

Rate-of-return regulation versus price regulation for public utilities

David M Newbery
Department of Applied Economics
Cambridge, UK
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Public utility regulation arose naturally in the nineteenth century for gas, water, rail, telegraph, and later, electricity and telephony because these utilities require a fixed network to deliver their services. These networks need access to rights of way which requires community or government approval, while the network is a natural monopoly that precludes efficient competition and confers potentially exploitative power on the owner that will inevitably lead to political demands for restraint. The durable, costly and irrecoverable nature of the network raises the fear that curbs on prices will prevent the investor recovering a fair return on his investment. Regulation evolved to balance the interests of investors and consumer/voters. Where a satisfactory balance could be achieved, utilities could remain under regulated private ownership. If private investors lacked confidence that they would be allowed to earn an acceptable return, or if the polity believed that it could secure a more satisfactory distribution of the benefits of the public utility, the outcome was public ownership. Britain and the US exemplified different solutions to achieving this balance of interest.

Historically regulation arose as part of the contract with municipalities, who granted rights of way in exchange for quality standards and curbs on prices, starting with coal gas and piped water. Coal gas lowered the cost of lighting by two-thirds when introduced in Britain in 1806 (Falkus 1982). This appealed to municipalities, who granted the right to lay pipes and disturb roads in exchange for concessional street lighting. Economies of scale gave monopoly power and high profits to the first entrant. Early attempts to regulate prices were ineffective in Britain, and profits could only be restrained by entry, which created obvious inefficiencies - by 1850 London had 14 gas companies (Foreman-Peck and Millward 1994: 30). In such a competitive environment, quality suffered, often with lethal consequences, making municipal ownership look increasingly attractive. The appeal of municipal ownership was that it kept prices reasonable, while the profits financed other local public goods and reduced local taxes. Parliament responded by creating limited life private franchises, which at their end could be bought at written-down cost by municipalities. By 1907, one-third of the net output of gas companies was public, as were 57% of trams, 64% of electricity, and 81% of water companies (Foreman-Peck and Millward 1994), and eventually all public utilities were nationalized.

The US evolved a different institutional solution for these utilities. Initially, most cities offered a contractual franchise, starting with the introduction of gas in New York in the 1820s (Priest 1993). These contracts typically provided for access to public rights of way and a franchise monopoly in return for restraints on prices and concessional terms for supplying the municipality. The contracts were typically for 20-30 years, long enough to repay the large capital investments. Inevitably, they had to be renegotiated as circumstances changed. Soon contracts made explicit provision for renegotiation, subject to arbitration,

or reference to an independent committee, which might also monitor service quality. The power of these regulatory committees grew, and in due course evolved into state public utility commissions (PUCs). Where competitive entry threatened monopoly profits, as with electricity and telephones, utilities sought franchise protection in exchange for forms of regulation that allowed utilities to pursue their technological objectives. According to Williamson (1985: 347), rate-of-return regulation was a development of an incomplete long term contractual relationship that offered utilities a fair rate of return in exchange for the ability to renegotiate the terms of the contract without excessively costly haggling.

Rate-of-return regulation evolved through a series of land-mark court cases in the US to provide procedural fairness in the allocation of rents accruing to franchise monopoly investor-owned utilities. Economists have increasingly criticized it for its inefficiency. Price regulation was designed in the UK to create an efficient system of regulation to enable publicly owned utilities to be transferred to private ownership. Politicians and the public have criticized it for its lack of fairness in the distribution of rents between consumers, shareholders, and managers.

Each of these two forms of regulation can be seen as a special solution to the general problem of designing a system of regulation in which the regulator has imperfect information about the costs and opportunities facing the regulated utility (Laffont 1994; Laffont and Tirole 1993). The regulator specifies rules that determine the utility's allowable revenue, R , in which

$$R = b\bar{R} + (1 - b)C$$

where \bar{R} is independent of the utility's total cost, C . The term b is the *power* of the regulatory incentive scheme, with $b = 0$ (the lowest power) corresponding to cost-of-service or rate-of-return regulation, and $b = 1$ to a high-powered scheme such as price regulation in which the utility receives all the benefit of cost reduction.

The central insight of this Bayesian optimising approach to designing the best incentive scheme given asymmetric information is that there is an inescapable trade-off between greater incentives for cost reduction and greater rent transfer to consumers (exactly as in the closely related field of optimal taxation), and that typically the optimum involves some intermediate level of incentives. In practice, both rate-of-return regulation and price regulation operate to achieve this. Price-caps are periodically reset to translate past cost reductions into future price reductions, while the regulatory lags under rate-of-return regulation allows utilities to benefit from cost reductions until new rates (regulated prices) are agreed. Although there are forces encouraging the convergence of the two systems of regulation, there remain important differences between them, at least as practised in the US and Britain.

THE PROBLEM OF REGULATORY COMMITMENT

The central problem of regulation is to agree a regulatory compact which reassures investors that their sunk capital will be adequately rewarded, and they will be protected from populist

pressure to reduce prices to avoidable cost. Gilbert and Newbery (1994) view the regulatory compact as the outcome of a repeated dynamic game, and compare the robustness of different regulatory regimes against the temptation of regulators to break the regulatory compact. They find that restricting the freedom of action of the regulator helps, that regimes which produce larger profit swings are more vulnerable to regulatory opportunism, and that changing demand and cost conditions can undermine the regulatory compact.

Rate-of-return regulation restricts the variation in profitability, hence removes one of the main reasons for breaking the regulatory compact, though seriously unbalanced tariffs, or technical progress facilitating competitive entry may nevertheless precipitate a restructuring of the utility and hence of the regulatory relationship. In response to these pressures, vertically integrated franchise monopolies have been unbundled to separate the core natural monopoly network from the potentially competitive services supplied over the network. AT&T was broken up in 1984 to allow it to rebalance its tariffs to compete with new entrants in the long distance market. US gas markets were deregulated after 1978 as regulation failed to deliver the desired redistributive benefits of low gas prices without costly shortages (Ellig 1991). Restructuring electricity exposes nuclear power stations to competition from cheaper forms of generation, allowing some customers to escape paying for past costly investments. Arguably, rate-of-return regulation, which appears to allow utilities to recover their investment costs prudently undertaken and 'used and useful', is more vulnerable to opportunistic liberalisation than price regulation, which offers no such guarantee, and where investors expect to earn a higher risk premium in compensation. As a result, there is stronger pressure in the US for the recovery of 'stranded assets' - past investments accepted into the rate base by the PUCs - which with the benefit of hindsight appear uneconomic. Rate-of-return regulation offers insurance against the risks of adverse technical progress in return for a lower return to investors.

Price regulation provides strong incentives for cost reduction which can lead to high profits, putting the regulatory compact under strain. The British solution to sustaining regulatory commitment is to specify the general framework for regulation and the duties of the regulator in Acts of Parliament but to place the main body of regulation in legally enforceable utility licences. In addition, the price-cap is reviewed periodically, and new targets are then agreed in a licence amendment. Licence modifications may also be negotiated between reviews in response to changed circumstances, as has happened with BT, but only with the agreement of the utility. In the event of a dispute between the regulator and the utility, the case is referred to the Monopolies and Mergers Commission (MMC) which can empower the regulator to impose the change.

British price regulation is therefore also (intermittently) responsive to changes in profitability, reducing the temptation to break the regulatory compact. The regulator was criticized for re-opening the electricity distribution price review in 1995 after hostile takeover bids and responses to them revealed significant scope for increased borrowing, enabling large repayments to shareholders. However, the reopening of the review happened as part of the process laid down in the Electricity Act for inviting, considering and responding to objections to proposed licence modifications before the latter had been incorporated into the licence. The companies could have appealed to the MMC but did not

do so. Similarly, the British Labour Party's 1997 manifesto commitment to impose a windfall profits tax on the privatized utilities to claw back 'excessive' past profits has been criticized for effectively changing the regulatory compact, though again neither the licences nor the Acts under which each utility is regulated restrict the government's general tax powers.

Both examples reveal the difficulties of commitment to high-powered incentive schemes. A related problem lies in combining regulatory flexibility (the ability to adapt licence conditions to changing circumstances) without sacrificing regulatory stability and commitment and undermining the incentive to respond to changing circumstances. The British solution is to allow independent arbitration by the MMC, which, because it is costly for each party, helps commitment.

METHODS OF REGULATION

Initially it was proposed to subject British Telecommunications (BT) after privatization to rate-of-return regulation, but Alan Walters, the Prime Minister's advisor, strongly criticized this as being effectively a 100% profits tax, with poor incentives for efficiency and a tendency to encourage excessive capital-intensity (the Averch-Johnson effect, described by Averch and Johnson 1962; Baumol and Klevorick 1970; empirically demonstrated by Petersen 1975). Walters proposed an Output-Related Profits Levy, where the rate of profits tax decreased with increased output. Stephen Littlechild was commissioned to advise on regulation, and recommended a local tariff reduction scheme, rapidly renamed RPI - X. His idea, set out in Littlechild (1983), was to confine regulation to the non-competitive core (local service), and leave competition to restrain other prices, thus providing incentives and avoiding the complexity of the US system of regulation. The privatization prospectus would specify which services would be regulated, and this basket of services would be used to construct a price index. For BT, the weights in the tariff basket are the previous year's quantities, so that if q_{it} is the quantity of service i in year t , and p_{it} is the price, then $P_t = \sum q_{it-1} p_{it}$ is the price index in year t .

At privatization, the initial level of the price index, P_0 , would be chosen, together with the real rate of decline of prices, X , meaning that each year the price index may not increase more than the percentage increase in the Retail Price Index, RPI, less X . The merchant banks would then set the flotation share price for the utility, based on the profit forecasts implied for the regulated and unregulated services, avoiding the need to measure the value of the assets. Littlechild argued that a non-discretionary form of regulation would avoid 'capture' by incumbent suppliers and that 'regulation is merely a stop-gap until sufficient competition develops.' (Littlechild, 1983: 1).

Rate-of-return regulation appears quite different. The regulated utility files a proposed new set of tariffs with detailed accounting information on the latest operating costs, the rate base, (the written down value of the assets necessary for the utility to meet its service obligations), and its cost of capital. The tariff *level* is required to just cover unit costs including the return on capital, and its *structure* to be fair and non-discriminatory, based on rules for allocating costs to each service. The PUC then holds a public hearing to

approve the new set of tariffs, which holds until the utility files for a revision.

Price regulation has considerable attractions at the point of privatisation. It appears to side-step the question as to what the 'fair' rate of return is, leaving it to 'the market' (actually, the merchant banks pricing the shares) to determine, and it allows 'the market' to take a view about the likely rate of efficiency improvement or cost reduction. This has attractions in Eastern Europe where the companies buying the utilities to be privatized prefer not to reveal what rate of return they require, lest this be thought excessive. There is little need to agonize either about P_0 or X . Higher values of P_0 or lower values of X merely increase the flotation value at the expense of consumers, but allow the government to retire more public debt and reduce taxes on the same tax-paying consumers. In some cases, such as electricity or gas distribution, the costs of buying bulk electricity or gas may be passed through directly, so that only the value-added of the distribution service is subject to price regulation. In other cases where the initial price is too low to finance needed capital investment, such as the water industry, the price control may be allowed to increase by K per cent annually specifically to finance the investment, and these K factors will be set in the light of the investment programme.

Many of the apparent differences between the two forms of regulation disappear when the price controls are reset at the first regulatory review. It was acknowledged that competition could not replace regulation for the core natural monopoly (except perhaps in telephones, where technical progress allows duplication of the network). At each review, the regulator has to reset the price control for a set period, typically 4-5 years, based on information about operating costs, investment plans, and the Regulatory Asset Base (RAB). The Acts under which each utility is regulated require that the utility be allowed to earn a return sufficient to attract funds for future investment. The regulators make essentially the same calculation as their US counterparts to determine the cost of capital for an enterprise of comparable risk, based on market evidence. The most obvious difference is that the RAB need not correspond to the book value of assets, but may reflect the value realised by the assets at privatization (Newbery 1997).

At each review, the regulator has to reset the price index and the new value of X . It is interesting that in reviewing the performance of price regulation, Beesley and Littlechild (1989) qualify the claim that price regulation is less vulnerable to capture than rate-of-return regulation by accepting that 'there is greater scope for *bargaining* in RPI - X than in rate-of-return regulation', partly because 'the UK regulator has more discretion and less need to reveal the basis of his decisions than does his US counterpart.' (Beesley and Littlechild 1989: 461). This may just reflect the differing traditions of administrative law in the two countries rather than any fundamental difference between the two forms of regulation. The trajectory of prices implied by the initial price level and value of X must be such as to generate a revenue stream leading to a terminal asset value (equal to the opening value less depreciation plus investment) whose present discounted value at the allowed rate of return is at least equal to the opening value of the RAB, assuming that the operating costs and investment are efficiently undertaken.

If the price index in the final year of the previous period is P_T , which by construction should be equal to the projected unit cost of c_T (operating cost plus depreciation plus the

return on the rolled forward RAB, per unit of output), and the actual current unit costs are c_T^* , then the new initial value of the price control may be set at a weighted average of P_T and c_T^* , converging on the forecast terminal unit cost at the end of the next period, c_{T+N} , by setting an appropriate value of X . Such a system allows the utility to keep a fraction of larger than expected cost reductions in the previous period, increasing the incentive to undertake cost reductions near the end of the regulatory period. The effect can be likened to a competitive market, in which cost reductions by one producer are likely to be imitated by others, but only after a lag, during which the producer enjoys the supernormal profits that are the reward to superior innovatory effort.

The main differences between rate-of-return and price regulation is that the former is based on actual costs, whilst in principle the latter is based on projected efficient costs, that is, costs that the utility should be able to achieve (possibly after some reorganization) if it were efficient. Where there are many comparable utilities, as with the 10 major water companies and the 12 regional electricity companies, the regulator can estimate the efficient frontier cost function using information about costs from all companies, and can then determine how far from the frontier any individual utility is, and how rapidly it might be expected to reach the frontier. Yardstick regulation in which the target for one utility depends of the performance of other comparable utilities has the advantage of using relevant cost information while preserving incentives for cost reduction (Shleifer, 1985). Where there is only one utility, as with BT, TransCo (the operator of the high pressure gas pipeline), and National Grid Company (the operator of the high tension electricity grid), such yardstick regulation is not directly possible (though international benchmarks are sought and used), Instead, the regulator may need to employ consultants to assess the efficient level of costs and investment required to meet performance standards.

A second difference is that although in principle, rate-of-return regulation could be indexed for inflation and based on a basket of services, in practice in the US it has typically not been indexed, and the entire structure of rates has been set at the review, reflecting the interests of the various pressure groups, or at least preventing rapid changes in the rate structure that might disadvantage some groups. Thus telephone rates were highly averaged across groups with very different costs of service (remote rural vs densely populated urban areas), with large cross subsidies (from long-distance to local service, reflecting the power of state interests of the PUC compared to out-of-state interests), or from business to domestic customers, who had greater voting power. Any changes in cross-subsidies must be renegotiated and is likely to be resisted by those who lose. The British system aims at efficiency by ruling out most cross-subsidies in the Acts, and encouraging competition, which forces utilities to align prices with costs. Utilities are therefore normally left free to rebalance tariffs between different classes of customers provided they do not increase the price index for the basket of services, leaving distributional issues to be addressed through the tax system.

Again, though, this difference can be exaggerated, for regulation in Britain as anywhere is inevitably subject to political pressures that may restrain the freedom of the utility to redistribute rents between customers. When BT was privatized, the rate at which the line rental could be increased was limited to RPI+2%, to avoid a sudden large increase

in the fixed and unavoidable charge coupled with a large decrease in the charge per minute. Such a move would have disadvantaged smaller customers, benefitted business users, and made competitive entry (which was targeted at high volume business users) more difficult. Later it was decided that there should be separate price-caps for different bundles of services, and that overseas calls, originally left unregulated, should be brought within the control. Similarly, faced with a political need to subsidize British coal, the Government persuaded the generators to sign contracts with British Coal at above market prices, backed by contracts with the regional electricity companies, which were passed through to domestic electricity customers, who had no choice of supplier. Larger customers avoided these costs as they could choose their supplier.

Protecting the interests of vocal political groups helps maintain regulatory credibility by reducing the incentives for these groups to intervene and change the regulatory rules. Such changes would increase regulatory uncertainty, increase the cost of capital and hence the price of the service, or undermine the ability of the utility to finance its investment programme. These costs probably outweigh the small deadweight losses of inefficient pricing.

LIBERALIZATION, VERTICAL DEINTEGRATION AND REGULATION

Traditionally, utilities have been granted a franchise to operate as a vertically integrated monopoly, protected from anti-trust scrutiny in exchange for regulation and various public service obligations (normally to offer service to everyone at the mandated tariffs, even where the cost might exceed the revenue, and not to discriminate between customers or classes of customers unless specifically allowed). Regulating vertically integrated utilities is relatively simple, as only final prices need to be regulated. Liberalization removes the statutory protection and allows competitors to offer services over the network in competition with the incumbent network owner, as in telecoms. Vertical deintegration separates ownership of the network (eg gas pipelines or the electricity grid) from the companies supplying services (generation or gas production).

Liberalisation and unbundling require access prices to the network to be regulated. If the network remains vertically integrated, access charges may be used by the incumbent to prevent competition. Initially BT set the access charges to other operators for completing calls to BT's customers by bilateral negotiation subject to regulatory appeal. Mercury (initially the only other licensed operator) duly appealed and in due course the access charge was subjected to regulation.

If the network is separately owned, as with the English electricity grid, biases against entrants are reduced. Encouraging efficient locational and time-of-use price signals proves to be very difficult under either system of price regulation. It is interesting that in Britain regulation of the gas and electricity networks is moving more towards rate-of-return regulation for the *level* of total revenue, while encouraging the network operator to propose efficient relative prices to improve the *structure* of tariffs, subject to regulatory approval - a system that requires vertical separation to avoid an anti-competitive pattern of charges.

The opposite tendency can be seen in telecoms regulation. Liberalising access makes

rate-of-return regulation obsolete or inappropriate. The breakup of AT&T provides a good example. Under the old system, proposals for tariff changes were subject to lengthy judicial hearings, and were poorly adapted to the rapid changes of tariffs by competitors in the contestable long-distance market. Since 1989, the FCC has switched to setting price-caps for inter-state services and allowing AT&T freedom to introduce new tariffs within those caps. The change made the whole system simpler and more flexible (Mitchell and Vogelsang 1991) as well as introducing stronger incentives (though arguably competition did that, and the main function of the new form of regulation was to bridge the gap between the old system of regulation and the ultimate goal of unregulated competition).

If there are no constraints on the rate at which prices can be rebalanced within an overall basket, and some services face the threat of competitive entry (eg long-distance telephones) whilst others are relatively more protected from entry (the local loop connecting the customer to the telephone exchange or local switch), then a regulated incumbent utility will be tempted to underprice and make a loss on the potentially competitive services to deter entry, secure in the knowledge that it can recover its profits by overcharging the monopoly service. This provides an additional argument to the distributional reason for having separate baskets and controlling the rate of rebalancing tariffs.

ASSESSMENT

How does the performance of two forms of regulation compare in practice? If rate-of-return regulation is replaced by price regulation, and the basket of prices uses as weights the quantities purchased under the earlier regulation, then any change in quantities will lead to increased consumer and producer surplus (Train 1993: 323; Armstrong, Cowan, and Vickers 1994: 65), provided that the utility is not allowed to use non-linear prices (Armstrong and Vickers 1991; Sappington and Sibley 1992). The US evidence supports the superior incentive effects of such a shift (Kaestner and Kahn 1990). States that offer greater flexibility to companies in setting tariffs have about 7% lower charges than those that do not (Mathios and Rogers, 1989). Greenstein, McMaster and Spiller (1995) find when comparing across US local telephone exchanges that those subject to price regulation are more innovative (faster to deploy modern equipment) than those either subject to traditional rate-of-return regulation or intermediate incentive schemes such as profits sharing schemes, in which utilities keep only a fraction of above-target returns. Braeutigam and Panzar (1993) conclude that the US evidence supports the view that price regulation 'is an effective means of controlling the *prices* of dominant firms when the control of their *profits* is left to the competitive marketplace' and is 'probably most effective as a transitory step on the path toward total deregulation and full competition.' (Braeutigam and Panzar 1993: 197). Certainly, price regulation is increasingly replacing rate-of-return regulation in the US for telecoms, while the World Bank is a strong advocate elsewhere. While it is clear that price regulation is superior for telecoms where it may only be needed in the transition to deregulation, it is less clear that permanent price regulation with periodic reviews is superior for core network monopolies like water, gas and electric distribution, balancing the better incentives of price regulation against the lower perceived investor risk and cost of capital

of rate-of-return regulation.

The quest for superior alternatives to these two forms of regulation will continue, and many ingenious schemes have been proposed (surveyed in Train 1993; Laffont and Tirole 1993; Armstrong, Cowan, and Vickers 1994; Wilson 1993), notably those in which utilities are offered a menu of alternative regulatory schemes, or those which iteratively revise the regulation (Vogelsang and Finsinger 1979, Sappington and Sibley 1988). Few of these articles adequately address the practical issue that regulation is a repeated game with periodic reviews, and of the need for regulatory commitment, stability, simplicity, robustness, proof against capture and manipulation, and public acceptability. Practice, which is evolving rapidly, continues to outstrip theory, providing challenges to the profession in modelling, testing, and proposing superior and workable alternatives.

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