

Water Pricing and Cost Data: Getting the Right Numbers

James E. T. Moncur and Yu-Si Fok

University of Hawaii

Economists have long recommended the marginal cost paradigm for setting water rates. Equating price to marginal cost will induce water consumers to use the resource efficiently. The rationale is appealingly simple: a consumer willing to pay \$P for the last gallon he purchases. Hence P measures the value derived by the consumer from that last gallon. Marginal cost, on the other hand, represents the value of all resources necessary to produce this extra gallon. If $P > MC$, the value of a marginal gallon, as the consumer sees it, exceeds the value of resources needed to produce that gallon. Thus society would be better off with a lower price and higher consumption.

The more common situation for urban water utilities has $P < MC$. In this case, the value to the consumer of an additional gallon of water falls below the value of resources needed to produce it. Gains could be had by raising price, thus inducing users to cut back on consumption. Some of the resources otherwise devoted to water "production" are thus freed up for other uses, and existing water sources are preserved for future exploitation. In the process, the water system forestalls the (usually higher) costs associated with augmenting its sources of supply.

Though a bedrock of economic analysis, marginal cost pricing generally has had a frosty reception among water utilities, irrigation districts and other institutions of the water "industry." EPA data cited by Tietenberg (1992) show that as of 1982, half of 578 municipal utilities surveyed used either a flat fee (pay the fee, use as much as you want) or declining block rates (the rate per thousand gallons declines with greater water use). Another 25% impose flat rates (constant rate per thousand gallons used). None of these pricing structures provides users with a positive stimulus to conserve.

For electric utilities, as Hall (1993) notes, dramatic cost pressures fifteen or more years ago helped stimulate a move from "average embedded cost rate design" to marginal costs as the basis of price. Ad hoc examples seem to indicate that some water utilities, facing similar if less sudden and dramatic cost pressures, are moving in the same direction. Yet many urban water utilities continue to use embedded average historical costs as the basis of price.

Even without full blown marginal cost pricing, however, many utilities fail to properly value the embedded costs of their systems and so wind up with rates too low. Three major sources of mispricing arise from standard

accounting practices: the use of actual historical cost data rather than current replacement costs, failure to incorporate the economic cost of certain assets in the rate base, and failure to include a scarcity premium reflecting the value of water in situ. Though one or more of these practices may be required by law or regulation or standard accounting practices, they nevertheless lead to underpricing and thus to inefficient water consumption.

Current operating costs are expended within a single period, so that accounting records for that period adequately represent the quantities of resources involved. But capital costs are accumulations of yearly values, each denominated in dollars of that year. After several years of inflation, accounting numbers representing plant and equipment used in the water utility will be severely distorted.

First, inflation makes the purchase cost of mains, pumps, and other water infrastructure considerably lower than current replacement costs. Adding \$100 worth of pipe purchased in 1980 to \$100 worth purchased in 1993 greatly misrepresents the 1993 value of plant and equipment in service. Depreciation reserves will not suffice to replace outdated capital items. The plant and equipment generated by historical debt levels would cost more if bought today, requiring a larger principal to be borrowed. Alternatively, accelerating or decelerating inflation would call for adjustments to interest rates and thus to debt service payments as a measure of capital cost.

Second, water utilities typically accumulate net income from year to year in a "retained earnings" account. As a form of equity, earnings retained by the utility are a genuine cost of water, representing resources not available for alternative uses. This cost typically is not included in the rate base and so is not passed on to consumers. Like other capital costs, the stated value of retained earnings needs adjustment for inflation.

Finally, utilities often require builders to pay a development charge (labeled "contributions-in-aid-of-construction," or "system charge" or the like), intended to recoup the cost of off-site water infrastructure serving a new development. These payments accumulate in what amounts to another source of equity capital for the water enterprise. Inflation affects CIAC entries exactly the same way as other equity and requires a similar adjustment.

Measures of Underpricing

Table 1 gives some idea of the magnitude of mispricing traceable to these accounting practices alone. The data represent diverse regions, hydrology and institutional conditions, but the number of cities reported here is small, so the results should be generalized only with some care. That said, the inflation correction alone would make the 1991 quantity charge in (for example) Madison, Wisconsin some 43% higher than the \$.76/1000 gallons actually levied. Adding the implicit cost of retained earnings raises the degree of underpricing to about 54%. Contributions-in-aid brings the figure to 71%, resulting in a quantity charge of \$1.30/1000 gallons.

Scarcity

In many cities, as the water utility expands its output to meet growing demand, current water sources eventually will be exploited to full capacity. Further increments to demand can be satisfied only by resorting to some relatively high cost "backstop" source of supply like desalination or a lengthy aqueduct. In this context, increasing water consumption now rather than delaying to some future

time generates a "scarcity premium" on existing water sources, in the same manner as a spurt in oil demand, say, would increase the value of oil in the ground. On the other hand, conservation in the present time period will forestall these higher costs.

In some cases, water is abundant relative to current and foreseeable demand, so scarcity is not a factor. In others, the purchase price of water rights includes a scarcity premium, to induce the rights holder to sell. Scarcity is an explicit cost and so is a part of the rate base. As a component of price, scarcity will affect consumers' decisions on how much water to use or to conserve.

In many other cases, however, scarcity arises from the gradual growth over time of demand for the utility's limited water sources. In privately owned companies, a sale, merger or buyout of the firm would bring about a revaluation of its assets to reflect current market demand for the product. With few exceptions, urban water utilities are publicly owned and never sold or merged. Thus utilities' assets, including water rights, are never revalued. With no explicit cash outlay, accounting records lack any reference to scarcity. Consumers, faced with fallaciously low price signals,

Table 1. Accounting Costs and Economic Costs

	Nominal Dollars/1000 gal		Current Dollars/1000 gal		
	Reported Average Revenue (1)	Quantity Charge (2)	Explicit Accounting Costs (3)	Column (3) + Equity (4)	Column (4) + CIAC (5)
<u>Denver</u>					
1980	\$.78	\$.58	\$.33	\$.35	\$.35
1991	1.13	.89	1.17	1.38	1.41
<u>Honolulu</u>					
1980	.74	.77	1.10	1.13	1.22
1991	1.39	1.34	1.86	1.91	2.15
<u>Madison</u>					
1991	.97	.76	1.09	1.17	1.30
<u>San Diego</u>					
1980	NA	.57	.76	.33	.86
1991	NA	1.44	1.60	1.34	2.01

SOURCE: Calculated from financial statements of utilities. For a discussion of methodology, see Moncur & Pollock, 1988.

NOTES: 1980 values are stated in 1980 dollars; 1991 values in 1991 dollars.

CIAC = Contributions-in-aid-of-construction or development charges

NA = not available

"Quantity charge" in column (2) represents the published rate paid by residents of the city. If the rate schedule is not uniform, the rate shown here is the rate paid for an additional unit of water by a single family household with average consumption.

understandably fail to conserve water as actively as they might.

Estimates of scarcity value are sensitive to several assumptions and measurement details and are thus imprecise. However, Martin, Ingram, Laney and Griffin (1984), in a study of the Tucson, Arizona water system, estimated that scarcity should add 58% to the existing quantity charge. Moncur & Pollock (1988) calculated scarcity value for water in Honolulu at \$1.50/1000 gallons under conservative assumptions, at a time when the quantity charge was \$.84/1000 gallons.

Taken together, these inflation adjustments, omitted items and scarcity premiums call for price increases on the order of, say, 200% in some cities. Mechanical application of existing elasticity estimates would suggest that a 200% price increase will induce conservation of 40% to 60%, though several cautions apply to such an estimate. For so large a price increase, elasticity may be lower than these values suggest. Consumers likely would have no small difficulty in actually achieving a 40-60% decrease in consumption, and whatever reduction they make probably would come only gradually over a period of years. Also, regional variations would be significant. Scarcity value, for example, is positive only in certain parts of the country.

Nevertheless, the data presented here indicate that a substantial increase in water rates is often justified by real economic costs that are often partially hidden by standard accounting practice. Such a rate hike would provide each individual water consumer with a continuing and pervasive incentive to adjust his water use. The resulting conservation would stretch conventional sources of supply and forestall for many years the eventual necessity of developing desalination or other truly expensive sources.

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James E.T. Moncur is Professor of Economics and Yu-Si Fok is Professor of Civil Engineering, and both are Researchers at the University of Hawaii Water Resources Research Center, Honolulu, Hawaii.