Fundamental Flaws in the Current Cost Regulatory Capital Value Method of Utility Pricing

Jim Cuthbert
Margaret Cuthbert
October 2006

1. Introduction

1.1 A fundamental problem with many utilities is that they are dependent on networks which are natural monopolies: there is no natural market which can set a market price. The difficulty, therefore, is how prices should be set, so that the natural monopoly is not being exploited to overcharge customers, while at the same time companies earn a reasonable return on their operating activities, and on the capital invested. The solution to this problem very often involves oversight by a regulatory body in setting revenue or price caps for the utility. Many of the techniques currently used by regulatory bodies in setting revenue or price caps involve an assessment of the total value of the capital assets employed by the utility: this is variously known as the Regulatory Capital Value, (RCV), Regulatory Asset Value, (RAV), or Regulatory Asset Base, (RAB): (in this paper, we will use the term RCV throughout.) Under a typical RCV based approach, prices are set so as to allow for the operating expenses of the utility, as well as an allowance for the depreciation of capital assets, and a return on the total value of the assets employed: other factors, like possible efficiency savings, are also commonly brought in.

1.2 There are many different approaches which can be employed towards the problem of estimating RCV. One basic decision, for example, is whether capital assets should be valued at historic or current prices. In this paper, we are concerned with versions of the RCV method which involve estimating the total value of the capital assets of the utility in some form of current prices: we denote such a version of the RCV approach as being a "current cost RCV approach".
A version of such current cost RCV pricing is, for example, used by the water regulator, OFWAT, in setting prices for the water industry in England and Wales: this version was developed in the mid 1990's: its antecedents can be found in a mid 1980's Treasury report, known as the Byatt report, on the problems of nationalised industry accounting in an era of high inflation. A similar version of current cost RCV pricing is now also applied to the water industry in Scotland, and to other utilities in the UK. Versions of current cost RCV pricing are also applied in several other countries.

1.3 This paper demonstrates that there are two fundamental errors in the current cost version of the RCV approach: (this is illustrated with reference to the version of current cost RCV pricing currently applied in the water industry in the UK). First, when utility prices are set to cover current cost depreciation, and to earn a market interest rate of return on the current cost capital value of the industry, (as happens under current cost RCV pricing), then the very act of investing in capital assets yields a large cash surplus to the utility. Investment itself thus becomes a highly profitable activity- largely irrespective of whether or not the investment yields an adequate physical return: and the longer the asset life of the investment, the larger the cash surplus. This has major effects on utility behaviour, resulting in distortion of capital

programmes, excessive dividend returns to equity holders, overcharging, and distortion of the gearing ratios of the companies.
The second fundamental flaw relates to mistaken handling of the concept of opportunity cost when a utility is a price maker. The concept of the opportunity cost of capital provides an important part of the rationale for the current cost RCV approach: and yet for a price maker, (like a typical utility), the burden of costs rests on the consumer, so opportunity cost decisions should be made at the level of the consumer, not at the level of the company running the utility. The RCV method therefore needs to be supplemented with appropriate reward and decision making mechanisms for consumers, so that they can exercise the required opportunity cost functions.

1.4 The structure of this paper is as follows:-
Section 2 introduces the RCV method of utility pricing, and gives some brief history.
Section 3 shows how the current cost RCV method as applied in the UK builds on the fundamental principles of current cost accounting developed in the Byatt report.
Section 4 shows how, on the basis of a simple financial model of a utility operating in a form of steady state, the application of current cost RCV pricing in the presence of even low levels of inflation results in the generation of a large cash surplus within the utility, over and above the cash required to satisfy the net present value criterion for investment.
Section 5 describes the resulting distortions in utility behaviour.
Section 6 answers the resulting paradox: how could the application of the reasonable sounding principles inherent in the current cost RCV approach lead to such perverse consequences. The answer is that there are basic fallacies in the current cost RCV approach. These relate in particular to a failure to identify the real cost savings resulting from the interaction of inflation with long asset lives: linked to this there is a failure to adequately distinguish the different sources, (debt, equity, retained profits, and inflation), from which the capital value of a company is funded: and there is the failure to address the fact that standard arguments of opportunity costs do not apply to price makers.
Section 7 sets out our conclusions and recommendations. In particular, there is now an urgent requirement

- to revisit some of the principles of current cost accounting set out in the Byatt report.
- to devise an acceptable alternative to the current cost RCV approach to utility price setting.

1.5 In the specific Scottish context, recent months have seen the start of what promises to be a lively debate about whether the water industry in Scotland should remain in public ownership. Various politicians, city firms, and the Scottish CBI have made statements in favour of either mutualising or privatising Scottish Water. Even the Treasury, according to media reports, supports such a move. Controversially, the Regulator, Sir Ian Byatt, was quoted as saying that water should be freed from State ownership. Our findings in this paper have profound implications for this debate. Given the substantial overcharging implicit in the current cost RCV approach to pricing, the overriding priority should be to correct this, and introduce a more soundly based system for charging for water in Scotland. Such a change, however, would have the effect of making investment in a privatised Scottish Water a much less attractive proposition. In effect, once the cushion implicit in RCV overcharging is removed, it appears doubtful whether there would be significant public expenditure savings to be made by moving Scottish Water into a privatised or mutualised status: (and indeed, given the higher cost of debt which a privatised or mutualised Scottish Water must incur, there might even be a net public expenditure cost involved in privatisation or mutualisation, because of the need to provide an initial dowry from the public sector in the form of substantial debt commutation). It is not the intention of this paper to go into these matters in detail. What is absolutely clear, however, is that no meaningful discussion can take place on long term options for change in the status of Scottish Water, until the fundamental problems identified in this paper have been rectified.

2. RCV Approaches to Price Setting: Outline and History

2.1 As noted above, in principle, the RCV of a utility is an estimate of the total value of the capital assets employed by the utility in performing its functions: it is the RCV which is the capital base used in setting charge limits. A typical RCV approach to price or revenue setting for the utility involves the regulator setting the maximum allowable prices, (or revenues), of the utility to cover

- operating expenses, (perhaps discounted for whatever level of efficiency savings the regulator judges is achievable).
- an allowance for depreciation, (that is, the amount of capital assets used up during the relevant period).
- an allowance for an appropriate return on the capital assets employed by the utility, (typically calculated as the product of an assumed rate of return multiplied by the RCV).

For further details, see, for example, World Bank (2004).

2.2 Within this general description of the RCV approach, a number of different options are possible, as regards the basis of calculation of RCV, and as regards the measurement of depreciation. For example, in estimating RCV, assets could be valued on some historic cost basis, or on some version of current cost, like replacement value, equivalent asset value, or disposal value: (see Kearney and Hutson, (2001), for more detailed discussion). The choice of the appropriate depreciation measure to use will normally be more or less determined by the method chosen to estimate RCV- but again, a variety of options, in either historic or current cost terms, is possible.
For the purposes of this present paper, we are concerned with versions of the RCV method which value the assets of the utility at current prices.

2.3 In a typical application of the current cost RCV approach to utility price setting by a regulator, (see for example Water Industry Commissioner for Scotland, 2005), the RCV is rolled on from year to year by :

a. uprating for inflation
b. adding in the value of gross investment
c. deducting depreciation, as assessed in current cost terms.

The regulator then sets revenue caps for the industry, (that is, maximum allowable revenues, which therefore determine maximum allowable prices), as the sum of

i. the level of current operating expenses the regulator is prepared to allow
ii. current cost depreciation
iii. a capital charge, calculated as the product of an assumed rate of return times the estimated RCV.

The assumed rate of return at (iii) will typically be set at the weighted average interest rate facing the utility in question weighted over the different sources of finance accessed by the company: (but see paragraph 4.11 below).

2.4 A current cost version of the RCV method of utility pricing was initiated in the mid 1990s in England and Wales by the water regulator OFWAT, (see, for example, OFWAT 2004), to set the revenue caps for the water and sewerage companies, which had been privatised in 1989. The approach has subsequently been extended in the UK to the regulation of the electricity distribution network, airports, and the publicly owned water industry in Scotland, and will in future be used for the water industry in Northern Ireland. Technical papers published by the World Bank advocate the use of current cost depreciation in RCV models, (see for example World Bank, 1999 and 2004): and versions of current cost RCV pricing are used in certain utilities in countries like Australia, Germany, and Laos: (see references Australia, (1992), Germany (2005) and Laos, (2004)). Note that some other countries, such as Estonia and South Africa, use an RCV approach based on historic cost: (see references Estonia, (2003) and South Africa, (2002)).

3. How the RCV Approach Relates to the Fundamental Principles of the Byatt Report

3.1 The current cost RCV approach as used in UK utilities, with its use of current cost depreciation, and of asset values estimated at current prices, is an example of the application of current cost accounting to the problems of utility regulation and price setting. Its primary intellectual antecedent was the report “Accounting for Economic Costs and Changing Prices”, produced for HM Treasury in 1986 by an advisory committee chaired by Ian Byatt (H.M.Treasury, (1986)): this report is commonly referred to as the Byatt report. Sir Ian Byatt went on to become the first regulator of the water industry in England and Wales, and in that role was responsible for the introduction of the current cost RCV method for price setting in the water industry.

3.2 In this section, we identify four of the key principles in the Byatt report which are reflected in the current cost RCV method. Note, however, that the Byatt report itself does not set out the principles of the current cost RCV approach. For one thing, the Byatt report was primarily concerned with problems of presenting meaningful accounts in an era of high inflation - rather than with the problems of how prices should be set: in addition, the Byatt report was concerned with nationalised (that is state owned) industries, while the current cost RCV approach has mainly been applied to the problem of price setting in privately owned utilities. It is important to bear this in mind, particularly since, as we will argue later, some of the problems which we shall identify are due to inherent difficulties in the Byatt report itself: while others are due to inadequate care having been taken in translating from the public sector context, with which the Byatt report itself was concerned, to the very different context of the private sector.

3.3 The four key principles of the Byatt report which are encapsulated in the current cost RCV method are as follows:

a. <u>Capital Maintenance</u>

The Byatt report argued that accounts should give a clear picture as to whether or not the capital of the business was being maintained. In fact, two concepts of capital maintenance were distinguished: maintaining the physical operating capital of the business, and maintaining the financial capital. This distinction is brought out in the following quotation:

> "Both operating capability and financial capital maintenance have their place, depending on the purpose of the accounts. Management of a continuing business will emphasise the need to avoid distributing funds required to maintain operating capability. Investors will want to calculate the real rate of return after the maintenance of the real value of their capital for comparison with returns available elsewhere."
>
> *Source: Byatt Report, vol. 1, para, 87.*

It can be seen from the description of the current cost RCV approach in the preceding section, how this principle has carried over into the current cost RCV method: if prices are set using the current cost RCV approach, then, since prices will incorporate an element representing current cost depreciation, sufficient financial provision has been set aside to maintain physical operating capacity. Moreover, since prices also include an element representing the assumed rate of return applied to RCV, then, since this rate of return will be close to current interest rates, a rational market would value the undertaking at a price at least equal to (RCV - Debt): hence implicit in the current cost RCV approach is the maintenance of financial capital.

b. Opportunity Cost

Another important principle in the Byatt report related to the concept of the opportunity cost of capital: the return being generated on capital assets should be clearly identifiable from the accounts, and that return should be at least equivalent to what could be earned in alternative uses of the capital - hence ensuring efficient deployment of capital resources. As paragraph 49 of the Byatt report states:

> "The cost of capital in nationalised industries has, therefore, been measured by the normal profit which could have been earned by using those resources in the competitive private sector, ie its opportunity cost to the economy as a whole."
>
> *Source: Byatt Report, Vol 1, para, 49.*

In terms of the current cost RCV method, this opportunity cost requirement is met by setting an appropriate rate of return on the RCV based on current market interest rates.

c. Securing the Benefits of Competition

While recognising that many utilities are de-facto monopolies, nevertheless the Byatt report was concerned that the nationalised industries at that time should behave as if they operated in competitive markets: and that the accounting, (and pricing), policies of nationalised industries should form no barrier to potential entrants. To secure this, Byatt intended that the accounts should identify economic costs, described as "…the costs of resources used (treating normal profit as a cost) at the prices which would be incurred by a new competitor entering the market now": *Source: Byatt Report, Vol 2, para, 3.13 .*

In current cost RCV terms, the requirement that prices should cover current cost depreciation, and a return based on current market interest rates applied to the whole current value of the capital base of the industry means that, in principle, a new entrant funding capital expenditure through borrowing could afford the resulting depreciation and interest charges. In other words, the current cost RCV approach ensures that prices are set high enough for new entrants to be able, in principle, to enter the market.

d. Enabling the Industry to Attract Sufficient Funds for New Investment.

The final principle of the Byatt report which we highlight is that the accounts should demonstrate whether the return earned on capital is sufficient to persuade investors to lend to the industry any capital it might require for investment purposes. As paragraph 3.11 of Byatt states:

> "In an efficient capital market, a business which is seen to be earning an adequate real return on investment will be able to raise any extra funds required to finance the maintenance or expansion of its operating capability."
>
> *Source: Byatt Report, Vol 2, para, 3.11 .*

In current cost RCV terms, a business maintaining its physical capital through charging current cost depreciation, and earning an appropriate rate of return on its RCV, would clearly satisfy the requirement of normally being able to attract new capital.

3.4 Thus we see that key accounting principles in the Byatt report are reflected in the current cost RCV method of setting utility prices. We will show in the next section, however, that, in effect, the way the current cost RCV method has been set up over-estimates the costs of running a utility on a sustainable basis.

4. A Simple Steady State Model, and What It Implies about the Operation of the Current Cost RCV Approach

4.1 In this section, we consider the case of a utility operating with a constant annual investment programme in real terms, (that is, measured at constant prices), and funding that investment by borrowing: we will contrast the utility's actual cash requirement for debt repayment and interest with the revenues which would be generated from customers by the application of current cost RCV pricing.

4.2 Let us assume that the utility starts out with a clean slate, (that is, it starts with no accumulated historic debt or financial surplus): and in every year from year 1 on carries out a fixed amount of real investment: (for simplicity, and with no loss of generality, the annual amount of real investment is assumed to be 1). It is assumed that capital assets have a fixed life, of n years. It is assumed that the inflation rate each year is r, (expressed as a fraction): so the actual amount of investment in money terms from year 1 on is $1,\ (1+\mathrm{r}),\ (1+\mathrm{r})^2,\ \ldots$ and so on. Finally, it is assumed that the utility finances its investment by borrowing at a fixed interest rate, i, (again, expressed as a fraction). There are therefore three parameters in the model, namely, n, r and i.

4.3 It is a standard result, (ref: Joskow, 2005, quoting Schmalensee), that, if the utility charges customers each year an amount equal to historic cost straight line depreciation of the capital assets, plus interest on outstanding debt, then this approach will satisfy the Net Present Value criterion for investment. In other words, this approach will generate sufficient revenue to repay the capital which has been borrowed, and give lenders a return on the loans equal to the opportunity cost of their capital. This approach is the so-called Brandeis formula, (Joskow, 2005), which is simply denoted here as the "historic cost" approach. The sum of historic cost depreciation and interest charges on outstanding debt therefore indicates how much cash a utility funding its capital investment by loans, actually needs to generate from charges each year to finance the capital side of its operations.

4.4 Now consider the difference between the amount of revenue the utility would be generating in charges from customers under current cost RCV pricing, (that is, the sum of current cost depreciation and the RCV capital charge), compared with its actual cash requirement as determined by the historic cost approach, (that is, as we have seen, the sum of historic cost depreciation and historic cost interest payments). After the utility has been in operation n years, this difference will attain a steady state in real terms, given by the following formula:

$$[1 + \frac{i(n+1)}{2}](1+r)^{-1} - \frac{[1-(1+r)^{-n}]}{nr} - i[1 - \frac{1}{nr}(1-(1+r)^{-n})]/r \qquad (1)$$

The derivation of the formula is given in Annex 1. This formula was originally given in JR Cuthbert (2006), in a response to a discussion paper issued by the UK regulators OFWAT and OFGEM, (Ofwat/Ofgem, 2006), relating to the observed increases in gearing in certain utilities in the UK.
The quantity in formula (1) will always be positive: that is, it represents a surplus. The major part of the remainder of this paper will be concerned with exploring the implications of this surplus: including the implications for the utility's behaviour, and the question of how the surplus arises. In relation to this latter point, we shall see that the current cost RCV method involves some fundamental misconceptions on the cost of running a utility in an inflationary environment, on what the contribution of the equity holder actually is towards the funding of the capital base of the utility, and how the different funders of the capital base should be reimbursed.

4.5 The current cost RCV method is based on current cost accounting. Current cost profit and loss accounts are important, because these are the regulatory accounts used by a regulator like OFWAT, which are meant to give an accurate picture of how the industry is performing. But note that very little of the surplus given by formula (1) need appear as observable profit in the current cost profit and loss account of the utility. This is because current cost depreciation, and interest charges on whatever debt the utility has, are allowable charges against profits. Hence, an unknown, but possibly large, part of the surplus in formula (1) will be subtracted from operating surplus in calculating observable profit on a current cost basis, and thus will not appear in the figure for profit. Thus, a more appropriate description of the quantity in formula (1) would be "concealed financial surplus", rather than "profit".

4.6 The above formula becomes informative when we consider specific values of the parameters n, r and i. Table 1 illustrates the values of the formula, expressed as percentages, for two selected interest rates, (5% and 7.5%), for asset lives of 10, 20, 30 and 40 years, and for a range of inflation assumptions. Note that the basic model assumes a steady state real annual investment of 1: therefore, the values in the table represent the concealed financial surplus expressed as a percentage of the level of investment.

Table 1a. First scenario: The Surplus Generated by RCV, in Excess of the Historic Cost Requirement, as a Percentage of Capital Investment, for Interest = 5%, and for Varying Lengths of Asset Life and Inflation Rates.

		Asset life (years)			
		10	20	30	40
Inflation (as percentage)	0	0.0	0.0	0.0	0.0
	0.5	2.6	6.2	10.4	15.4
	1.0	5.1	11.9	19.8	28.8
	1.5	7.5	17.2	28.3	40.7
	2.0	9.7	22.1	36.0	51.1
	2.5	11.9	26.7	42.9	60.3
	3.0	14.0	31.0	49.2	68.5
	3.5	16.0	34.9	54.9	75.7
	4.0	17.9	38.6	60.1	82.1
	4.5	19.7	42.0	64.8	87.8
	5.0	21.4	45.2	69.0	92.9

Thus, in this scenario, for an asset life of 30 years and an inflation rate of 2.5%, the current cost RCV method yields a financial surplus over the historic cost requirement of 42.9% of capital investment.

Table 1b. Second Scenario: as above, but for Interest = 7.5%

		Asset life (years)			
		10	20	30	40
Inflation (as percentage)	0	0.0	0.0	0.0	0.0
	0.5	2.8	7.0	12.2	18.5
	1.0	5.5	13.5	23.3	34.8
	1.5	8.0	19.5	33.3	49.2
	2.0	10.5	25.1	42.3	61.8
	2.5	12.8	30.3	50.5	73.1
	3.0	15.1	35.1	58.0	83.0
	3.5	17.2	39.6	64.7	91.9
	4.0	19.3	43.8	70.9	99.8
	4.5	21.3	47.7	76.5	106.8
	5.0	23.1	51.4	81.6	113.1
	5.5	24.9	54.8	86.2	118.7
	6.0	26.7	58.0	90.5	123.8
	6.5	28.3	60.9	94.4	128.3
	7.0	29.9	63.7	97.9	132.4
	7.5	31.4	66.3	101.2	136.0

Here, for an asset life of 30 years and an inflation rate of 2.5%, the financial surplus is 50.5% of capital investment.
It is immediately apparent that the financial surplus under the current cost RCV method grows rapidly with each of n, r and i, and that the surpluses are large.

4.7 In the real world, of course, there is also the question of tax. If it is assumed that the utility has so managed its affairs that its debt is close to what debt would have been under the historic cost method, then the "historic cost" component of the current cost RCV revenues will not be subject to tax, since (in the UK), the taxman uses the historic cost accounts, not the current costs accounts, in assessing tax. However, the financial surplus given by formula (1) will be subject to tax. If the utility pays 30% tax on this surplus, then, for example, in the n=30, i=5%, r=2.5% case, the utility would have a post tax surplus of 42.9*0.7 = 30.0%. For an interest rate of 7.5%, the surplus would be 50.5*0.7 = 35.4%. Hence the post tax surpluses implied by formula (1) are still very substantial.

4.8 What the above means is that, under the current cost RCV method of setting utility prices, the mere act of undertaking capital investment funded by fixed interest borrowing yields a very considerable concealed financial surplus for the utility, that is, over and above what is needed to run the business on an ongoing basis, given that it can borrow at the interest rate in the model. We shall consider some of the likely implications of this in more detail in the next section. But to give an idea of the magnitude of the effects involved, imagine that the hypothetical utility we are considering had originally been set up by an equity owner who put in a token share capital of a penny, and never put in any more equity finance: that is, to all intents and purposes, this utility is still the entirely debt funded entity considered in formula 1. Then the entire post-tax surplus of the utility could, in principle, be taken by the owner as a dividend, while in no way compromising the ability of the enterprise to keep operating. In other words, the token initial equity stake of a penny could generate, in principle, an annual dividend equal to 30% of the yearly level of capital investment by this utility, (in the n =30, i =5%, r =2.5% case): an extremely attractive return. Alternatively, if there was no equity owner to take out the surplus as a dividend, and the surplus was therefore retained in the utility, then in a relatively small number of years, the utility would first become debt free, and later, the owner of substantial, and growing, positive financial assets.

4.9 It is also useful to consider another implication of the above model: namely, what the gearing would be, (that is, the ratio of debt to RCV), for a utility operating under the historic cost model, but charging its customers prices as determined under the current cost RCV method. (In considering what the gearing of such a company would be, we are assuming that the concealed cash surplus under the RCV method is not retained within the company: if it was retained, the company would rapidly become debt free, and the concept of gearing would become meaningless.)
The steady state ratio of debt to RCV for such a utility is given by

gearing ratio:-
$$\frac{2[1 - \frac{1}{nr}(1-(1+r)^{-n})](1+r)}{r(n+1)}, \qquad (2)$$

and is a function only of r and n: see Annex 1 for derivation of this formula. Table 2 shows the values of this ratio, expressed as percentages, for a range of values of r and n. We see that as inflation increases and as asset life increases the gearing of debt to asset value falls.

Table 2: Gearing, (that is, ratio of debt to RCV), for a Utility Operating under Historic Cost Model.

Percent

Inflation (as percentage)	Asset life (years): 10	20	30	40
0	100	100	100	100
0.5	99	97	95	94
1.0	97	94	91	88
1.5	96	91	87	83
2.0	94	89	83	79
2.5	93	86	80	74
3.0	92	84	77	71
3.5	91	81	74	67
4.0	89	79	71	64
4.5	88	77	68	61
5.0	87	75	66	58
5.5	86	74	64	56
6.0	85	72	62	54
6.5	84	70	60	52
7.0	83	68	58	50
7.5	82	67	56	48

4.10 The most important implication of table 2 and its associated theory, is what it says about the concept of gearing. It is implicit in much that is written about gearing that RCV, (that is, the value placed on the physical assets of the utility at current prices), is essentially financed from two sources, namely, debt and equity. In fact, as table 2 shows, gearing ratios will be less than 100, even for an entirely debt funded utility in which there is no equity at all, as soon as inflation is above zero: and the higher the rate of inflation and the longer the asset life, the lower the gearing will be. A proper decomposition of RCV, (as estimated at current prices), into the components which contribute to its financing would distinguish four different components: namely, debt funding, equity funding, funding from retained profits, and the effect of inflation in enhancing the value of capital assets. For the debt funded utility being considered here, only the first and last of these components contribute to RCV. Failure to separate out these components of current cost RCV means that much conventional discussion of gearing ratios is likely to exaggerate the importance of the equity contribution to RCV. If the different contributory components to the funding of RCV are not properly distinguished, then it is likely to be impossible to work out a system for rationally apportioning the return on capital to the correct recipients: and the current cost RCV method, which implicitly regards all of the current cost RCV not funded by debt as being funded by equity, will grossly over-reward equity.

4.11 Finally, as noted in paragraph 2.3, the description of the current cost RCV method underlying the modelling in this section is based on the RCV method as implemented in Scotland: (WIC, 2005). In one important respect, however, the RCV method as applied in Scotland differs from the version of RCV as currently applied by OFWAT to the water industry in England and Wales: the difference relates to the assumed interest rate applied in calculating the RCV capital charge. OFWAT have confirmed, (private communication), that they calculate the capital charge, in cash terms, by applying the current real average market interest rate to the RCV of the

company, rather than, (as is the case under the version of RCV applied in the water industry in Scotland), applying an average nominal rate.
At first sight, it might therefore appear that formula (1), which is based on the nominal rate of interest, would overstate the financial surplus being generated under the version of RCV as applied by OFWAT, who apply the real rate of interest. However, closer examination of the interest rates actually assumed by OFWAT tells a different story.
In their determination of charges for 2005-10, OFWAT assume a real, post tax return on the non-debt component of RCV of 7.7%, (see OFWAT 2004, p219), which equates to an 11% real return pre-tax. They also assume a real pre-tax rate of 4.3% on the debt component of RCV. OFWAT weight together the debt and non-debt real interest rates on the assumption that debt represents 55% of RCV. This leads to an average pre-tax real rate of 7.3%, which is, effectively, the percentage OFWAT actually apply to RCV in working out the cost of capital, (including tax). However, as we have seen, OFWAT's real pre-tax rate of return on debt is 4.3%: this would equate to a nominal pre-tax cost of debt of 6.8%, which is less than the figure of 7.3% which OFWAT actually apply to their RCV in setting charges.
Since formula (1) is based on the assumption of the same interest rate being applied to RCV to calculate the cost of capital as is paid on the debt of the utility, the implication is that formula (1), and the figures in Table 1, would actually understate the level of financial surplus being generated under the OFWAT variant of RCV.

4.12 There is, in addition, a general moral to be drawn from this example - that great care has to be taken to distinguish exactly how the RCV method is being applied in any specific case. This is often by no means clear given the inadequate levels of detail commonly published by those applying the RCV approach - probably because the details of the calculation will typically relate to matters which may be regarded as being "commercial in confidence".

5. The Likely Effects of Current Cost RCV Pricing on the Behaviour of Utilities

5.1 This section discusses the likely implications of the above theory for the behaviour of utilities. The probable effect will be to materially distort a number of important aspects of behaviour. These were identified in the paper by JR Cuthbert (2006) as follows.

5.2 Distortion of Capital Programmes.
If capital investment in itself is a highly profitable activity because of the return it generates in charges on consumers, this may well distort the capital investment programme itself. For one thing, utilities may pay insufficient attention as to whether a given capital project is justified in terms of its physical return to the utility: so the utility may over-invest in intrinsically poor projects. Moreover, as can be seen from table 1, the financial surplus on a project increases with increasing length of asset life: this may encourage utilities to invest in long term projects disproportionately, at the expense of short term projects. In the extreme, this may help to explain the water companies' traditional relative unconcern about detecting and repairing leaks, since in the water industry infrastructure renewal projects are funded straight from revenue, and therefore generate no RCV surplus. In fact, if reducing leaks saved enough water

to reduce the requirement for long term capital investment, this would be financially disadvantageous to the utility.
Of course, utilities do not take investment decisions in isolation: instead, they are operating in an environment where they have to achieve the efficiencies which will enable them to meet any output targets set by the regulators: and regulators will also typically have the right to limit the amount of investment that is added to the RCV base. So the actual outturn on investment decisions will reflect a complex interplay between the perverse incentives inherent in current cost RCV charging, with the pressures exerted by the regulator.

5.3 Danger of a Disproportionate Return on Equity.
As has been noted above, most of the financial surplus on investment is concealed, and will not show up directly as profit when the accounts of the utility are expressed in current cost terms. It is not immediately clear, therefore, how this surplus can be easily removed in the shape of dividends for equity holders, without the utility showing an apparent current cost loss. However, in the case of the water industry in England, another element in the regulatory accounts becomes relevant at this point. This is the so-called "financing adjustment", which represents a notional income element in the regulatory current cost profit and loss account, representing the benefit received through the eroding effect of inflation on cash debt. It turns out that, if the debt of the company is approximately equal to the level of debt implied by the historic cost model, then the financing adjustment will typically be of the same order of magnitude as the concealed financial surplus accruing under the current cost RCV method: (the approximation is very good for asset lives of around 10 to 15 years: for longer asset lives, the surplus will be greater than the financing adjustment.) Because of the existence of the financing adjustment, the effect is that equity holders can remove a large part of the financial surplus generated by the RCV method from the company, without pushing current cost retained profits in the regulatory accounts into the negative.

5.4 Is there any evidence of an excessive return being taken on equity? At this point, the discussion in para 4.10 above becomes relevant. A much better indicator of the true return on equity is to relate dividends to the actual amount of capital which has been raised by the company by means of equity, rather than to the quantity (RCV-debt), (since, as has been noted in para 4.10, this latter quantity also includes components relating to capital financed from revenue, and the effect of inflation on RCV.) It is revealing to perform the relevant calculation for the water and sewerage companies in England, over the period since the mid 1990's, when the RCV method was introduced. As OFWAT has confirmed, the amount of capital raised through equity is given as the sum of the terms "called up share capital" and "share premium", in table 7 of (OFWAT, 2005), and corresponding tables in earlier volumes. Table 3 shows dividends expressed as a percentage of this amount:-

Table 3.

Water and Sewerage Companies in England and Wales: Dividends as percentage of called up share capital plus share premium.

1996/97	22.2%

1997/98	34.5%
1998/99	32.4%
1999/2000	18.6%
2000/01	19.3%
2001/02	13.9%
2002/03	23.5%
2003/04	18.4%
2004/05	18.6%

The figures are striking, and suggest that the return to the equity capital actually raised by the water and sewerage companies is indeed grossly excessive: (remembering that the utilities involved, which are, after all, local monopoly suppliers of an essential commodity, will therefore be protected from many substantial risks).

5.5 Excessive Customer Charges.

Since the financial surplus generated by the current cost RCV approach arises directly from charges on customers, it follows that customers will be being overcharged. Overcharging, however, will not just arise as a direct effect. As has been argued above, the current cost RCV approach will result in significant sub-optimalities in investment decisions: the resulting inefficiencies will, in due course, lead to cost increases which will also be passed on to customers, leading to additional, indirect, increases in customer charges.

5.6 Distortion of Gearing Ratios

Since capital investment financed by fixed interest debt yields a substantial concealed financial surplus, the effect is likely to be that utilities increase their gearing ratios to benefit from this. This could account for the observed increase in gearing for, for example, the water and sewage companies in England. Given the size of the concealed financial surplus, the normal risks associated with high gearing will be more apparent than real, since the financial surplus is available as a buffer should the utility experience a downturn. Given this, owners of companies will have little incentive to inject equity capital, which would merely dilute the return on existing equity.

6. The Mistakes and Fallacies in the Current Cost RCV Approach

6.1 The analysis in this paper leads us to the following conundrum. How could the current cost RCV approach, which is based on the reasonable sounding principles set out in section 3, (namely, ensuring capital maintenance, making sure that capital generates a return equal to its opportunity cost, securing the benefits of competition, and enabling the industry to attract funds for new investment), nevertheless lead to the consequences identified in sections 4 and 5 above? This section looks again at these principles, and identifies where, and how, things have gone wrong.

6.2 Capital Maintenance

There are two fundamental flaws in the application of the capital maintenance criteria, set out in paragraph 3.3a -.

a. First, the current cost RCV method overestimates the cash requirement for running a utility company on a sustainable basis. This is demonstrated by the modelling in section 4, which shows that the cash required to keep the utility running on an ongoing basis, including fully providing the required stock of physical capital, is significantly less than the cash revenues generated by RCV charging. But how has this happened? To answer this, we need to go back to the original Treasury Byatt report on which the RCV is based. What appears to have gone wrong is that the Byatt report has been too simplistic in its analysis of the interaction between inflation effects and time effects: Byatt neglected the fact that, if a service is provided by means of long lived capital assets in an inflationary environment, then there is a real cash benefit since the average asset base which provides the service will always be several years old, and hence has been provided at the reduced costs of several years ago: instead, Byatt calculates depreciation and interest at today's prices.

b. Second, as regards financial (as opposed to physical) capital maintenance, the current cost RCV approach fails to distinguish precisely what components of financial capital need to be maintained. As noted in paragraph 4.10 above, there are conceptually four different components to the funding of RCV: namely, debt, equity, retained profits, and inflation, (that is, the time lag effect noted at (a)). As well as earning the required interest to service its debt, the reasonable requirement would be to preserve the value of the equity funded component of RCV, as narrowly defined. This would require that the equity component of RCV earns a market interest rate of return. But what the RCV method actually does is ensure not just that the equity component earns a market interest based rate of return, but in addition so do the retained profit, and inflation components of RCV - all of which are available to reward the shareholders. Far from just preserving the value of the equity finance which has gone into the company, the current cost RCV method implies a gross over-enhancement of the market value of a company's equity, relative to the (inflation preserved) value of the equity finance actually raised by the company.

<u>The Opportunity Cost of Capital</u>

6.3 There are, again, fundamental flaws in the opportunity cost argument that earning a market interest rate of return on RCV ensures the efficient utilisation of capital resources.

a. By efficient utilisation of capital resources, what is meant is that capital should be deployed on projects which yield an optimal real physical benefit to the company or the community. But what we are talking about under the current cost RCV method is a monetary rate of return charged on the value of the capital involved: so the economic efficiency argument will only work if there is some identity between the real physical return on an investment, and the monetary capital charge.

That there will be such an identity is a consequence of optimisation behaviour - provided that the managers of the undertaking are operating under a budgetary constraint: for a body operating within a tight fixed budget constraint, (like some government departments), or for a price taker firm operating in a competitive market, then it will indeed be true to say that a manager will only be able to justify the charge against profits represented by the monetary capital charge if this is compensated for by some real benefit to the undertaking. But this link breaks down, and in fact, goes into reverse, for a price maker firm, (such as a typical utility), which is able to pass the capital charge onto consumers in the form of increased charges - as happens under the RCV method of pricing. In these circumstances, the capital charge is in danger of becoming the stimulus which drives the system - and the real return from the asset of becoming secondary. Far from ensuring efficient utilisation of capital resources, application of the RCV method for a price maker is a recipe for encouraging over-investment in schemes which may have limited real utility - particularly if such schemes have long asset lives: since, as implied by formula 1, the financial surplus yielded by a scheme increases with length of asset life.

b. There is, however, another manifestation of the opportunity cost argument, not in terms of the marginal capital investment decision as discussed in (a), but in terms of the potential decision to realise all the assets of the business, and deploy them elsewhere. On this version of the opportunity cost argument, unless a utility is seen to be generating a return equal to current market interest rates on the whole of its RCV, then economic efficiency would be improved by realising the RCV, and redeploying the resources elsewhere. This argument is again flawed, however, for the following reasons.

i. Given society's need for continuing access to utility services like water, wholesale realisation is not an option.
ii. Practically, fixed assets like dams etc. are unlikely to be realisable.
iii. An important issue of ownership also arises here. As we have seen, funding of RCV should in principle be decomposed into four components, namely, debt, equity, retained profits, and inflation effects. It could be argued that consumers, and society, as generators of the third component, are in effect part owners of RCV, and should be due a return on any realisation. So neither the decision to realise RCV, nor the sole benefits from any resulting distribution of assets, should rest solely with the nominal owners of equity. (It is of interest that a broadly similar point arises in the document (World Bank, 2004), which envisages that in certain circumstances where capital assets have been funded by the customer, the operator would receive no return on that portion of its regulated assets.)
iv. Society and consumers have conferred upon the equity owner the right to supply the utility service in question. Implicit in this contract there is also a duty to supply. The equity owner cannot unilaterally abrogate this duty to supply - and cannot unilaterally realise the assets involved in RCV and redeploy these elsewhere if this would involve cessation of supply, or indeed undue risk of cessation of supply.
v. Linked to (iii), if society has chosen, (as it might well do), to take part of the return due to it in the form of lower prices, hence reducing the apparent rate of return on RCV, this should not be taken as evidence of a failure by the utility to generate an adequate overall return on the capital employed.

6.4 The issue of opportunity costs has, however, further and even more fundamental implications for the RCV method. We have seen that the standard opportunity cost argument does not hold at the level of the utility itself - because, as a price maker, the capital charge is simply passed on to the consumer. Opportunity cost decisions can really only be taken at the level in the system where price increases can no longer be passed on: which means, in this case, at the level of the consumer. But for the consumer to be able to take opportunity cost decisions there would have to be significant extra mechanisms in place, which do not exist in a conventional utility. Consumers would presumably have to operate collectively in any such decision: so democratic mechanisms would have to be put in place to enable consumers to express a collective will. Consumers would then have to be much better informed about the nature of the issues facing them: and they would need to be provided with realistic options among which they could actually choose. One way of achieving this latter point would be for consumers to be able to exercise decisions over the rewards which,

as we have argued in the previous paragraph, they should be entitled in relation to "their share" of RCV. So consumers might, for example, decide collectively to take their share of the return due to them in terms of low charges now - or might decide to forego lower charges now for the sake of increased capital investment, and hence an enhanced service, or to subsidise charges to industry for the sake of increased economic development.
Overall, the implication, and it is an important implication, is that opportunity cost is going to be an effective mechanism under RCV only if there are fundamental extensions to the extent to which consumers and society as a whole are democratically involved in decision taking.

6.5 Competition

The argument is that the current cost RCV approach secures the benefits of potential competition, since it ensures that prices are set at a level which provides no barrier to potential entrants. Again, there are a number of basic fallacies with this argument.
a. First of all, for most network utilities, free entry, in the sense of the potential to set up a competing network, is in any event, largely a myth. For most utilities, the best sites, (of dams, of tracks, for pipelines, for pylons etc.) will already have been secured, leaving a potential competitor faced with sub-optimal choices, and horrendous costs associated with planning and so on. So the potential for genuine new entrants is *de facto* very small in most cases, and arguably, given that there is a natural monopoly, a single network is likely to be the most economically efficient approach: setting prices high enough to make new entry possible is then a nonsense.
b. That leaves the potential for new entry in the sense of a bidder coming in to take over the existing utility. In this case, the RCV strategy of setting prices high will be reflected in high returns, and a high market valuation of the asset. This could indeed attract entrants, as has indeed been the case with the water companies in England: but arguably, such entrants might be more concerned with the financial rewards available through the mechanisms of the current cost RCV method, rather than with securing the improved efficiency and service to customers which would be the normal benefit of competition.
c. Note also the perverse effect of the strategy of setting prices high to attract new entrants. This is precisely counter to the normal benefit of competition which is low prices. What the high RCV prices do is to enable the equity owner to take a return, by way of dividend, which should in part accrue to the consumer, due to their contribution to the funding of RCV through retained profits.

6.6 It is worth noting here that other approaches are possible, which might do much more to stimulate competition. For example, it would greatly increase the potential for new entry if it was clear that what was for sale was not the whole RCV of the utility at an inflated price: but only that portion of the RCV which had been funded from equity, together with the temporary right to manage the utility as a whole. This would mean that entry was cheaper for potential competitors: and that society, (and consumers), would be in a much stronger position to strike a deal which secured for themselves the benefits to which they were due. These benefits due to society and consumers would include some economic rent, arising from:

- the consumers' share of RCV as funded by retained profits.

- the value which society is giving to a new entrant by bestowing upon them a "right to supply", and the right to earn a normal profit from managing the utility as a whole.
- Arguably, in the case of national resources like water, the rent due to society through their inalienable rights in the water resources of the country.

6.7 The Ability to Attract Investment Funds

In fact, as has been seen from the model in section 4, the current cost RCV method sets charges at a level well above what is required to satisfy the Net Present Value criterion for investment, which is the base level that would be required to attract new investment funds. All that is needed to satisfy the Net Present Value criterion is to charge historic cost depreciation, and to earn a market rate of return on the components of RCV funded by debt, and funded from equity. There is no need to earn a return on the retained profits and inflation components of RCV.

6.8 What we have seen in this section, therefore, is how each of the current cost RCV principles outlined in section 3 contains basic fallacies. In fact, most of these fallacies boil down to one or other of three failures:-

a) the failure to identify the real cost savings arising from the interaction of long asset lives with the operation of inflation.

b) the failure to grasp that the standard opportunity cost argument does not hold, (and, indeed, that it is perverse), in relation to the rate of return on capital, when the industry is a price maker rather than a price taker: and that for a price maker, the opportunity cost argument will only work if there are radical extensions to consumer democracy.

c) failure to distinguish carefully enough the different funding sources of RCV, estimated at current cost, with the result that the equity holder of the company is over rewarded.

6.9 Of the failings identified in the previous paragraph, the first two are largely inherent in the Byatt report itself. The Byatt report also failed to distinguish adequately the potential range of funding sources of RCV: but this did not matter greatly, since the report was dealing with nationalised industries. As the Byatt report said, "Having attributed a share of the total real returns to taxation and loans, those with an "equity" interest- in this case the nation in general- receive the balance." *Source: Byatt Report, Vol 1, para, 125.* The fundamental failure at c) in the previous paragraph occurred at the stage of translating the principles of the Byatt report to the private sector: at this point, a much more developed understanding of the funding sources of RCV was required, but was not forthcoming.

7 Conclusion.

7.1 In this paper we have demonstrated that there are two fundamental flaws in the current cost RCV method of utility pricing. First, the application of the RCV method turns capital investment itself into a highly profitable activity for a utility, such that it leads to a cash surplus for the utility which could commonly amount to 30% or even much more of the value of the investment, post tax. The overall effects include substantial overcharging, the potential distortion of capital investment programmes, excess profits for equity holders, and high gearing ratios for companies. These effects

have been demonstrated through a simple model of utility operation, and also accord with observed utility behaviour in the real world.
Second, there is a failure under the RCV approach to realise that the standard arguments of opportunity cost do not apply to a company which is a price maker, like a typical utility. Imposing a capital charge on a price maker will simply result in this charge being passed on to the consumer: if effective opportunity cost decisions are to be taken, these have to be taken at the level where the charge finally sticks- namely at the level of the consumer. This has fundamental implications for the need to extend democratic decision taking by consumers and society. As currently practised, the RCV method disenfranchises society and consumers.

7.2 These failings stem from basic mistakes and fallacies in the fundamental principles on which the current cost RCV approach is based. These relate in part to weaknesses in the original Byatt report, and in part to errors in translating the principles of the Byatt report to the different context of price setting for a privatised utility.

7.3 Given our findings, there is an urgent need
a) to revisit the principles of current cost accounting set out in the Byatt report.
b) to reconsider the current cost RCV approach to utility price setting.
c) to extend democratic decision making so that consumers and society can make realistic opportunity cost decisions.

7.4 Once there is general agreement on how RCV at current cost should be decomposed into its different funding sources, this opens up the potential for a radical rethink of the whole concept of the ownership of a utility, and what utility privatisation actually means. There would be many advantages for a model in which a potential private sector entrant bid, not for the whole RCV of a company at inflated prices, but only for
i) that part of RCV funded from equity
ii) the right to manage the utility for an agreed period:
this would open up the option for much cheaper entry, and therefore for truly effective competition. It would also open up a natural route by which society could negotiate lower charges, reflecting the economic rent due to society arising from the factors identified at para 6.6 above.

References.

Australia, (1992): “Water Resources and Waste Water Disposal Report No.26”: Industry Commission.

Cuthbert, J.R., (2006): “How the RCV Method Implies Excessive Returns on Capital Expenditure”: response to OFWAT/OFGEM consultation on Financing Networks.

Estonia, (2003): “The Principles for Approval of Natural Gas Prices”: Energy Market Inspectorate.

Germany (2005): “The German Energy Industry Act: Regulating Grid Access and Grid Fees in the Electricity and Gas Markets”

H.M.Treasury, (1986): “Accounting for Economic Costs and Changing Prices”: report of a working group chaired by Ian Byatt, (the “Byatt report”): HMSO.

Joskow, P.L., (2005): “Regulation of Natural Monopolies”: prepared for “Handbook of Law and Economics”, Polinsky and Shavell, editors, Elsevier, B.V.

Kearney, C. and Hutson, E., (2001): Alternative Methodologies to Measure the Regulatory asset Base of Regulated Companies”: Report to the Irish Commission for Aviation Regulation.

Laos, (2004): “Ministerial Decision on Water Supply Tariff Policy of the Loa PDR”.

OFWAT, (2004): “Future Water and Sewerage Charges 2005-10: Final Determination.”

OFWAT, (2005): “Financial Performance and Expenditure of the Water Companies in England and Wales: 2004-05 Report”.

OFWAT/OFGEM, (2006): “Financing Networks: A Discussion Paper.”

South Africa, (2002): “Regulatory Framework for the Economic Regulation of the Electricity Supply Industry of South Africa.”: National Electricity Regulator.

Water Industry Commissioner for Scotland, (2005): “Strategic Review of Charges, 2006-2010: The Draft Determination”.

World Bank, (1999): “Toward a Financially Sustainable Irrigation System: Lessons from the State of Victoria, Australia, 1984-1994”, K John Langford, Christine L. Forster, Duncan M. Malcolm, Technical Paper No. 413.

World Bank, (2004): “The Regulation of Utility Infrastructure and Services”: developed for the World Bank and the Public Private Infrastructure Advisory Facility by M.A. Jamison, S.V.Berg, F.Gasmi, and J.I.Tavara.

Annex1. Derivation of Formulae 1 and 2

Historic cost.

1. In the steady state, (that is, after at least n years), depreciation in year t in cash terms will be the sum of components from the current and preceding n years, as follows:-

$$\text{Historic cost depreciation in year t} = \sum_{k=0}^{n-1} \frac{(1+r)^{t-1-k}}{n}$$

$$= \frac{(1+r)^{t-1}}{n} \sum_{k=0}^{n-1} (1+r)^{-k}$$

$$= \frac{(1+r)^{t-1}}{n}\frac{[1-(1+r)^{-n}]}{[1-(1+r)^{-1}]}$$

$$= \frac{(1+r)^{t}[1-(1+r)^{-n}]}{nr} \quad . \qquad \text{(i)}$$

2. Calculating the historic cost interest payment involves evaluating an expression of the form $\sum_{k=1}^{n} kx^{k-1}$. This expression has the following value:-

$$\sum_{k=1}^{n} kx^{k-1} = \frac{d}{dx}[\sum_{k=0}^{n} x^{k}] = \frac{d}{dx}[\frac{x^{n+1}-1}{x-1}] = \frac{(n+1)x^{n}}{(x-1)} - \frac{(x^{n+1}-1)}{(x-1)^{2}} \quad .$$

Interest in year t in cash terms will be the sum of components from the current and preceding n years, as follows:-

$$\text{Historic cost interest in year t} = \sum_{k=0}^{n-1}\frac{(1+r)^{t-1-k}(n-k)i}{n}$$

$$= \frac{i(1+r)^{t-1}}{n}\sum_{k=0}^{n-1}(n-k)(1+r)^{-k}$$

$$= \frac{i(1+r)^{t-n-1}}{n}\sum_{k=0}^{n-1}(n-k)(1+r)^{n-k}$$

$$= \frac{i(1+r)^{t-n-1}}{n}\sum_{k=1}^{n}k(1+r)^{k}$$

$$= \frac{i(1+r)^{t-n}}{n}\sum_{k=1}^{n}k(1+r)^{k-1}$$

which, using the above,

$$= \frac{i(1+r)^{t-n}}{n}[\frac{(n+1)(1+r)^{n}}{r} - \frac{((1+r)^{n+1}-1)}{r^{2}}]$$

$$= \frac{i(1+r)^{t}}{r}[1 + \frac{1}{n} - \frac{(1+r)}{nr} + \frac{(1+r)^{-n}}{nr}]$$

$$= \frac{i(1+r)^{t}}{r}[1 - \frac{1}{nr}(1-(1+r)^{-n})] \quad . \qquad \text{(ii)}$$

The corresponding expressions for debt under the historic cost model follow immediately on omitting the term i in the above.

<u>RCV</u>

3. In this paper, we have slightly simplified the RCV method as it is normally applied in practice, in that we assume RCV is calculated at the start of the year in question, rather than at the mid-year average.

For $t \geq n$, depreciation at current cost in year t will consist of n tranches, each consisting of $\frac{1}{n}$ of a capital asset valued at current prices: that is, at the prices at the beginning of year t: hence, current cost depreciation charge in year t = $\dfrac{n(1+r)^{(t-1)}}{n} = (1+r)^{(t-1)}$. (iii)

Also, for $t \geq n$,

$$\text{RCV in year t} = (1+r)^{(t-1)} \sum_{k=1}^{n} \frac{k}{n} = \frac{(n+1)(1+r)^{(t-1)}}{2} ,$$

so the RCV capital charge in year t is $\dfrac{i(n+1)(1+r)^{(t-1)}}{2}$. (iv)

4. Subtracting expressions (i) and (ii) from the sum of expressions (iii) and (iv) then gives the cash excess of RCV revenues in year t over historic cost depreciation and interest charges. Formula (1) then follows on deflating this cash expression to real terms. Since we assume that interest and depreciation payments are made at end year, we have used a deflation factor for year t of $(1+r)^t$, reflecting end year prices.

Formula (2), for the gearing ratio, follows immediately on dividing the expression for historic cost debt at the end of para 2 above by the expression in para 3 above for RCV.