

**WATER PRICING:  
CONCEPTUAL AND  
THEORETICAL ISSUES**

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## Introduction

Water is a valuable and essential commodity, in its direct use as well as indirectly through its environmental functions. Yet a large amount is sold below cost or is free at point of use. A large amount is also allocated to uses where its return is lower than in alternative uses (or to uses that exist only because certain activities are subsidised). Meanwhile, environmental side effects of water use are often not taken into account. As for most goods or services treated in this manner, the predictable outcome is underfunding, over-use of the resource, disincentives to the use of efficient technology, losses of water in distribution systems, and environmental degradation. Some of these outcomes benefit certain sections of society, but for the reasons stated they are often detrimental to the common good and, especially, to the sustainability of the resource.

It is appropriate therefore that the European Commission (1999) should propose a Directive in the field of water policy. It states, in particular, that *Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs.*<sup>1</sup> This paper outlines guiding principles for policy on water pricing, with a view to achieving the greatest common good. It then looks in more detail at certain aspects of pricing, including the metering decision and the practical application of long-run marginal cost pricing. There are observations on the related issue of reducing pollution of rivers by farming; on how to address the difficulties faced by low-income households and issues of acceptability; and, finally, on the inadequate "status" afforded by the EU Treaties to the Polluter Pays Principle. The aim of the paper is to present the issues rather than to be prescriptive.

Often the manner in which a policy is applied is as important as the choice of policy. It should also be stressed that differing circumstances in different countries require the principles outlined to be sensitively applied. Ireland is a case in point where domestic water charges are concerned, as they have recently been abolished. Revenue shortfalls of local authorities were then made good, first with the proceeds of motor taxation, and subsequently by funds from central government through its mechanism for funding local government, which itself is a subject of regular reappraisal.

Useful observations can be made with regard to Ireland's case. Plentiful rain does not remove the requirement for capital expenditure on water services (amounting to approximately one billion Euros in the 1994 to 1999 plans, largely from European funds). There is also a mismatch between the Eastern region, where most of the demand is, and the West where there is larger supply (Mac Carthaigh, 1998). Even in the West of Ireland, finding water to supply fast-growing towns has posed problems and, to give a recent example,

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<sup>1</sup> Article 9 of the version of 30 July 1999. It is clear that this version is broadly weaker than the version of 8 June 1998, drawn up prior to discussions by the European Council, in which Article 12 ensured full cost recovery, broken down at least into households, industry and agriculture. That is, no cross-subsidisation would have been allowed. Cross subsidisation would still be transparent, however, in the new version's requirement that sectoral cost data and prices be computed and reported.

abstraction from an important salmon river was temporarily under consideration. Plentiful rain does mean that in a world where water supplies are under increasing pressure,<sup>2</sup> international water-using companies will look with interest on such a location - a case in point is the removal from Ireland to Morocco of a large textile company in pursuit of lower wages, excepting the thirsty dyeing plant. Irish water will enjoy increasing scarcity value.

### Guiding principles

The Dublin Statement of the International Conference on Water and the Environment stated that "water has an economic value in all its competing uses and should be recognised as an economic good". Being an **economic good** implies that it should be "correctly priced". This occurs at the price where quantity demanded (which tends to be higher the lower the price, i.e. demand is downward sloping) equals quantity supplied (where supply is charged at the cost of the last unit supplied). If the good is charged at below this equilibrating "correct price", costs are incurred that are not matched by the benefits enjoyed or willingly paid for by the consumer. In short, costs outweigh benefits.

The reference in the Dublin Statement to **competing uses** conjures up the idea of exchange or trading. We know intuitively that, in conditions of unimpeded trade, widely divergent prices disappear. People with access to cheap water will tend not to use it for a low value use if they can sell it to a high value use for more money. Owing to the fact that a consumer's valuation tends to be lower at higher quantity (downward sloping demand, again) allocation between competing uses ends up when prices willingly paid by different consumers are the same. If, owing to inhibitions to trade, there is an unsatisfied consumer who is willing to pay more, then a potential benefit to society as a whole is foregone.

These principles for ensuring the highest common good are, however, only really applicable if demand is downward sloping. Briscoe (1996) points out that, owing to economists' jargon, many people erroneously but understandably believe that this is not the case, because they hear that demand for water is termed "inelastic".<sup>3</sup> Demand for most non-luxuries, including water, tends to be inelastic but it is responsive to price nevertheless. Accumulated evidence shows, in particular, that the response is usually greater once consumers are given time to adjust. For example, a 1 per cent price rise can induce a 0.11 to 0.44 per cent decrease in water consumption, varying with user category, which is indeed rather small. But in the long run the decrease can be in the region of double this amount (Schneider, 1991).

Following Briscoe, it is useful to think separately of (1) the costs incurred by the utility, be it in public or private hands, in providing the water service

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<sup>2</sup> Dinar and Subramanian, 1997, have constructed a Water Availability Index, which shows a general decline.

<sup>3</sup> "Inelastic" in fact means that the change in demand is not *disproportionately* large in relation to a change in price.

(including waste water services) and (2) the water resource *per se*. The price that water utilities should charge for the *service* should therefore be the supply price of the last unit, the marginal cost. This can be close enough to the average cost for it to be applied in the case of current costs. In the case of capital cost, where this closeness usually does not apply, some practical estimation of long-run marginal cost is required. A simple example is given later for situations in which an investment programme is underway.

The use of, or the right to the use of, the *water resource per se* also has a value, which is equal to what it could earn in its most valuable alternative use. This is its so-called opportunity cost. Ideally, competing users should be charged the optimum allocation price resulting from the trading operation described above, but this would be difficult to estimate with certainty. Allowing the market to do this instead, as recommended by Briscoe, is perhaps the ideal route. Water rights (initially allocated in some agreed manner) that are in low-reward uses will tend to be willingly sold to high-reward uses, helping the move to better allocation. A system of tradable rights provides incentives to use water efficiently and to gain additional income through the sale of saved water (Dinar et al, 1997). Many present allocations are the result of policies aimed at supporting certain activities or sectors; if these are deemed deserving of support it is preferable that subsidies be openly targeted at the activity, rather than be applied through the provision of cheap water.

Finally, correct charging should ideally incorporate environmental costs, as stated in the proposed Directive. These are also in the nature of opportunity costs. For example, water can maintain wetlands or be used by the domestic sector, but the difference here is that the value of the water in its environmental use, e.g. the wetland, or the loss of value by removing it, is not readily estimated. Indirect methods for valuing environmental uses or losses are required (Pearce, 1999). One may need to place a value on an uncharged-for environmental site that people visit, or estimate people's willingness to pay for its continued existence or quality improvement. An example of quality valuation is the Norwegian survey to discover the value that households would put on a 50 per cent reduction in nutrient leaching to the North Sea. Households were willing to pay between 592 NOK and 1943 NOK per year (between 73 ECU and 242 ECU) in extra sewerage taxes to promote this quality improvement (Magnussen, 1992). Interestingly, a recent survey suggests that respondents with higher educational qualifications are more conservationist (Clinch et al, 1999). Given a growing share of the population with higher levels of education, this implies that there could be higher valuations of the environment in the future.

We need to develop agreed ways for charging users of water for the environmental costs that they impose. In the meantime, a practical starting point for charging the environmental costs is to include costs of remediation. These will have been identified in the Environmental Impact Assessments. To add another point: a category of user of water services, not officially classed as such heretofore, is the transport user, the motorist in particular. Rubber, metal and exhaust residues wash into the sewerage system, imposing extra treatment costs. In some countries perhaps 25 per cent of waste water treated

comes from highways, and means should be found, probably through a charge on fuel, to reimburse the costs incurred by the waste water treatment operation.

### **The metering decision**

A prerequisite for the operation of the market principles outlined above is that the water service be charged according to the quantity used. Owing to the cost of meter installation, however, metered charging in the case of domestic users, who use small amounts, is often considered to be uneconomic. To determine whether investment in metering is desirable it is necessary to estimate the costs and benefits of installation. Metering and volumetric pricing are to be recommended, as with any investment decision, if benefits outweigh costs. Simply put, the condition for metering to be worthwhile, according to OECD (1987), is that:

The reduction in water use  
*times* the long-run marginal cost of water supply  
*plus* associated external benefits

**should be greater than or equal to**

The resource costs of metering and volumetric charging  
*plus* the value of water foregone.

The size and likely trends in the components of the above condition are worth discussing. First, the benefits (the components on the left-hand side): it is noted that costs of water supply are increasing so that reductions in water use will see increasing benefits, including environmental benefits.<sup>4</sup> The reduction in water use depends on the responsiveness of demand, which in turn could be enhanced by the installation of reader-friendly meters and the supply of information on water-saving devices. Studies show that the introduction of metering to reduce demand can have an effect in the range of 10 to 30 per cent, and often higher in the case of peak demand (OECD 1987, Zweegman 1995).

Turning to the costs (the components of the right hand side of the above condition), the cost of meters is falling. The cost of retro-fitting meters might lie anywhere between IR£70 and IR£290 (86 and 356 ECU), the reinstatement of ground or pavement constituting a major share. By contrast the cost at time of construction of the house might be as little as IR£45 (55 ECU) of which the meter itself might be but IR£20 to IR£40 (25 to 50 ECU).<sup>5</sup>

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<sup>4</sup> Other benefits could include assistance to the management function and the promotion of the view that the resource is not valueless. These benefits were important enough to swing the balance in favour of metering, in the view of the Chinese authorities when considering rural and small-town water services (J. Briscoe, personal communication).

<sup>5</sup> New housebuilding is expected to increase Ireland's housing stock by 30 per cent in the next few years and there exists the opportunity to reduce the future cost of meter installation quite substantially by installing the meter boxes now. Owing to the abolition of domestic water charges this course is not being pursued.

At the time of building it is possible to install the meter box for a negligible sum and it would therefore seem to be a sensible course of action (Scott and Lawlor, 1997). Turning to the next component, volumetric charging, the labour element of this may in fact be rising due to increasing labour costs. On the other hand the technology improvements in meter reading may be reducing the costs. Estimates of the annual combined cost of metering and volumetric charging vary a lot. Examples are UK£28 (41 ECU) per customer per year in the UK and NZ\$ 8.14 (4.28 ECU) in Christchurch New Zealand (OFWAT 1998, Dinar and Subramanian 1997). Finally, the value of water foregone is probably negligible because, the water having been uncharged, customers consumed up to the point where the marginal benefit to them is zero.

In sum, satisfaction of the condition for determining whether metering should proceed may in fact be marginal in a case such as Ireland's just now. It would vary by region, being definitely satisfied in regions where new supply is costly. The matter needs proper examination. Further benefits to environmental protection, to the management function and the financial security of the water services operation would probably tip the balance, if not now then in the future.

### **Long-run marginal cost pricing of capital costs**

There are certain advantages in charging customers of water and wastewater treatment services for the long-run marginal cost of capital. In the case of industrial customers, for example, firms can respond to the charge by saving water, recycling or by undertaking own treatment. Charging will encourage them to take the right decision, that is those who can abate pollution most cheaply will be encouraged to do so. Furthermore, the water utility will benefit, because it will know that rising demand is a true indication that it should expand capacity, rather than an artificial demand boosted by undercharging. For pricing purposes, using a long-run cost of capital means that the price, which would otherwise occur in periodic lumps, is somewhat smoothed. Customers will not therefore face widely different prices owing to their order of arrival.

We will take an example of a simple practical charge for waste water treatment. Requirements of a charging system are that it be fair and simple, and furthermore that it be capable of recovering total costs. This suggests raising the capital charge in two parts: (1) a standard charge on capacity that the firm reserves annually, based on long-run marginal cost<sup>6</sup> and (2) the

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<sup>6</sup> For example, the relationship between total capital cost of treatment plant (expressed in Irish pounds) and capacity (expressed in PE) can be described for Ireland as follows:  $\text{Cost} = 2,500 \text{ PE}^{0.75}$ . From this the marginal cost of an extra PE can be calculated for any size of plant, and annualised over, say, 20 years to give an annual charge. The relationship can also be disaggregated for specific levels of peak flow and pollution in terms of COD and Suspended Solids per day (Scott and Lawlor, 1994). In the case just described, the cost curve falls with capacity. In important areas of the supply business, such as reservoirs, cost curves rise with capacity. In these cases marginal costs are greater than average costs. This would imply that the second part of the charge, described in the main text above, would be negative, and could be offset against some of the fixed charge perhaps.

second part (which will be smaller) to recover the balance, which could be in the form of a flat charge.

The long-run marginal cost can be calculated from recent experience of construction of treatment plant and can be given for broad size categories. The charge is expressed per unit of peak-time capacity that the firm wishes to reserve, the timing of the peak to be indicated by the utility. The charge can also be broken down to reflect components of capacity, for dealing with different levels of flow and pollution rate. The charging system needs to be clearly spelt out at the time of the planning stage of the water services expansion programme. This enables firms to assess the relative costs of the options open to them and to make a realistic estimate of the capacity, which they wish to have built or reserved on their behalf. This charging method appears to be workable.

### **Pollution from agriculture**

Pollution from agriculture may appear to be peripheral to the issue of pricing of water services until one remembers that it is possible to spend a large sum of money on improving water status<sup>7</sup> and yet have declining river water quality (EPA, 1999). River water quality in Ireland has deteriorated between 1987-90 and 1995-97. The proportion of river length that is slightly or moderately polluted has risen from 21.7 per cent to 32.2 per cent, attributed in the main to nutrient (phosphate) enrichment or eutrophication, mostly by agriculture.

Given that the problem has been a cause for concern for over two decades, an examination of the incentives facing farmers is called for. Standards and bye-laws have been tightened and farmers are now urged to draw up nutrient management balances. Indeed, they can now be required by the Local Authority. In drawing up these balances, farmers have to itemise all the nutrient inputs to their farms (fertilisers and feed), and all the nutrients embodied in the flows out of their farms (sales of animals, cereals et cetera). On reflection, it is clear that the recording of inputs and outputs is remarkably close to what already happens in fulfilment of the requirements of the VAT system. Records of inputs are kept in order to deduct VAT paid on inputs from the VAT paid on outputs.

Given the similarity of the information required, it would appear sensible to harness the VAT system to help to remedy water quality deterioration. A condition could be attached that VAT is only deductible if the farmer shows evidence of a satisfactory nutrient management balance and good farming practice. If this cannot be undertaken within the Inland Revenue, possibly for legal reasons, it could operate alongside and be complementary to the VAT

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<sup>7</sup> On wastewater treatment plant alone about 0.4 billion Euro has been spent between 1994 and 1998. Nearly 0.6 billion Euro has been approved for the 1994-1999 plans, though this expenditure could rise to nearly three-quarters of a billion Euro according to the latest cost estimate.

system, with small extra administration costs.<sup>8</sup> In non-sensitive areas, the condition might be waived. Compliance costs would also be small, except for the drawing up of nutrient management balances, which farmers will increasingly be urged to undertake in any case.

The advantages of an approach along these lines are that non-polluting farmers would be no worse off, while only those with unsatisfactory nutrient balances would forfeit their tax. Those farmers who are not registered for VAT would be compensated via the so-called flat-rate system, and the incentive effects would still encourage reduced fertiliser application and give a relative advantage to sensitive farming practices. This is because farmers who use below average amounts of fertilisers would gain, while the opposite would also apply.

### **Low-income households**

Low-income households are vulnerable when domestic water charges are imposed and this is often given as a reason for discrediting charges. It was partly this perception that lay at the root of the abolition of domestic water charges in Ireland - that and the fact that the bills were largely flat-rate, were infrequent and therefore quite large, and that customers in richer regions were unfairly exempt altogether. Indeed it is possible that, now that the funds for water services come from central government, the distributional effects have actually become fairer, because the central government raises a large portion of its funds from income taxes which are more sensitively structured to families' financial circumstances.

There are many ways to alleviate payment problems faced by the poor, as described in the OECD paper on household water pricing. Broadly speaking, the tariff can be structured in a discriminatory way, with free or low-price initial blocks, or discounts can be given to cushion the effect on target groups. If the funding for this is financed by the utility itself, then cross-subsidisation from other users is the result. Cross-subsidisation can and does occur widely, both from non-household sectors (e.g. from industry and commerce) and also within the household sector (i.e. from rich to poor).

An alternative way to alleviate problems posed to low-income families by water charges is for the funding to come from government bodies (local, regional or national). The funds can either be applied to enable the utility to target certain groups, or they can be used to address the underlying problem in the form of an income support. It seems intuitively obvious that if a family's income is inadequate to meet the water bills, the family's financial circumstances are in need of help. Is it appropriate to put this responsibility on to water service providers, or onto the providers of any other good or service for that matter, rather than to give the responsibility to the department that is charged with overseeing social welfare? The social welfare department would

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<sup>8</sup> In fact fertiliser and animal feed are zero-rated for VAT in Ireland, but EU moves to unify the VAT system could change this.

tend to be the more capable of being sensitive to families' individual circumstances.

In any event it can be argued that the utility should deal with its own task rather than be distracted into a social welfare role. Briscoe (1997) gives three examples, Santiago in Chile, Conakry in Guinea and Buenos Aires in Argentina, where water is managed as an economic good and the poor are better served. In Santiago a targeted, means-tested programme of allocating "water stamps" was used to cover part of their water bill: "The utility then not only strengthened its focus (getting out of the welfare business and focusing on becoming the most efficient utility it could), but it now had a clear incentive to serve the poor, who became revenue-generating customers like all others."

The incentive effect and personal choice are of course best served if the tariff is not overly "socially adjusted", and if the government-financed aid comes in the form of extra cash through social welfare payments. The poor, hopefully, will not remain poor, and it is not in their interests, nor those of their growing children, to view water as cheap. However, aid in the form of cash also has its disadvantages. There is no perfect solution. Ultimately the best way to alleviate hardship will depend on the country's circumstances, and on consultation on the options and their implications.

### **Consultation and PPP**

The proposed Directive calls for consultation and public information (Articles 14, 15 on River Basin Management Plans and Annex III on cost recovery of water services and, by implication, on financing options).

Consultation on financing options can produce encouraging results. A survey which, by contrast with the methods employed in the electoral process, accurately spelt out the options, asked the following question (Murphy, 1994):

"To meet EC obligations regarding the protection of the environment, it will be necessary to improve our methods of waste disposal and other services. These improvements will have to be paid for, one way or another. This may be through *higher taxes* such as income tax, VAT etc., or through *fixed service charges* on households or by *charges based on the amount of the service* a household or firm uses (for instance, by metering water and charging per gallon used).... how do you feel it should be paid for?"

In reply, only two per cent said that they wanted to pay for water through higher taxes. The vast majority wanted charges. Those wanting charges were divided between wanting a fixed charge and a charge based on the amount used, with only 5 per cent difference between them (51 per cent in favour of fixed charge and 46 per cent in favour of the amount used). Logically enough, half of households would perceive their consumption as above average so they would prefer fixed charges; the other half with below average consumption could be expected to prefer metered charges. An appropriate opportunity to ask these questions again may arise in next year's International

Social Survey, or possibly as an attachment to the monthly EU Consumer Survey, the latter course requiring coordination through DGII.

These replies are also in keeping with the Polluter Pays Principle by which, if sufficient status were accorded to it, the aims of the Commission's proposals in the Directive would be better supported legally. Water use would come under the PPP umbrella in the sense that use of water is putting pressure on the environment. Of course the PPP is included in the Treaty, but how and where? It is at the end of the second sentence, of the second part of Article 174. It is notably absent from the "Principles" in Part One of the Treaty, which is arguably its logical place.

The Amsterdam Treaty was claimed to have enhanced the environmental area, but there are mixed views on this. As one legal opinion puts it:

"Environmental protection is still relegated to the bowels of the Treaty with a qualified aspiration at the start of the amended text." (Godfrey, 1999)

There is work to be done on the next revision to the Treaty to help make the Polluter Pays Principle more easily applied and thereby provide a more supportive framework for water policy.

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