Profit-Sharing Regulation: An Economic Appraisal

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I. INTRODUCTION

The stock market, take-over bidders, executive pay setters, perhaps Stephen Littlechild himself, even last summer's weather, all seem to have been undermining RPI–*X* price-cap regulation. Until recently, price-cap regulation was regarded as demonstrably superior to US-style rate-of-return regulation, and regulatory reform in several countries has embraced price-cap regulation.[2] But in Britain, where price- cap regulation originated, the case now appears to be less compelling: price-cap regulation is perceived by some as conferring unwarranted profits on the utilities and imposing unsustainable demands on regulators. As a consequence, many people believe that we are slipping inexorably into some form of profit regulation.

It is time for reform, say the critics, and the leading candidate to displace RPI–*X* is `sliding-scale' regulation, which would share profit gains (and losses) between the regulated firm and its consumers. New Labour has embraced profit-sharing regulation, and some of the regulators, notably the Director General of Gas Supply, are interested in it too. In addition, there is a body of academic literature that supports sliding-scale regulation, including the recent papers by Burns, Turvey and Weyman-Jones (1995a and 1995b).[3] Proponents of sliding-scale regulation point to four kinds of advantage: allocative efficiency, distributional fairness, risk sharing, and sustainability of regulation.

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[2] See Braeutigam and Panzar (1993) and Greenstein, McMaster and Spiller (1995) on price regulation in the US telecommunications industry.

[3] For related ideas and analysis, see Braeutigam (1993), Ireland (1995) and Schmalensee (1989).

In this paper, we address two questions:

(a) Is profit-sharing regulation indeed superior to price-cap regulation?

(b) Are the problems of price-cap regulation as it now operates in Britain best solved by a move to profit-sharing regulation?

While not denying the force of the arguments mentioned above, we conclude that the answer to (a) is far from clear. Furthermore, we contend that the advantages claimed for profit-sharing regulation can be better achieved by modifying rather than abandoning price-cap regulation. We therefore answer (b) in the negative and suggest that profit-sharing regulation fails to address some of the most serious defects of price-cap regulation as it has been practised in Britain.

The plan of the paper is as follows. The next section reviews some economic theory of regulation, emphasising issues of information, incentives and dynamics. Section III assesses the problem of measuring profit for regulatory purposes. Section IV puts forward alternative approaches. The concluding section summarises our answers to the two questions above.

II. ECONOMIC PRINCIPLES FOR REGULATION

For simplicity, we shall focus on regulation of a single-product monopolist that aims to maximise profit (or its net present value (NPV) in a dynamic setting). Generalisation to the multi-product case would add important issues to the analysis, but for the most part they do not concern the main points at issue. The working assumption of profit maximisation abstracts from some managerial incentive questions, but these will be taken up in subsequent discussion.

Also for simplicity, we shall take it that regulatory schemes are to be evaluated by the welfare criterion of the (possibly weighted) sum of consumer surplus and profit. Three commonly distinguished components of welfare are:

• allocative efficiency, which calls for cost-reflective pricing;
• productive efficiency, which requires supply at minimum industry cost; and
• distributional considerations, which involve curbing excess profit.

Regulatory schemes are viewed as incomplete contracts, the terms of which are revised over time, and which might leave considerable scope for the exercise of discretion by both the firm and its regulator. The regulatory arrangements give the firm incentives that are partly *explicit* (e.g. incentives resulting from the price- control formula) and partly *implicit* (e.g. incentives to influence regulatory reviews and the exercise of regulatory discretion).

1. Neo-Classical Analysis

Neo-classical theory describes the firm by its production function, which specifies the level of output $Q = F(L,K)$ as a function of labour and capital inputs used. Letting p, w and r denote the prices of output, labour and capital respectively, we have that profit is equal to $\pi = pQ - wL - rK$.

The best-known result in the neo-classical theory of regulation is the Averch–Johnson effect which arises under rate-of-return regulation that allows the firm to earn a rate of return $s > r$ on its capital. The firm, maximising π subject to the constraint that $pQ - wL \leq sK$, will produce its output with an inefficiently high K/L ratio. Thus the regime gives the firm an incentive to overemploy capital in order to earn the margin $s–r$ on more K, and productive inefficiency is the result. In sum, the firm distorts its input choice to manipulate regulation in its favour.

Burns, Turvey and Weyman-Jones (1995a and 1995b) also take a neo-classical approach. One of the forms of profit-sharing regulation that they examine requires the monopolist to rebate to consumers a fraction $\tau(p)$ of its profit, where $\tau'(p) > 0$, so that the profit rebate is larger, the higher the price charged. Then the firm's objective is to maximise $\pi(1 - \tau(p))$. Provided that $\tau<1$, productive efficiency is best for the firm (unlike in the Averch–Johnson model). So this form of profit- sharing regulation involves no compromise of productive efficiency, and its built-in flexibility would seem to have advantages over fixed price-cap regulation in terms of allocative and distributional efficiency, and hence general credibility and robustness.

2. Asymmetric Information[4]

The economics of regulation has been developed in recent years to take explicit account of two key issues:[5]

(a)   incentives in a world of uncertainty and asymmetric information; and
(b)   difficulties of making credible commitments over time.

The practical importance of these issues is very well illustrated by the regulatory crisis following the bid by Trafalgar House for Northern Electric. Bringing them into the analysis permits exploration of trade-offs between different regulatory schemes. With the neo-classical approach, on the other hand, it is often the case that many schemes can implement the ideal solution, and the theory of optimal regulation lacks bite.

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[4] Our discussion abstracts from possible agency problems arising from asymmetric information between managers and investors. The inclusion of these issues would not fundamentally alter the conclusions from the analysis.

[5] See Laffont and Tirole (1993) for a thorough exposition of the theory of regulation that emphasises problems of asymmetric information. See Armstrong, Cowan and Vickers (1994) for an overview of the theory and an assessment of regulatory practice in the UK.

First, consider static models with asymmetric information. Suppose that, unlike the neo-classical firm which always operates on its production frontier, the firm can reduce its costs (or add to its value for money) by making *unobservable* but costly efforts. To capture the idea that costs are affected by the firm's effort e, let the *observable* unit cost level $c = \theta - e$, where θ is a parameter unknown to the regulator. So the regulator cannot observe, for example, whether low cost is due to good luck or hard work. Let the cost of effort, which is borne by the firm (or its managers), be a convex function $\psi(e) >$. The firm's incentives to make effort depend on how its regulated price p varies with c. Suppose that this variation is linear, and let $\alpha = dp/dc$. Thus α measures cost pass-through, or, equivalently in this framework, the extent of profit sharing. In the simplest example with inelastic unit demand, the firm will choose the effort level e that satisfies $\psi'(e) = 1 - \alpha$. Pure price- cap regulation has $\alpha = 0$, and pure cost-plus regulation has $\alpha = 1$. The former has perfect effort incentives but no sensitivity to allocative efficiency, whereas the latter has the opposite qualities.

What is the optimal level of α? To answer this question fully, it would be necessary to specify the regulatory tools and information conditions in more detail — for example, whether the regulator can use lump-sum transfers, and whether the firm knows θ when it chooses e. But in a wide range of circumstances, optimal α will lie *between* zero and one. Starting from pure price cap ($\alpha = 0$), some relaxation of incentives is desirable because the loss of productive efficiency is second-order whereas the gain in allocative efficiency (or distributional efficiency, or risk sharing[6] in a richer model) is first-order. In a static setting, then, incentive theories of regulation suggest that some profit sharing is a good idea.

3. Credibility and Commitment

But now we come to issue (b): difficulties of making credible commitments over time. The regulator, even if he or she wanted to, could not credibly commit not to adjust price in the light of unfolding events. From time to time — at prescribed intervals and sometimes in between — prices get reviewed. As a result, there is a kind of ratchet effect — after a while, cost reduction by the firm will be passed on to consumers in the form of lower prices. This blunts the firm's cost-reduction incentives. Even if the current explicit price-control formula says that $\alpha = 0$, the *effective* level of α could be significantly greater than zero taking account of the implicit incentives deriving from the prospect of

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[6] It is not obvious that the 'sharing' of risk that profit sharing entails is desirable. For example, the profits of British Gas are influenced by the weather. Since the weather is a source of idiosyncratic rather than systematic risk, it should not affect British Gas's cost of capital, at least according to the capital asset pricing model (CAPM), and it seems unlikely that consumers want to bear risk associated with the weather. (To the extent that they do, they could buy British Gas shares!)

regulatory review. Indeed, it has been estimated that well over half of the net present value of unanticipated cost saving is enjoyed by consumers.[7]

In short, price-cap regulation with periodic reviews itself involves profit sharing, albeit with a lag.[8] What matters for incentives is the combination of cost pass- through in the price-control formula (explicit profit sharing) and the lag between price reviews (implicit profit sharing). To keep incentives the same, more cost pass- through would have to be accompanied by longer regulatory lag. It could, of course, be argued that a weakening of incentives should be tolerated in order to promote credibility and perceived fairness, though this point does not seem to be part of the case made by proponents of profit sharing. The analysis that follows suggests that shortening regulatory lag would be a better way of doing this than profit sharing.[9]

Of course, regulatory lag cannot simply be fixed exogenously, because there is the issue of interim intervention. Unless credibility not to intervene is total, the *effective* lag, so to speak, will be shorter than the explicit lag. Might profit-sharing regulation help incentives by increasing the credibility of non-intervention? Suppose that 50:50 sharing of current excess (or deficient) profit were introduced and that lag were doubled from five to 10 years. Ignoring discounting, this would leave the value of incentives unchanged. How does credibility compare between the two cases?

A simple example suggests that the answer to this question is ambiguous.

Suppose that θ, the exogenous component of cost, evolves randomly according to the stochastic process $\theta_t - \theta_{t-1} = z_t$, where z_t is an independent random variable with mean zero and variance σ^2. Assume away problems of measuring profit (see Section III), and assume that price was set so as to yield a normal return at the start of the regulatory period. It is appropriate to compare the credibility of the price-cap regime after n periods with that of the 50:50 profit-sharing regime after $2n$ periods.

Suppose first that the credibility of the regulatory system (e.g. the probability that there will be no interim intervention) is inversely related to the variance of *current* profit.[10] In the price-cap regime, the current profit variance after n

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[7] See the NERA calculation reported in Viehoff (1995).

[8] Both profit-sharing arrangements and reductions in regulatory lag reduce the cost of capital, *r*. Furthermore, costs of capital vary over the regulatory cycle — see Gandolfi, Jenkinson and Mayer (1995). We assume throughout that the price cap reflects the cost of capital associated with the particular form of regulation in place.

[9] Alternatively, the extent of 'clawback' at the periodic regulatory reviews could be increased, i.e. prices set for the future could be inversely related, according to pre-specified rules, to profits made in the past. This would reduce the frequency of burdensome regulatory reviews.

[10] Regulatory instability can be thought of as an option granted to customers to prevent profits rising above certain upper bounds by adjusting regulatory formulas. From option theory, the value of such options depends on $n\sigma^2$. Likewise, there is an obligation on regulators to ensure that firms have adequate revenues to finance their Likewise, there is an obligation on regulators to ensure that firms have adequate revenues to finance their businesses. This provides firms with a form of insurance, the value of which will again be dependent on $n\sigma^2$.

periods is $n\sigma^2$. In the profit-sharing regime, the current profit variance after $2n$ periods is $n\sigma^2/2$. In this case, the profit-sharing regime is more credible than the price-cap regime, because profit sharing reduces current profit variance more than proportionately.

But now suppose that credibility depends on the variance of *accumulated* excess (or deficient) profit. (Share values might be expected to reflect this stock measure more than the current profit flow.) In the price-cap regime, the accumulated profit variance after n periods is $[n^2 + (n-1)^2 + ... + 1]\sigma^2$. In the profit-sharing regime, the accumulated profit variance after $2n$ periods is $[(2n)^2 + (2n-1)^2 + ... + 1]\sigma^2 / 4$. The profit-sharing regime is *less* credible than the price-cap regime, because the effect of cost shocks on accumulated profit, though somewhat dampened by profit sharing, is magnified through accumulation.

Examples of this kind could easily be enriched, for example by modifying the stochastic cost process or by introducing discounting. But the two cases presented suffice to make our main point, which is that it is by no means obvious that profit sharing is superior on credibility grounds. Profit sharing must be accompanied by longer intervals between regulatory reviews to avoid incentives being weakened. Profit sharing helps credibility for a given lag but may worsen credibility when incentives are preserved by lengthening the lag. Furthermore, profit sharing might have disadvantages on credibility grounds if it involved continuous, rather than periodic, regulatory discretion over the measurement of profit.

4. Some Evidence from Local Telecommunications Operators in the US

The discussion so far has been in terms of economic principles. Empirical evidence on the relative merits of price-cap and profit-sharing schemes is hard to obtain because the importance of industry- and country-specific factors makes cross- industry and international comparisons hazardous, and intra-industry regulatory practice within countries tends to be uniform (not only if there is nation-wide monopoly). A notable exception, however, is the case of local telephone exchange companies (LECs) in the US, which have been studied by Greenstein, McMaster and Spiller (1995). Following the break-up of AT&T, state regulators adopted a variety of approaches to price controls — including price caps, profit sharing (known as earnings sharing) and hybrid systems — thereby providing some kind of 'natural experiment'.

Greenstein et al. examine the rate of investment in modern infrastructure (e.g. fibre-optic technology) by all large LECs, and seek to isolate the effect of regulatory policies by controlling for economic and demographic factors. They conclude (p. 187) that

> First, price regulation (and, in particular, price caps) is a more potent regulatory mechanism
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> than the standard earnings sharing scheme. Second, when associated with an earnings

sharing scheme, price regulation is less effective in triggering infrastructure deployment than when it is implemented by itself.

Investment in new technology is, of course, but one aspect of industry performance, though it is one that might be rather influenced by regulatory credibility. Institutional and other differences between the US and Britain mean that the same findings might not apply here. Nevertheless, this evidence in favour of price-cap regulation from LECs in the US, which offer a rare opportunity for comparison between the effects of different regulatory methods, gives at least some empirical support for the earlier theoretical analysis.

III. MEASURING PROFITS

In this section, we consider whether profit can be measured well enough to be incorporated explicitly into price controls. For firms with few capital assets, e.g. trading firms, where current operating costs form the bulk of costs, the answer is positive and implementation of the analysis of the previous section is relatively straightforward. But capital assets, typically inherited from before privatisation, are hugely important in the utility industries. The costs attributed to those assets are a large component of overall cost and a major determinant of 'profit'.

Profits are traditionally measured in historic cost terms. Current cost accounting has, however, been employed in a number of UK utilities, particularly water and electricity. Current cost accounting has advantages in relation to the information it provides about the existence of economic rents and profitable investment and disinvestment opportunities. In contrast, historic cost accounting provides little reliable information relevant for the economic regulation of firms.

There are, however, formidable problems involved in the determination of profits (on a current cost basis). Asset valuations should be based on the principle of modern equivalent assets (MEA) — the lowest-cost investments required to provide the same level of services that existing assets offer.[11] For example, a gas pipeline or electricity distribution network may have been created in a piecemeal fashion over a long period of time as system needs evolved. A new system would probably comprise a quite different configuration from that inherited from the past. The MEA approach values the hypothetical new system on the grounds that it is the lowest-cost way of providing the services, and if the owners of the current assets are rewarded on a higher valuation, then it will be efficient for a new system to replace the old. Likewise, electricity generating companies' assets should be valued on the basis of the hypothetical lowest-cost configuration of generators, which might differ considerably from the actual

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[11] See Edwards, Kay and Mayer (1987).

mix, for example if relative fuel prices have altered since existing power-stations were built.

It will be apparent that asset valuation on the MEA approach necessarily involves a large element of subjectivity, if only because the optimal system to build today depends on projected cost and demand movements. Correspondingly, there is substantial scope and incentive for manipulation. Most unregulated companies, and their managers, have incentives to make profitability appear high.[12] This encourages undervaluations of assets to raise reported rates of return, to reduce depreciation entries in profit-and-loss statements, and to allow subsequent upward revaluations. For regulated firms, however, incentives for manipulation are less clear. In so far as there is profit clawback — explicitly by profit-sharing regulation and/or implicitly at periodic reviews — companies have incentives to depress reported profits and rates of return by overstating asset values.

Profit rate measurement is still more problematic in the utilities because of events before and at the time of privatisation. While, in principle, current cost is the appropriate basis for evaluation, in practice the asset values of many utilities are far removed from this. The water companies, whose market valuations are about one-tenth of their current cost valuations, provide a particularly stark example. Before privatisation, the charges levied on customers by many utilities fell well short of those needed to earn a return equal to the cost of capital on the current cost value of assets. Basically, consumers in many sectors were being substantially subsidised by nationalised industries. At the time of privatisation, it was politically impossible to raise prices to levels corresponding to current cost valuations. So the regulatory system for many regulated utilities inherited a pattern of subsidy from the previous regime, and their asset valuations stand well below current cost.

The asset valuations used for regulatory purposes evolve as follows. New investments made since privatisation (or the last regulatory review) are added to the valuations used then (with due allowances being made for depreciation). At a price review, the regulator allows the firm to capitalise some of the efficiency gains made since privatisation (or the last review) and passes through to consumers any residual profits in the form of lower charges. Thus there is a serious endogeneity in the determination of profits: the return that a firm earns over a regulatory period depends on the proportion of cost reductions that the firm is allowed to retain, which in turn depends on the incentives that the regulator believes to be appropriate.

To see this point in more detail, consider a company formed at the start of period 1 which lasts until the end of period 2. Let V_t be the value of its capital stock at the start of period t. Let R_t^s be the firm's expected revenue in period t

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[12] See Shin (1994) for a theoretical analysis of firms' incentives with regard to the reporting of financial information.

where expectations are formed at the start of period s, and define expected cost C_t^s likewise. For simplicity, assume no discounting. Then, by definition,

$$V_1 = (R_1^1 - C_1^1) + (R_2^1 - C_2^1)$$

and

$$V_2 = (R_2^2 - C_2^2)$$

Period 1 profit is

$$\pi_1 = (R_1 - C_1) + V_2 - V_1$$
$$= [(R_1 - C_1) - (R_1^1 - C_1^1)] + [(R_2^2 - C_2^2) - (R_2^1 - C_2^1)]$$

where R_1 and C_1 are out-turn revenues and costs in period 1. Thus profit in period 1 is a combination of (a) the extent to which current earnings exceeded expectations *and* (b) the extent to which expectations of period 2 earnings have been revised from what they were at the start of period 1.

The latter depends on how the regulator is expected to react to earnings reported in period 1. Suppose, for example, that a proportion β of the cost shock $C_1 - C_1^1$ is expected to persist in period 2, and that the firm is allowed to pass through α of this shock. Then period 1 profit is

$$\pi_1 = [1 + (1 - \alpha)\beta](C_1^1 - C_1).$$

Profit therefore depends on (a) how expectations of future earnings are revised and (b) how the regulator is expected to react to new information in allowing cost pass-through.

More generally, it is clear from this example that profit is a forward-looking concept. Investors can earn profits without any excess operating earnings being observed in the current period if expectations of future earnings have been revised upwards. This seems to characterise quite well the supposed deficiencies of regulation that have been revealed by take-over bids for regional electricity companies such as that by Trafalgar House for Northern Electric. The current earnings of Northern Electric have altered relatively little, while its share price has risen sharply, chiefly because the Trafalgar House bid revealed the potential for future earnings gains (if only from tax savings). Note that a profit-sharing arrangement based on Northern Electric's *current* earnings would have done

little to ameliorate the revealed shortcomings of OFFER's initial distribution review, and so would not have contributed much to regulatory stability.

Share prices reveal anticipated future monopoly rents from lax regulation which are only reflected in earnings after an extended period of time. Instead of basing profit sharing on past accounting earnings, stock market returns may be a more relevant measure of performance. A take-over bid that discloses large potential cost savings is reflected in market values but not in past operating earnings. Lax regulation is revealed by high market capitalisation relative to the amount of invested equity capital. Thus the ratio of market value to regulatory book value can be used as a measure of the stance of regulation at each regulatory review. However, market values in turn reflect expectations of future regulatory behaviour, and, as the example above illustrated, there is an inherent circularity in trying to base regulation on market values — for example, the market value at the start of period 2, V_2, depends on the prices set by the regulator.

In summary, profit measures are subjective, open to manipulation and prone to an inherent problem of circularity. Strict price-cap regulation avoids these problems by removing any relation between performance and prices. However, as noted above, it does this at the expense of introducing potentially diverging relations between prices and costs. The compromise that has been found has been to undertake occasional reassessments of prices at periodic reviews and, in principle, to leave price limits unchanged between reviews. The attraction of this

in comparison with profit-sharing rules is that it restricts profit measurement exercises to particular occasions when the necessary detailed public consultation and analysis (and possibly reference to the Monopolies and Mergers Commission) can be undertaken. By contrast, the inclusion of explicit 'profit' terms in price controls might create continuous costly argument and indeed an increase, rather than a reduction, in regulatory uncertainty.

The problems of measuring profit prompt a search for alternative ways of seeking to keep prices in line with costs between reviews. This is the subject of the next section.

IV. ALTERNATIVE APPROACHES

So far, we have considered how the price that a firm is permitted to charge should be related to its costs (this being equivalent to linking price to profit in the simple examples under discussion). A principle of incentive theory is that all relevant information should be exploited when setting incentive contracts. The firm's own cost (or profit) is unlikely to be the only relevant information for price setting, in which case there is scope for improving the trade-off between incentives for productive efficiency and the aims of allocative and distributional efficiency.

1. Yardstick Measures of Profit

Some but not all of the problems discussed in Section III can be ameliorated by using 'yardstick' measures of profit.[13] Some UK utilities were privatised as regional rather than national monopolies, notably the water and electricity distribution industries in England and Wales. In these cases, there is the possibility of using industry-wide performance information as well as individual company data.

If, as in an earlier example, earnings vary from expectation for two reasons — good/bad luck and high/low effort — and if luck affects all firms in the industry in similar ways, then the variation of a firm's performance from the industry average or yardstick is informative about the performance of the individual firm. A system that aims to give consumers the benefit of good fortune should then be based on the industry yardstick and not (just) on the performance of the individual firm.

It is well known that in the polar case where luck is perfectly correlated across firms, it is possible to combine allocative efficiency with perfect incentives for cost efficiency by relating the price that firm i can charge to the average cost performance of all *other* firms in the industry. In profit-sharing terms, the rebate to i's consumers depends on the profit performance, relative to what was expected, of firms in *other* regions rather than on the firm's own profit performance.

Such a system has a number of attractive properties. First, there is no dilution of i's incentives to cut costs: the firm's own profits do not affect the customer rebate. All the incentive properties of pure price-cap regulation are therefore retained. Second, there is no incentive for firms to manipulate their reported profits. Third, if the *market* valuations of other firms, rather than their current earnings, are used as the basis for price setting at times of regulatory review, then the point that profit should be a forward-looking concept can also be met. The circularity problems inherent in using own market valuations are avoided.

What yardstick measures of profit cannot overcome are (a) the subjective nature of profits measures discussed above, (b) the imperfect nature of inter-firm comparisons (luck is not perfectly correlated across firms) and (c) the fact that market valuations may reflect more than the regulated activities of the firms in question.

2. Other Yardstick Measures

There are three main reasons why performance may deviate from expectations: demand, operating costs or capital costs may differ from predictions. The most straightforward measure of performance that incorporates all three factors is net cash flow defined as revenue minus operating costs minus capital expenditures

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[13] See Shleifer (1985).

and taxes paid. It can be extended to include net receipts of interest and net debt issued. If it is, then by the sources and uses of funds identity, cash flow is equal to dividends paid to shareholders less new equity raised from shareholders, i.e. net distributions of cash to shareholders. This is an extension of the proposal that dividends should be used as the basis of a tax, i.e. that dividend increases should only occur when customers derive some benefits in the form of lower prices. Note the importance of including net new issues of equity. Not only does this put share repurchases on the same basis as dividends but it also brings acquisitions of shares into the tax base and thereby ensures that customers automatically share in the benefits of take-overs. Increasing the effective tax rate on dividends paid by regulated utilities might also have the advantage of encouraging investment, which might be expected to be suboptimal if regulatory risk is significant.

Cash flow avoids the subjective nature of asset valuations involved in the determination of depreciation and is much less readily open to manipulation than profits in so far as it excludes provisions. Again, if comparative information is available, then price adjustments are best made on the basis of deviations of cash flows from expectations of other firms in an industry. However, it is important to appreciate that cash flow is not a profits measure in so far as it excludes returns that accrue in the form of capital gains: shareholders can earn high rates of return in the form of capital gains in the absence of dividend distributions. It is therefore not a substitute for asset valuations and profit projections but it serves to emphasise that the complex assessment of expected future earnings is the proper subject of periodic reviews.

The value of comparative information depends on the degree of correlation between the luck/misfortune element of the performance of firms. This may well vary across the different components of net cash flow. For example, the determinants of revenues in water utilities depend on the industrial/domestic composition of their customer base. Unless industrial and domestic demand are closely correlated, net cash flows may display little correlation even where there is a high degree of correlation of firms' costs. Where this applies, adjustment to prices may be more appropriately conditioned on comparative information on deviation of costs rather than cash flows from expectations.

A simple example illustrates. There has been much concern that regulators in the UK made too generous provision for costs, both operating and capital costs, in the last round of periodic reviews. Indeed, the subsequent adjustment that Littlechild made in electricity suggests that potential cost savings were underestimated the first time round. A system of adjusting prices on the basis of deviations of actual costs from expectations would, over time, have picked up this error. However, basing the adjustment on own costs seriously diminishes incentives to pursue efficiency savings. Instead, if deviations of actual from predicted costs of other firms in the industry are used, then common cost

influences can be incorporated in prices at the same time as incentives are retained.

3. Conditioning Price on Exogenous Cost and Demand Information

The potential for performing yardstick comparisons does not exist in all industries. Some utilities were privatised as monopolies, e.g. British Gas and BAA (formerly the British Airports Authority). Some have competitors but only very limited comparators, e.g. British Telecom. In these industries, the use of sharing arrangements based on either profits or other bench-marks raises incentive problems. In this section, we suggest that instead of pursuing the idea of profit sharing, attention is better devoted to trying to establish exogenous determinants of performance that do not adversely affect incentives.

We consider two examples in British Gas and BAA, for both of which the single most important exogenous influence on performance is demand. Temperature variations are a major influence on revenues in gas. In airports, the main reason for high rates of return has been growth in passenger revenue in general and income from retail outlets in particular. Some growth in demand can be attributed to the success of the firm in promoting the use of airports and retail outlets. But a large element of the growth in passenger revenues simply reflects increased air traffic and the importance of London as a hub in Europe. In both cases, there is therefore a good case for adjusting prices to reflect demand fluctuations.[14] There is a well- established relation between temperature and demand in gas, and evaluating the influence of passenger numbers on airport income is quite straightforward.

In addition to demand, there are a number of components of costs that are outside the control of firms. The two most important are wage costs and capital goods prices. While some reduction in costs is attributable to efficiency savings of firms in, for example, reducing manpower, some is attributable to changing unit costs through, for example, falling construction price indices, which have nothing to do with efficient management. Likewise, there are sectoral and regional labour cost indices that could be used to distinguish unanticipated cost savings due to efficiency from exogenous unit labour cost changes. In other

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[14] This would introduce an element of revenue-cap regulation by which revenue rather than price limits are imposed. If prices can be adjusted more or less instantaneously as volume changes (relative to expectation), this implies higher/lower prices during periods of low/high demand. An objection to linking price to demand in this way is that it increases the price risk faced by buyers (note that prices rise in recession). If, on the other hand, price adjusts with a lag, then the possibility of short-term profit fluctuation remains. In view of these points, the Monopolies and Mergers Commission considered that the benefits of a volume adjustment in the RPI–*X* control for London airports were not sufficient to justify complicating the formula (see Monopolies and Mergers Commission (1991), especially paragraph 13.37). More recently, however, the public importance of reducing the volatility of long-run profitability (e.g. as reflected in share prices) seems to have increased, indeed to the point where the credibility of regulation is at stake. In any event, the additional complications caused by a volume adjustment do not appear large.

words, the retail price index alone might not be the best cost/price index for regulatory purposes. At the time of privatisation, the RPI may have had the political attraction that consumers were protected in terms of real price movements, but profit movement seems now to be a major public concern.

Essentially, this proposal to employ more exogenous cost and demand information is equivalent to, at least partial, demand and cost pass-through. Price- cap formulas are adjusted to incorporate the exogenous components of performance. We would suggest that where yardstick measures are poor, attention is better devoted to improving the demand and cost pass-through components of pricing formulas than introducing profit-sharing arrangements.

4. Diversified Firms

The creation of diversified conglomerates out of single-sector utilities poses serious problems for performance measurement. Initially, diversification took the form of utilities investing in or purchasing companies in sectors outside their core activities. For the most part, the scale of these investments was small in comparison with the value of assets employed in their core businesses. However, recently there have been a number of proposed acquisitions of utilities by companies in other or related industrial or geographical sectors. The bid by Trafalgar House for Northern Electric was the first example of a proposed acquisition of an electricity company by a firm outside the sector; Hanson's bid for Eastern Electricity is a similar case; Southern Company's bid for South Western Electricity is an example of an overseas acquisition of an electricity distribution firm; and the bid for Manweb by Scottish Power is an acquisition of an electricity distribution company by a vertically integrated supplier. If these bids succeed, then a majority of the combined group's activities will be situated outside the industrial or geographical sector of the acquired utility. The bids by PowerGen and by National Power for regional electricity companies, which involve vertical integration in the same geographic market, are, of course, another matter.

The response to this problem has been to require companies to report separate accounts for their core and other businesses through, for example, holding the assets of the utility in a subsidiary account. In practice, the implementation of separation raises serious difficulties. Transfer pricing allows companies to shift resources to and from the subsidiary and to subsidise the activities of core or non-core activities. Regulators attempt to avoid this by requiring companies to market test transactions with the utility and to establish market prices at which transactions should take place. However, this imposes formidable information requirements on regulators.

These problems become significantly more serious when utilities are acquired by other firms. First, the concept of a separate business unit loses economic meaning. Consider, for example, the cost of capital of the utility. While it can be

argued that the cost of equity capital should relate to the systematic risk of the core business rather than the group, the same cannot be said of debt finance: the cost at which the utility can raise debt finance will be largely determined by the group rather than the utility, even if in principle there are legal limitations on the liability of the group to the utility. The same applies to trade creditors, and the cost at which the utility will be able to purchase goods and services will reflect the perceived riskiness of the group rather than the core. More generally, there will be economies of scale in the cost of goods and services purchased and sold which will make the separate identification of prices for the core almost meaningless.

Second, on completion of the acquisition, the utility will be delisted from the stock market and no separate share price will be observable. This makes it impossible to determine performance from returns to shareholders, to identify the systematic risk of the utility separately from the business as a whole, and to compare the book or regulatory value of assets employed with their market value. Third, as the regulator of the water industry in particular has noted, acquisitions reduce the number of companies that can be included in comparative efficiency exercises. Acquisition therefore entails a significant loss of information for the regulator — though, as events in the electricity sector have illustrated, take-over *bids* may reveal important information.

The loss of information to the regulator caused by acquisitions could be significantly reduced by requiring bidders to satisfy one condition: the listing of a certain proportion of shares in the utility subsidiary on the stock market.[15] It is commonplace for continental European companies to list a minority of shares (e.g. 20 per cent or 30 per cent) of a subsidiary on a stock market. This is regarded as being valuable in (a) providing information to parent companies about the performance of the subsidiary and (b) allowing external equity to be raised by the subsidiary. The market in subsidiary shares is often quite liquid, and abuses of minorities are avoided through requiring dividend distributions to parent companies and other shareholders to satisfy certain (e.g. equal payment) rules.

In the case of utilities, a stock market listing allows the regulator to monitor the share price performance of the core utility. Equity costs of capital could be determined from the systematic risk of the subsidiary's shares, and accounting and regulatory book values could be compared with market values. Furthermore, by establishing a group of investors who are concerned about the performance of the subsidiary as distinct from its parent, the regulator would have valuable support in his or her efforts to police transfers of resources out of the utility. For

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[15] This idea was discussed, but not adopted, by Stephen Littlechild, the electricity regulator, following the bid by Trafalgar House for Northern Electric. Ian Byatt, the water regulator, has supported the proposal (see, for example, his letter to the *Financial Times* of 29 December 1995). He has secured agreement from Lyonnaise des Eaux that it will list its British water interests on the stock exchange by 2005.

example, minority shareholders have incentives to ensure that they receive their fair share of net cash distributions from subsidiaries (dividends paid less new equity capital received from parents), which Section IV(2) proposed as a less subjective measure of performance than profits.[16] While performance measurement problems will unquestionably remain, the regulator can enhance his or her information about both utility performance and the extent of parent company abuse by requiring utilities to have separate stock market listings.

In sum, diversification undermines performance measurement and the practicality of profit sharing. If minority shareholding requirements can be imposed, then market value information can be used and, in industries with more than one utility, it may be possible to employ comparative market value data. However, in general, the difficulties raised by diversification point further in the direction of conditioning consumer prices on exogenous cost and demand information.

V. CONCLUSION

Our main conclusion is that, although price-cap regulation as it has been practised in the UK has serious weaknesses, it is by no means clear that profit-sharing regulation would be superior. There are good reasons for seeking reform of current price regulation: allocative efficiency, distributional fairness and the credibility of regulation can all be enhanced through changes to existing regulatory rules. However, it is doubtful that profit sharing as it has been discussed to date is the best way of doing this.

The paper began by questioning the supposed advantage of profit sharing in diminishing regulatory instability, given that the time between regulatory reviews would have to be lengthened in order to preserve incentives for companies to reduce costs. It was shown that a combination of more sharing and longer regulatory lag to maintain incentives has mixed effects on regulatory stability and may, according to certain criteria, actually worsen it. If weaker incentives are to be tolerated, then shorter regulatory lag may be a preferable alternative to profit sharing.

The paper then noted the serious measurement problems that arise in using profits as a basis for price regulation. Profit measures of performance are particularly subjective and prone to manipulation in utilities because of difficulties of determining asset values. The fact that asset values are dependent on charges to customers introduces a circularity between profits and the basis on

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[16] The problem of imposing profit sharing on subsidiaries of diversified conglomerates is similar to the taxation of multinational companies. It is interesting to note that corporate taxation of international organisations is nearly always based on remittances of earnings to parent firms (dividends) rather than total profits. Similar measurement difficulties to those discussed above undermine attempts to tax the unremitted component of earnings.

which regulators determine prices. Of course, price-cap regulation does not escape from these problems, but it has the advantage that they are addressed at particular occasions when detailed consultation and analysis (and reference to the Monopolies and Mergers Commission if necessary) are conducted, whereas the explicit incorporation of `profit' terms in price controls runs the risk of continuous costly dispute and regulatory uncertainty.

Problems of circularity and weakened incentives can be diminished in industries with more than one utility by using comparative performance data. Profit sharing can then be related to the performance of other firms in the industry. We suggest that, despite the well-known difficulties of putting explicit yardstick regulation into practice, yardstick profit sharing would be superior to own profit sharing.

Problems of subjectivity and manipulation can be further reduced by using cash- flow or cost rather than profit measures of performance. However, all performance measures are undermined by the increasing level of diversification of utilities out of their core businesses and, in particular, by the acquisition of utilities by other firms. Separate listing requirements for utility subsidiaries would ameliorate the latter problem.

Where serious problems of performance measurement remain or it is not possible to use comparative performance information, more attention should be devoted to the identification of exogenous influences on costs and demand. Price formulas could be amended to incorporate more cost and demand pass-through items. The effect would be similar to profit sharing, with profits and prices being negatively correlated, but incentive and profit measurement problems would be diminished.

In sum, profit sharing has perhaps been an unduly hasty response to a problem that could alternatively be treated by modifying rather than abandoning price-cap regulation. The stability of regulation will only be enhanced if the current system is amended in a way that establishes an objectively fair basis for sharing benefits that preserves the incentive properties of price-cap regulation. For this to be achieved, more attention needs to be devoted to measures of performance and the identification of exogenous influences on performance. We have not sought in this paper to give a detailed answer to the question of how price caps in different industries should be amended to take account of these factors. However, we suggest that this warrants at least as much attention as has recently been devoted to the question of the relative merits of price-cap and profit-sharing regulation.

REFERENCES

Armstrong, M., Cowan, S. and Vickers, J. (1994), *Regulatory Reform*, Cambridge: MIT Press.

Braeutigam, R. (1993), 'A regulatory bargain for diversified enterprises', *International Journal of Industrial Organization*, vol. 11, pp. 1–20.

— and Panzar, J. (1993), 'Effects of the change from rate-of-return to price-cap regulation', *American Economic Review*, Papers and Proceedings, vol. 83, pp. 191–8.

Burns, P., Turvey, R. and Weyman-Jones, T. (1995a), 'General properties of sliding scale regulation', Technical Paper no. 3, London: Centre for the Study of Regulated Industries.

—, — and — (1995b), 'Sliding scale regulation of monopoly enterprises', Technical Paper no. 11, London: Centre for the Study of Regulated Industries.

Edwards, J., Kay, J. and Mayer, C. (1987), *The Economic Analysis of Accounting Profitability*, Oxford: Oxford University Press.

Gandolfi, M., Jenkinson, T. and Mayer, C. (1995), 'Price regulation and the cost of capital', mimeo, School of Management, Oxford.

Greenstein, S., McMaster, S. and Spiller, P. (1995), 'The effect of incentive regulation on infrastructure modernization: local exchange companies' deployment of digital technology', *Journal of Economics and Management Strategy*, vol. 4, pp. 187–236.

Ireland, N. (1995), 'Fairness in regulation and privatization', mimeo, Warwick University.

Laffont, J.-J. and Tirole, J. (1993), *A Theory of Incentives in Procurement and Regulation*, Cambridge: MIT Press.

Monopolies and Mergers Commission (1991), *BAA plc: A Report on the Economic Regulation of the South-East Airports Companies*, London: Civil Aviation Authority.

Schmalensee, R. (1989), 'Good regulatory regimes', *RAND Journal of Economics*, vol. 20, pp. 417–36.

Shin, H. (1994), 'News management and the value of firms', *RAND Journal of Economics*, vol. 25, pp. 58–71.

Shleifer, A. (1985), 'A theory of yardstick competition', *RAND Journal of Economics*, vol. 16, pp. 319–27.

Viehoff, I. (1995), 'Evaluating RPI–*X*', NERA Topic no. 17, London: National Economic Research Associates.