost of capital.

⁷⁸ Since 1996 there has been a noticeable decline in asset betas for the UK casting some doubt on the World Bank conclusions.

⁷⁹ A positive coefficient is uncovered for 1987, when the (losing) Labour party promised renationalisation of BT were they elected to government; a negative coefficient is found for 1992, where this policy was absent (Antoniou and Pescotto, 1997).

⁸⁰ The Director General of Electricity Supply released a press statement on March 7, 1995, indicating that he would review the electricity industry's price caps which had been set the previous August. This action was precipitated by reports that one of the regional electricity companies (RECs), Northern Electric, was very well placed financially to fight off a hostile takeover bid from Trafalgar House.

Antoniou and Pescetto (1997), using an alternative methodology, directly examine the impact of unanticipated regulatory announcements on beta risk for BT, over the period 1984 to 1993. They hypothesise that:

- announcements or events that enhance competition in the telecom sector will increase beta risk (and therefore the cost of capital), whereas restrictive legislation will decrease the cost of capital;
- events that facilitate an increase in prices will decrease BT's cost of capital, and vice versa; and
- events that enlarge the scope of services that BT can offer will decrease beta risk, and vice versa.

Their research finds evidence for a strong relationship between unanticipated regulatory interventions and systematic beta risk, but not necessarily in the direction expected. For example, measures that resulted in price decreases for some of BT's service were generally found to have decreased beta risk, in direct contrast to their hypothesisation. The authors speculate that a price cap on BT services could act as a deterrent to new entrants, who will face higher costs than the incumbent, and therefore effectively reduce the threat of competition. Overall, the authors conclude that regulators can influence a company's systematic risk, and therefore its cost of capital, although the direction of change is not always easy to predict.

4.2.2 Regulatory Asymmetries

It has been argued that the ability of regulators and governments to exercise freedom and discretion when making regulatory decisions can have the effect of reducing returns that are high without commensurately subsidising returns that are low. As an example of this, Cooper and Currie (1999) cite regulatory proposals to claw back "excessive" returns through error correction mechanisms (eg. the UK windfall tax). In contrast, external risks, such as exchange rate risk, happen independently of the particular behaviour and position of the firm or industry in question and have a natural symmetry of impact.

The CAPM model in its basic form cannot take account of skewed risks such as downside asymmetric risk. However, Conine and Tamarkin (1985) have suggested that we extend the traditional mean-variance CAPM model to accommodate third moments, reflecting the skewness in a company's returns. The authors studied 60 utilities in the USA over a period of five years, and calculated the expected return using the CAPM, as well as the modified third moment CAPM. Whilst the former gave a nominal return of 15.81%, the latter suggested nominal 17.16%, implying an additional 1.3% to the cost of capital of a typical utility by considering this "third moment risk", although this was not all attributed to regulation.

If the effect of asymmetric regulatory interventions produces an expected return which is less than the actual cost of capital, companies will not invest. This means that the regulatory regime must adjust to these circumstances. This can either be done by removing the regulatory risk, or by promoting another source of returns, e.g. by increasing the parameters in the CAPM, by increasing the operating expenditure allowance, or through retention of higher profits from cost savings (see Kolbe et al. (1993) and Grout (1994))⁸¹.

4.2.3 The Impact of the Price Review Process

It has been argued that price control consultation procedures are a source of uncertainty by utility companies due to what they see as arbitrary negotiation practices (Robinson and Taylor, 1998b). A seminal paper on the impact of regulatory procedures on the risk to which a utility is exposed was that of Brennan and Schwartz (1982) who defined a consistent regulatory policy "as a procedure for determining the holding of a rate hearing and setting the allowed rate of return at the hearing such that, when properly anticipated by investors, the procedure causes the market value of the regulated firm to be equal of the rate base at the time the hearing is held".

Within the context of UK regulation, the market to book ratio is widely regarded as an important tool for bringing market information to bear on the issue of whether allowed rates of returns set at periodic price reviews are adequate. Houston (1996) argues "...if the regulator is doing his or her job properly, the stock market valuation of the utilities should be broadly in line with the regulatory asset base". Morin (1994) argues that regulation can increase business risk if it does not provide the utility with the opportunity to earn a fair rate of return.

An empirical study of the effect of the price review process on utilities' costs of capital by Gandolfi et al (1996) contends that beta will follow a "saw-tooth" cycle over periods of regulatory review, declining as the review approaches, since product/service market risks are passed through to customers in the tightening or loosening of price caps at the time of the review. Gandolfi et al interpret this as consistent with the view that the frequency of price reviews in UK regulation makes the process akin to rate-of-return regulation and reduces variability of earnings.

⁸¹ For example, Kolbe et al (1993) suggested that there are two possible responses to accommodate the downside risk so as to ensure that the expected ex ante return is equal to the cost of capital. One is to add a "regulatory risk premium" to the allowed cost of capital. Another option is to add an "insurance premium" to the revenue requirement.

Bibliography to Appendix 4

- Alexander, I., Mayer, C. and Weeds, H., "Regulatory Structure and Risk and Infrastructure Firms: An International Comparison", Policy Research Working Paper 1698, World Bank 1996.
- Alexander I. and Irwin, "Price caps, rate of return Regulation and the cost of capital", World Bank, 1996.
- Alexander I., Estache A. and Oliveri A., "A few things transport regulators should know about risk and the cost of capital", World Bank, 1999.
- Antoniou A. and Pescetto G., "The effect of regulatory announcements on the cost of equity capital of British Telecom", Journal of Business Finance & Accounting, 1997.
- Armstrong, M., Cowan, S. and Vickers, J., "Regulatory Reform: Economic Analysis and British Experience".
- Binder J. and Norton S., "Regulation, profit variability and beta", Journal of Regulatory Economics 1999.
- Bishop M., Kay J. and Mayer C., "The Regulatory Challenge", Oxford University Press, Oxford, 1995.
- Brennan, M.J. and Schwartz E.S., "Consistent Regulatory Policy Under Uncertainty", Bell Journal of Economics 13(2), 1982, 506-521.
- Buckland R. and Fraser P., "Political and regulatory risk: beta sensitivity in the UK electricity distribution", Journal of Regulatory Economics 2001.
- Conine T. and Tamarkin M., "Implications of skewness in returns for utilities", Financial Management 1985.
- Cooper, I. and Currie, D., "The Cost of Capital for the UK Water Sector", Regulation Initiative Discussion Paper Series Number 28, May 1999.
- Copeland T. and Weston J. F., "Financial theory and corporate policy", third edition, 1988, Addison-Wesley Publishing Company.
- Ergas, H., Hornby, J., Little, I. and Small, J., "Regulatory Risk", A Paper prepared for the ACCC Regulation and Investment Conference, Manly 26-27, March 2001.
- Grout F., and Zalewska-Mitura, "The impact on the stock market of changes in regulation of companies", Leverhulme Centre for Market and Public Organisation (CMPO), February 2000.
- Gandolfi M., Jenkinson T. And Mayer C., "Regulation and the cost of capital", Oxford School of Management Studies, University of Oxford, 1996.
- Grout, P., "The Cost of Capital in Regulated Industries" in "The Regulatory Challenge", M. Bishop et al.
- Helm, D., "British Utility Regulation", Theory Practice and Reform in D.Helm (ed.) British Utility Regulation, Oxford, OXERA. 1995.
- Houston, G., "Regulatory Tobin's Q, Tracking Shares and All That", NERA Topic Paper 18, April 1996.
- Kay, J. C. and Mayer, C., Oxford University Press 1995.
- Kolbe, A.L., W.B. Tye, and Myers S.C., "Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries" (1993).
- Littlechild, S., Regulation of British Telecommunications Profitability, HMSO, 1983.

- Morin, R., "Regulatory Finance: Utilities' cost of Capital", Public Utilities Reports 1994.
- Morana C. and Sawkins J., "Regulatory uncertainty and share price volatility: the English and Welsh water industry's periodic price review", Journal of Regulatory Economics 2000.
- Nwaeze E., "Deregulation of the electric power industry: The earnings, risk and return effects", Journal of regulatory economics, 17:1 2000.
- OFWAT, MD167 "Modification of conditions of appointment: Proposal about condition B, Part IV (interim determinations) and other possibilities, January 2001.
- Peltzman S., "Toward a more general theory of regulation", Journal of Law and Economics 1976.
- Peltzman S., "Petition for approval of delivery services tariffs and tariff revisions and residential delivery services implementation plan, and for approval of certain other amendments and additions to its rates, terms and conditions", 2001.
- Rees, R. and Vickers J., "RPI - X Price-cap Regulation", The Regulatory Challenge, Oxford University Press 1995.
- Robinson T. A. and Taylor M. P., "Regulatory uncertainty and the volatility of regional electricity company share prices: the economic consequences of Professor Littlechild", Bulletin of Economic Research 1998.
- Robinson T. A. and Taylor M. P., "The effects of regulation and regulatory risk in the UK electricity distribution industry", Annals of Public and Cooperative Economics 1998.
- Roll R. and Ross S., "An Empirical Investigation of the Arbitrage Pricing Theory", Journal of Finance, 35, 1980.
- Ross S.A., "The Arbitrage Theory of Capital Asset Pricing", Journal of Economic Theory, 13(3), 1976, 341-360.
- Ross S.A., "Risk, Return and Arbitrage", in I. Friend and J.L. Bicksler eds., Risk and Return in Finance, Vol 1, Cambridge, MA: Ballinger Publishing Company, 1977, 189-218.
- Sherman R., "The regulation of monopoly", Cambridge University Press, 1989.
- Williamson, B., "Under Pressure", Utility Week, May 2000.

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

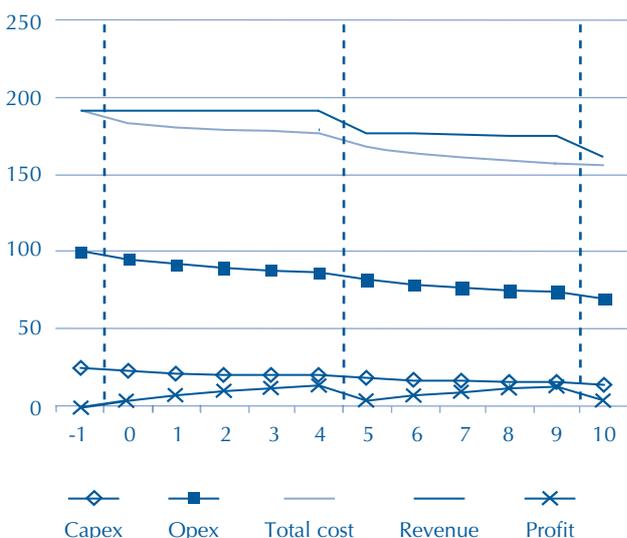
Assumptions:

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.

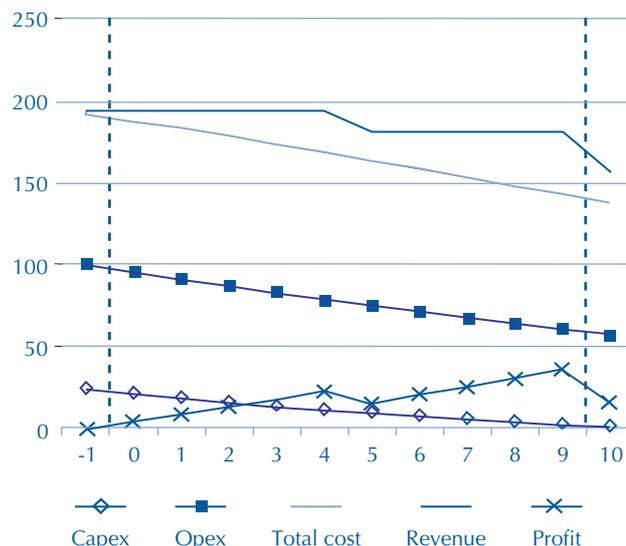
28 A simple way of implementing this approach is to reduce prices by the present value (PV) of cost reductions over the previous five years. Under this approach the regulator calculates the PV of total allowed revenue and total costs over the outgoing price control period. Future revenue is then reduced 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.

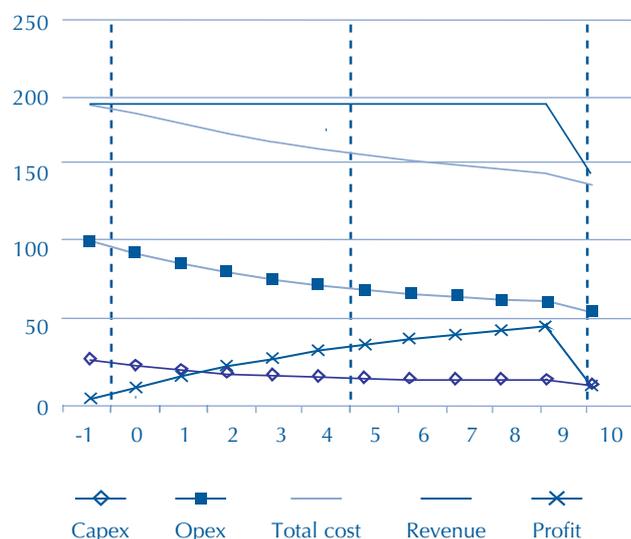
⁸⁷ This approach is identical to the rolling incentive except in the method of calculation.

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:

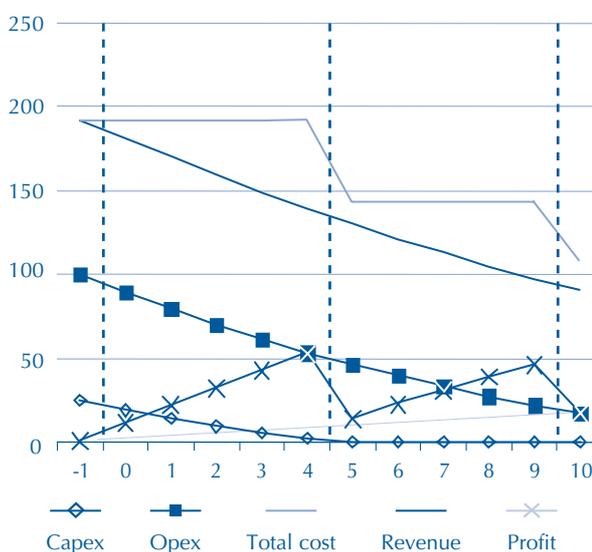
- through benchmarking, regulators gain the confidence to set revenue exogenously rather than with reference to the firm's own costs (thus realising the superior incentives described above); or

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.

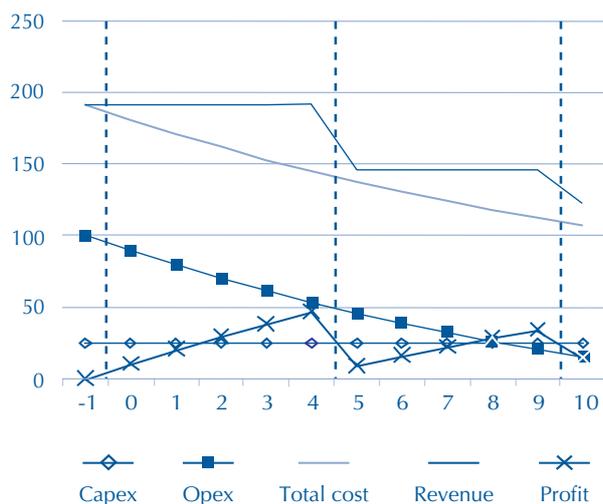
Spreadsheet model - capitalisation

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%

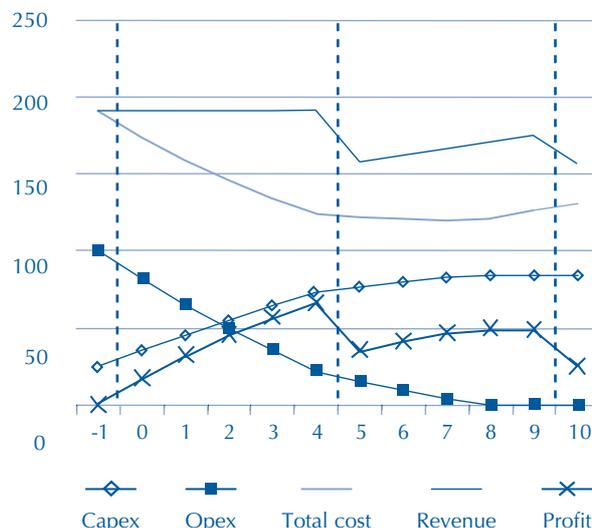
The firm makes rapid reductions in operating expenditure because of the powerful incentive properties of the benchmarking regime (see section 3).

- 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).

Glidepath	An approach to setting price limits in future years that seeks to reduce company profits gradually from a starting level in excess of the normal level (that is, the level required to reward investors for committing funds to a company) to that normal level.
Incentives	Within economic regulation, incentives describe the arrangements put in place by regulators to encourage companies to improve services and reduce costs.
Operating expenditure	Expenditure whose benefits are only enjoyed within the current accounting period, usually presented in contrast to capital expenditure.
P₀ adjustment	A component of the price limit that seeks to reduce company profits through an immediate cut in the maximum price a regulated company may charge, reflecting efficiency gains achieved by companies.
Price review	The process by which an economic regulator considers the appropriate level of price limit to apply to a regulated company. It typically occurs every five years, though a four year price review is used in telecommunications.
Regulatory accounts	Accounts provided by a regulated company to economic regulators in a form specified by the relevant regulator, showing revenues and costs for the regulated part of the company's operations.
Rolling mechanism	Mechanism by which economic regulators can allow companies to retain the benefits of efficiency savings for a fixed period, regardless of when, within the five year price review period, the savings arise.
Unanticipated efficiency	Efficiency gain achieved by a regulated company during a price control period that was not anticipated (and included in price limits) by the economic regulator at the price review.
Unintended incentives	Incentives created by price regulation which were not intended and which may not be in line with the regulator's overall objectives.
Yardstick competition	Process for estimating the efficient costs of a regulated company on the basis of a comparison with similar companies within the same industry. In this approach, though the companies do not actually compete in the normal sense, each company serves as a yardstick for the others. Yardstick competition represents a more specific form of a general regulatory approach of benchmarking, which involves comparing the way different companies undertake similar activities.

The performance and condition of networks

Asset condition	The performance and need for renewal of an asset owned by a regulated company.
Network resilience	The ability of the network assets to withstand unexpected events, such as adverse weather conditions or sudden surges in demand.
Outputs	The services provided by the network owning companies, including the reliable delivery of water, electricity and telecommunications services to customers.

Financing of investment

Beta	Standard measure of riskiness of companies, based on the relationship between a company's own return and the return to the market as a whole.
Capital Asset Pricing Model	Standard method for calculating the returns required by investors from an asset, given the risk profile of that asset.
Cost of capital	The amount that a company must pay investors to compensate them for the risk of providing funds - whether as debt or equity - to a company.
Financeability	The extent to which an economic regulator's proposals for price limits will allow a regulated company to raise necessary finance and to pay reasonable returns to existing investors.
Financial model	Computer model of company's revenues and costs through which the regulators estimate an appropriate level of price limits to apply to companies in future.
Financing structure	Mixture of debt and equity within a company's balance sheet.
Rate of return on investments	Weighted average return earned by investors in a company on their investments.
Regulatory asset base	The assets held by the regulated company for the purpose of delivering the service which is subject to regulation. Also known as regulatory capital value.