Georgia Water Series

Issue 4: Issues in Water Pricing

Jeffrey L. Jordan
University of Georgia
Department of Agricultural & Applied Economics
Faculty Series 98-16

ISSUE 4: ISSUES IN WATER PRICING

Rates charged to public water users are generally based only on the costs of producing and distributing water and not on the resource itself. Thus, water is treated as an economically "free" commodity. Water pricing has traditionally followed standard utility pricing schemes for a firm-controllable flow commodity. In such cases, there is sequential use of units, no transfers spatially or temporally, high fixed costs with low variable costs, and usually a two-part rate structure made up of a minimum fixed charge and a use charge.

The cost of water is increasing and will continue to increase throughout the US. In the 1980s, water rates increased by more than 7% per year---double the general rate of inflation. Russell and Woodcock (1992) identified six reasons for the increase, including a nationwide growth-induced expansion of capital facilities. New treatment plants will continue to be built as will reservoirs and other water supply facilities, due to population increases. Additionally, old and deteriorating facilities are in need of replacement. Much of the current capacity throughout the US was built in the early to late 1960s with federal revenue sharing money. Those facilities are now more than thirty years old and in need of replacement. The requirements of the Safe Drinking Water Act are also placing additional burdens on local water facilities to test for more contaminants at lower and lower levels. In addition, most federal grant programs no longer exist forcing local utilities to go to the bond markets for money. Increasingly, municipal systems are switching to a self-sustaining operation. With the revolt against property taxes across the US, systems are relying less on ad valorem taxes for operation and moving to a user fee basis. Finally, with the increased demand for water, systems across the country are designing water rates to encourage conservation.

Rate Surveys

The Raftelis Environmental Consulting Group conducted a rate survey during the fall of 1997. The survey included 156 cities in forty-six states and four Canadian provinces. The average monthly water bill for 7,480 gallons was $15.70, up from $13.98 in 1996. The average sewer bill was $17.57 for residential customers using a 5/8" meter which was an increase from 1996's level of $16.97. For non-manufacturing/commercial customers using a 5/8" meter and 22,440 gallons, the monthly charge averaged $43.97. The average water bill for commercial/light industrial 2" meter customers using 374,000 gallons was $639.78 and for 8" meter industrial customers using 11,220,000 gallons, was $17,233.85. Sewer bills for the two larger meter sizes were $825.23 and $24,416.73, respectively.

The report gave a breakdown of the results for very large, medium and very small systems. The very large systems had the lowest average bill for 7,480 gallons at $14.35. Very small systems averaged $16.83 while the medium systems had the highest monthly bill of $17.28. That pattern changed for commercial/industrial users where the very small systems had the highest average monthly bill. Residential wastewater bills averaged $18.93 for all systems. Average connection charges (or tap fees) were $501 for water and $577 for wastewater, and average system development charges were $1,381 and $1,229, respectively. The systems averaged charging 42% more in water bills for outside jurisdiction customers. The survey found that 34% of the systems used a uniform

rate structure for residential customers, 35% used a declining structure, and 31% an increasing rate structure.

From the 1996 Report, Raftelis concluded that:

- Larger systems appear to have more recently enacted rate structures.
- Larger systems predominately get their water from surface sources.
- Regional differences are apparent in rate structure choices, reflecting in part supply availability.
- The variety of rate structures is growing.
- Nonresidential wastewater charges often incorporate surcharges for strength characteristics.
- Utilities are using stormwater pricing more frequently.
- There are many different connection and system development charges.
- Outside rates for customers beyond municipal boundaries are becoming more common.
- A difference exists in pricing practices between public and private systems.

In another study, the National Utility Service, Inc. surveyed water rates for industrial customers. The study found that U.S. industries enjoy water bills that have increased below the rate of inflation and are among the lowest in the world. For the period July 1994 to July 1995, industrial water prices increased an average of only 2.68%. The average U.S. monthly industrial water bill was $357.88 per month up from $348.30 in 1993/94. Water bills calculated on an average usage of 220,200 gallons per month were the third lowest among fifteen countries surveyed. Per cubic meter cost in the U.S. was $.52 while in Germany the cost was $2.05. Canada had a lowest per cubic meter price of $.38.

Pricing Trends

Over the past few years, more and more water utilities throughout the U.S. have examined the use of water rates as part of their effort to conserve water. Consequently, the use of increasing rate structures has expanded. Increasing rate structures, also called "inverted-block rates," "inclining blocks," "increasing blocks," "inverted-pyramid" rates or "conservation pricing," involve a unit charge that increases with increasing consumption (AWWA Manual M34). For each of the multiple blocks in the rate structure, the rate per unit of consumption increases. The purpose of an increasing rate structure is to give customers a monetary incentive to reduce water use. In Tampa, Florida, they are seeking a 10% reduction in water use through increasing rates due to recurrent droughts. In Boston, increasing rates are being used to finance repairs and upgrades.

In Georgia, a 1989 report showed that 87.5% of the state's systems used a declining rate structure and only 6.4% used an increasing rate structure (Ewing, 1991). In contrast, a 1992 survey (Jordan and Elnagheeb, 1993) showed that 51% of the systems used a uniform rate, 33% a declining rate, 7% and increasing rate, and 9% still used a flat or unmetered rate. By 1996, 59% used a uniform rate, 20% a declining structure, 8% used an increasing structure and 5% a flat, unmetered fee (Jordan, 1996). The use of increasing rates went from 11% to 14% between 1990 and 1992 in the Atlanta metropolitan area (Atlanta Regional Commission, 1992). In the Atlanta area, the Atlanta Regional commission is suggesting water supplier's at least switch to a uniform rate structure and the

use of seasonal surcharges. This is due to the observation that a large part of seasonal outdoor water use in Atlanta is for automatic irrigation systems (Thomas and Stevens, 1991).

Another trend is the use of alternative rate structures. These include the more common increasing rate structure for conservation but also rates for low income users (lifeline rates) and rates that address development and growth issues. One result is social rate making where water rates are used to advance social policy in the community.

Another issue in water pricing is the question of who should bear the costs of development. Impact fees are often used to shift costs to new users. Other related techniques are the use of case-by-case negotiated fees, extractions (private provisions), special assessment districts and differential user charges based on infrastructure use. In a study on the justification for impact fees, Levine notes that such charges are mostly imposed by communities where they had financed existing services through property taxes or subsidized interest rates. The result is new users pay, in advance, at private market interest rates, the full cost of capacity plus all local property taxes, and often, higher water rates than longtime users. Consequently, the new assessment of impact fees is really tax relief for existing customers. The provision of public water leads to growth, increasing the tax base to service debt incurred for not only water capacity but schools, road, recreation, and other government service. Levine notes that when existing residents are called to pay for service to benefit newcomers, they rebel, though their infrastructure was paid for the same way. Often, when impact fees are used, all social costs are incorrectly assigned to the marginal cost contributor even when many future users may be unchargeable. In fact, consumers in new subdivisions are often charged a fee more than their true marginal cost. As impact fees are more widely used, mechanisms for insuring the fees are earmarked and accounted for need to be examined. Also, the impact of such fees on growth and land use must be determined. Little research has been done to determine the "correct" impact fee or the economic efficiency or equity impacts of such fees. Another area of research must examine the objectives of impact fees. Should they be used just to finance construction? To raise the revenues that used to come from federal or state subsidies? To provide subsidies for existing users? To manage growth and local use?

Utilities are employing complicated rate structures that include special rates. In the Raftelis Environmental Consulting Group's 1996 rate survey they highlighted, innovative rate structures. The report notes that in Los Angeles they adjust a two-block seasonal increasing rate structure for lot size, temperature zone and household size. In Las Vegas, a four-block increasing structure defines the highest block as an excess-use charge. System development charges, when characterized as substantial, are phased-in to cover new demand. Johnson County, Kansas, combines a two block increasing rate with a peak demand charge. Long-term marginal costs are the basis for a three-seasonal uniform rate in Phoenix.

Reactions to Price Increases

While customers often say they want safe water at any cost, water rate increases are a highly contentious issue in any community. Reacting to rate increases, utilities seek to defer some spending

and engage in better planning. Customers often demand greater involvement in the planning and rate setting process. Large volume customers often intervene in the rate setting process through political means. Consumer groups want “fairer” or affordable rates. Simultaneously, environmental groups demand conservation efforts that can add to the price of water.

While there may be reluctance to pay higher bills, recent research shows that people are willing to pay for improved water quality, even if the improvement is not perceptible. Most people in the state of Georgia receive their water from a public water supplier -- either a city, county, or authority. While the respondents to a survey were concerned about the quality of their water, most believed that the water they received was safe. It should be noted that a substantial number of people in Georgia practice averting behavior by buying filters, bottled water, or boiling their water prior to drinking. Yet, the satisfaction level regarding the taste, odor and appearance was high. With an average statewide water bill of $23.80, the survey respondents were willing to see their costs increase on average of $10.34 in support of a strengthened SDWA.

Much of the debate regarding the 1996 reauthorization of the SDWA focused on whether the costs of the provisions were higher than water rate payers would be willing to pay. The results of this survey suggested that when asked to pay higher water bills to improve water safety -- even when that improvement is not likely to be felt by the rate payer -- people would be willing to have higher bills. In a 1993 survey on customer attitudes on water quality issues (Hurd) it was found that health and safety issues were more important than price. Far more people were willing to pay for water quality improvements than was expected by the authors. Only 6% of those surveyed mentioned price as a concern when thinking about health and safety issues.

Affordability

One of the most important issue in water pricing is affordability. Although water is priced extremely low compared with most other goods, it is an essential good. People have little choice but to use water and pay a local monopoly. Besides affordability, equity issues are part of the rate making process. Are rates fair across customer groups? Are people paying for the cost of service? Are some groups getting price breaks on the backs of others?

While the issue of affordability is important, revenue adequacy remains the number one priority of any water system. Issues of income effects and affordability must be secondary or should be addressed directly through other government social programs.

A basic issue in affordability is who to protect and at what levels? How much income protection should be supplied through the water rate making process? Affordability issues in the future will require careful planning. Consumers must be educated about why rates are set as they are, and customer feedback should be monitored.

What does rate affordability mean? The US EPA suggests that water rates that are 2% or less of median monthly household income (MHI) are affordable. In a survey of 1,600 utilities in five

states, the EPA found that water rates ranged from .1% to 3.1% of MHI with an average of .5% (Rubin). The 1998 Rafetilis report also notes that system averages in their survey are 2% of MHI for both water and wastewater charges. Thus by EPA standards, water is affordable, on average. However, as Rubin's research shows, taking a closer look at rates facing low-income customers is necessary. Between 1990 and 1992, the Ernst and Young survey indicated that water bills had increased 30% or more in twenty-one cities, ranging from 30.9% to 163%, averaging 58.2%. During the same period, Aid to Families with Dependent Children (AFDC) payments increased an average of .9%, with no increase at all in six of those cities.

Rubin found that in fifteen cities, water bills went up 60% while AFDC payments did not change. Additionally, 86% of occupied housing is connected to public water and 87% of low-income households (income below $10,000) were on public water. Rubin's study shows that 9.1 million one-parent families were paying 2.5 times as much for utilities (energy, water, sewers, phone) than for health care. Between 17% and 25% of water customers in these cities were already paying 2% or more of MHI for water with another 17% were paying between 1% and 2%. Such concerns are leading more utilities to employ life-line rates and low income discounts.

Pricing Priorities

The primary function of water pricing is the efficient allocation of existing supplies in the short-run and the provision of needed information for the optional expansion of supply capacity over time (Howe, 1993). In the short-run, with water supplies fixed, price is a valuable tool to help adjust demand to the available supply. Howe also notes two other major functions of pricing: the production of revenues for the utility and the fairness or equity among users.

In the larger economic sense, efficiency occurs when each user pays a price that reflects the marginal cost of the good. For water, that means each user must pay the cost of replacing the water used. This implies that prices must be set at current replacement costs, not average historic costs. This type of pricing leads to the use of seasonal and peak pricing. The idea is to promote patterns of water uses that reduce the total costs of meeting overall needs (Boland). Water pricing affects water demand: underpricing induces over consumption and waste and consequently higher supply costs and inefficiencies.

Since a water utility operates as a natural monopoly, supply and demand forces do not determine prices as set in the market. Yet, prices set by a utility must perform the same function: motivate capital attraction, provide efficiency, and control demand. They must also be set to meet cash reserve and debt coverage needs within any bond covenant.

When setting rates, a utility must determine the objectives it wishes to fulfill. Of the many priorities that can be met with rate making, the number one priority remains revenue adequacy. It is the job of water rates to produce the required revenues to meet the water needs of the community. The only way to achieve this goal is through the full-cost pricing of water. Another priority is revenue stability. To run a water utility, revenues must be predictable. Wide swings up and down

prevent adequate planning. Minimum charges should be used to guard against unexpected fluctuations in demand.

Although a trend in rate making has been for more complicated rate structures, the customers ease of understanding remains important. Rates can and should be used to produce incentives for people to act in accordance with the goals of the utility. Customers must understand the rate structure and the incentives sought to achieve the utility's goals. Not only should rates be easily understandable, they should be easily developed. With nearly 90% of all utilities serving less than 3,300 people, the ability to develop a complicated rate structure is limited. The types of data needed to develop complicated structures means that most utilities are unable to do so.

Moreover, conservation has become an issue involved in pricing. Rates can be used to encourage water conservation through increasing rate structures or through seasonal rates that deal with peak demand in the summer months. Equality, affordability, and legal constraints facing regulated utilities, are also pricing considerations. Some of the above issues are complementary. Some are not. Each utility must set its own priorities before designing a rate structure.

Rate Making

The essence of the rate making problem is the replacement of the market system with government order as the principal institutional device for assuring good performance. Whether a government entity runs the water utility or they regulate a private utility, government replaces the two prime requirements of competition--freedom of entry of new firms and independence of action. In this case the government determines the price of water, the quality and conditions of service and imposes the obligation to serve all customers. The rates set have to provide the water supplier with the incentives that competition and profit maximization ordinarily provide. The incentives include controlling costs, finding ways to provide better service, and operating at the least cost. In much of the U.S., public utility commissions regulate the rate of return allowed by water systems on their rate base. Table 1 shows 31 rate of return decisions since 1991. The average rate of return was 9.84%, ranging from 5.57% to 14%.

Determining the Rate Level: Like the general price level in the economy, the rate level for a water utility is a statistical abstraction expressed as an index of the individual rates for various classifications of service. What remains to be determined is the generation of total revenue. Unfortunately, regulators often do this in reverse, by deciding what total revenues the supplier is entitled to take in, and then adjusting the rate levels to get the predetermined total revenue. To do this, it is necessary to know the total cost of providing water service, so a discussion of rate making begins with the supervision and control of operating costs and capital outlays.

Determining which costs to authorize, which to charge to operating expense, and which to capitalize in the form of annual allowances for depreciation and return on investment is the regulators first task. To be able to attract capital and to borrow for improvements, water operators must have

returns on investment. As with setting a discount rate in benefit/cost analysis, determining the proper rate of return combines social and political issues with economic concerns.

The major traditional issues in pricing are that of measuring the minimum cost and pricing as if competition existed. The elusiveness of proper economic standards for determining the rate of return contributes to making water pricing difficult. Regarding setting rate structures, rates should be set so that they are not "unduly discriminatory." Differences in rate charges to various customers or classes of customers should be "just and reasonable." Microeconomics, by contrast, is interested in the determination of individual prices. Economic theory can give water rate makers some guidance on how to set prices. The rules of microeconomics are simple: prices should be equated to marginal costs.

Table 1. Selected Rate of Return on Rate Base for Water Utilities

Agency	Utility	Date	Rate (%)
Alaska PUC	College Utilities	02/08/93	12.01
Arizona CC	Paradise Vallet Water	05/05/95	5.57
Arkansas PSC	Shumaker	03/14/94	10.14
California PUC	California Water Svc.	08/04/93	
Connecticut DPUC	Connecticut Water	03/27/91	10.74
Delaware PSC	Wilmington Suburban	10/19/93	10.90
Florida PSC	Southern States Util.	03/22/93	10.67
Idaho PUC	Boise Water Corp.	07/14/94	9.51
Illinois CC	W. Illinois Water	12/08/93	9.72
Indiana URC	Indiana Cities Water	09/29/93	8.40
Kentucky PSC	Kentucky-American	11/19/93	9.27
Maine PUC	Consumers Maine	06/01/95	10.08
Maryland PSC	Carpenters Point	05/94	9.37
Massachusetts DPU	Ashmere Water Service	02/07/94	10.00
Michigan PSC	Harvest Hills Corp.	02/08/93	9.00
Missouri PSC	Raytown Water Co.	09/20/92	11.25
Montana PSC	Mountain Water	04/24/95	10.18
Nebraska PSC	Lakeland Estates	04/04/95	10.23
Nevada PSC	Sierra Pacific-Water	06/07/93	7.87
New Hampshire PUC	Pennichuck Water	11/02/93	8.81
New Jersey BPU	Elizabethtown Water	03/18/93	9.93
New Mexico PUC	Mesa Development	07/18/94	10.54
New York PSC	Long Island Water	04/20/94	9.22
North Carolina UC	Heater Utilities	08/18/93	9.19
Ohio PUC	Ohio-American Water	09/02/93	10.20
Oklahoma CC	Frontier Shores Water	04/28/94	14.00
Oregon PUC	South Hills	04/01/93	10.00
Virginia SCC	Virginia-American	06/27/94	9.36
Washington UTC	Solmar Water System	12/30/92	10.61
West Virginia PSC	WV-American Water	12/22/94	9.20
Wisconsin PSC	WP&L	09/30/93	9.24

Source: National Association of Regulating Utility Commissioners. 1995. *Utility Regulatory Policy in the U.S. and Canada: Compilation 1994-95.*

Marginal Cost Pricing

In trying to be "just and reasonable" the benchmark for rate levels is the cost of production including the necessary return on capital. This implies that rates may differ if costs differ. Since the

beginning of regulation, price discrimination has been practiced. Price discrimination occurs when customers are charged different rates for various services even when costs do not differ. In the water industry, however, charging different customers different prices is normally associated with varying costs of service to different customers. As the AWWA manual on water rates (MI) notes, rate schedules should reflect the cost of providing water service. Thus, " a sound analysis of the adequacy of charges requires allocation of costs among the customers commensurate with their service requirements in order to recognize differences in costs of furnishing service to different types of customers." (page 9). Peaking factors, for example, of different customer classes may require different costs of service. Thus a utility is justified in charging different prices to residential and commercial, industrial and agricultural users.

The central policy prescription of microeconomics is the equation of price and marginal cost. Marginal cost is the cost of producing one more unit, or the added cost of incremental output. At any given time, the economy has a fixed bundle of resources so the basic economic problem is choice. If a firm produces one thing, it foregoes producing something else. The cost to society of producing anything is the good that must be sacrificed -- or the opportunity cost. If people are to make the best choice, prices must accurately reflect opportunity costs. So the price the consumer has to pay must reflect the cost of supplying more of the good: the marginal opportunity cost.

If a buyer is charged more than the marginal cost, they will buy less than the optimum quantity. With the price higher than the marginal cost, the opportunity cost is exaggerated. Buyers would have society allocate its productive resources to more water related goods and less of others. If the price charged for water is below the marginal cost, production will be higher (and all other products lower) than it ought to be. Society then would sacrifice other goods because the price of water does not reflect the true marginal cost. To allocate resources effectively marginal costs must include *all* of the cost of production to society.

Using Marginal Cost Pricing

For a water utility to use marginal cost pricing they must first specify the time perspective. In the short run fixed costs are irrelevant. The only costs relevant to deciding how much to produce are the variable costs of operating the water plant with equipment already installed. Yet, as time increases the perspective also increases. More costs become variable, as for instance, new plants and equipment. In the long-run, even capital costs are variable costs. The intermediate-run includes the costs of repairs, maintenance and operation.

If a utility is operating below capacity then marginal cost is the incremental cost of producing more water for new customers within the existing capacity. Then, marginal cost is practically zero and represents short-run marginal cost. If new capacity is required to meet new customer needs, then long-run marginal costs involve the building of new capacity plus the added operating costs. Consequently, calculating marginal cost involves forecasting capacity needs and operating costs over time dependent on demand estimates (Raftelis, 1993).

If some marginal cost approach is not used in water pricing, three major distortions occur:

1. The use of actual historical cost data rather than current replacement cost.
2. Failure to incorporate the economic cost of some assets in the rate base. While operating costs are often accounted for, capital costs are accumulations of yearly value. Thus, capital depreciation must be included in the rate making process. At the very least, rates need to account for capital replacement costs in current dollars.
3. There is usually a failure to include a scarcity premium reflecting the value of water itself (Moncur and Fok).

Economic Principles

Two basic economic principles should guide water pricing:

1. All purchasers of water should bear such additional costs, *only* such costs, but also *all* such costs, as are imposed on the economy by the provision of the additional unit of water.
2. Short-run marginal cost should always be used at any given time since it reflects the social opportunity cost of providing additional units at the time of the buying decision.

The first principle states that all costs of producing water should be included regardless of when they are incurred. The second principle implies that only short run costs are relevant. However, variable costs should include any reduction of future value or any future higher costs due to present consumption. The price of water must cover all costs that reflect the marginal cost to society of providing the service. To the extent that maintenance, depreciation, and the cost of capital are related to use, they belong in the marginal cost. If they are related only to time, they do not belong in marginal cost pricing. It is with higher future costs or the decline in future values and not fixed or sunk costs that marginal production is concerned. It is only the future, and not the past, that costs will be saved if the production is not undertaken.

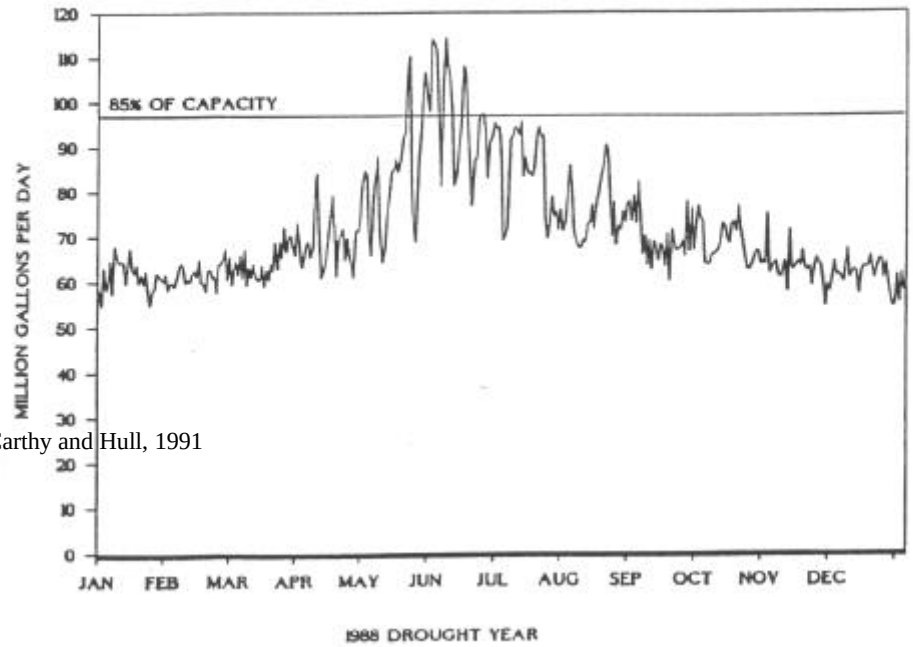
Specifying the Incremental Block of Output

Water suppliers can find the cost of one additional user up to some point. This is usually just the variable cost, which is practically zero. At some point there is a need to build a new plant to sell to not just the one new customer - but for example, 10,000 new customers. The marginal cost difference between any two customers would be zero, but the marginal cost of adding new capacity is not zero. Once a plant is built, the incremental cost of taking on a customer is practically zero.

This had led to the use of average cost pricing and the problem of identifying marginal costs when most costs are common. While the marginal cost of any new water customer may be zero, the large lump of common costs to build water systems are not incurred on a customer-by-customer basis. The unit of production (the water plant) which is the basis of cost incurrence, is larger than the unit of sale (the individuals water use). While marginal cost of a new customer is zero, the cost of the water plant per customer is far from zero.

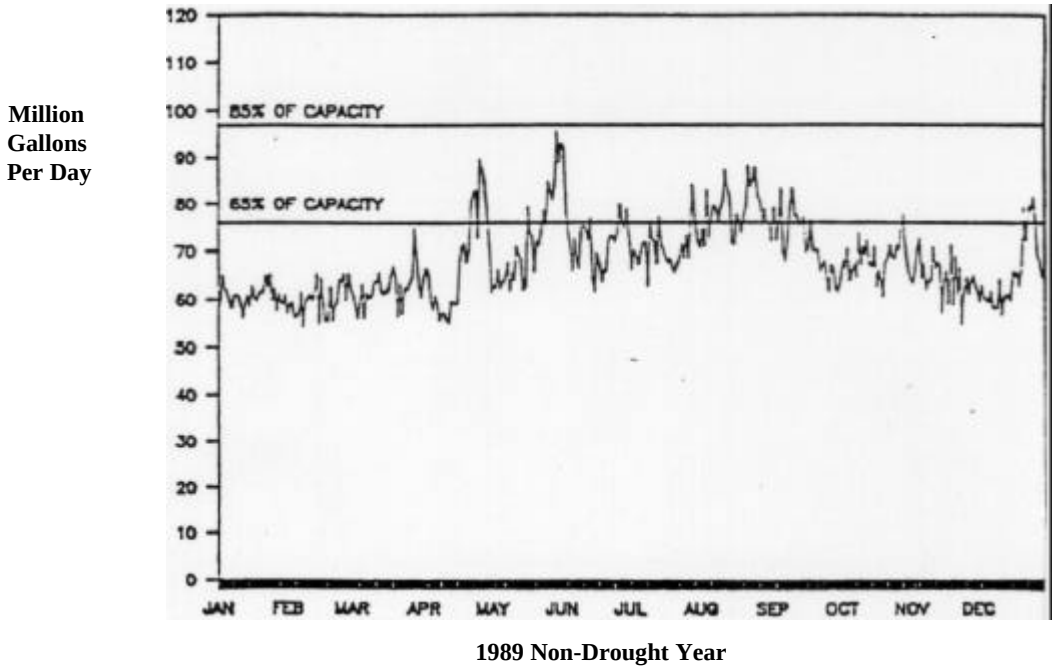
In the water industry an achievable version of short-run marginal cost pricing is "full cost" pricing that includes ways to charge customers for peak demand periods. Figure 1 shows the problem facing utilities in peak water pricing. During the 1988 drought year, one of the worst in the U.S. South, daily demand in Cobb County, Georgia was more than 85% of plant capacity for fourteen days. During the next year, (figure 2) daily demand never reached the 85% capacity level. Yet, utilities have to build that last 15% of capacity, though the normal daily demand is between 50% and 60%. It has been calculated that the true cost of using the top 15% of peak demand for only a few days during drought years is twenty-two times the base rate.

Figure 1. Peak Daily Demand During Drought Year



Source: McCarthy and Hull, 1991

Figure 2. Peak Daily Demand During Non-Drought Year



Source: McCarthy and Hull, 1991

Which Price?

If prices are to be an effective tool for water managers, consumers must understand and respond to price signals. The question is, which price is the one that consumers use to judge how much water to buy?

Economic theory is clear that marginal price should be used since consumers, in achieving equilibrium, equate benefits with the cost at the margin (Taylor). The marginal price is the price for another unit. If a person goes to a store to buy a product, the marginal price is clear. For water, what is the marginal price and do consumers have the information to determine the price at the margin? Usually, the block in the rate structure where the consumer is observed represents the marginal price (Howe, 1982). For example, in a rate structure that charges $1.50 per thousand for the first 3,000 gallons and $2.00 per thousand for use between 3,000 and 10,000 gallons, the marginal price for a customer using 8,000 gallons is $2.00. However, studies have shown that people are not aware of the marginal price of water (Nieswiadomy and Molina).

While many studies say marginal price should be used when block prices exit, Foster and Beattie (1981) believe that the perfect-knowledge postulate implicit in marginal price models does not apply to water. They believe that average price is the motivating price for consumer response. Foster and Beattie conclude that, given billing procedures and the high cost for consumers to gain and act on information about the actual water rates, the use of marginal price models does not reflect consumer

actions. Few people would gather information necessary to apply a marginal cost decision model.

As shown in table 2, the way economists think of most goods does not apply to water. When a person goes to a store to buy a good, the choice is discrete --- do they buy another unit or not? Consumers know the marginal price since it is the price marked, as is the average price. The consumer can decide to buy one, or ten or any known amount and they make payment before use. For water, a consumer does not buy in discrete units like gallons, but in bulk. The consumer does not know the marginal price for every use of water or the amount used at any one time. Finally, water bills come after use. Consumers cannot adjust the quantity demanded at discrete block boundaries. Knowing consumption during the billing period is difficult since a consumer cannot easily check the meter.

Table 2. Water vs. Other Goods Price Decisions.

Other goods	Water
Discrete choice	Bulk Buying
Known marginal price	Do not know marginal price
Known average price	Do not know average price
Known amount purchased	Do not know amount price
Pay before use	Pay after use

Further, water bills often do not carry information needed to make decisions. They also often convey so much unrelated information that sorting it out is difficult. In a survey in Tulsa (Agthe, et al, 1988) a lack of rate structure knowledge was evident. Only 21% of those surveyed were aware that there was a block rate structure at all. To get information on blocks, consumers had to contact the utility. It was found that the complexity of the structure confused customers and prevented information acquisition. Often, the complexity of the bill itself is a hindrance to information collection. Figure 3 shows an actual water bill for a local utility. They show water charges along with wastewater, electric, fuel cost adjustments, garbage disposal and collection and other charges. They show the recipient of this bill that water consumption for March to April 1996 was 61, with average consumption 2.033. What is a consumer to think about these figures? Did they consume 61 gallons, or 6,100 as the bill is supposed to convey? What is the marginal price charged for the last unit consumed? While units for each charge are shown on the back of the bill, their usefulness to consumers is questionable. On the other end of the spectrum, Figure 4 shows a water utility bill with little information. Here, it is shown that 7,700 gallons were consumed but information on rates, structures, or charges is lacking. In a 1992 survey in Georgia, 400 people were asked if they knew how much they paid for water in an average month. Of those, 62% knew their water bill and provided an answer that, when checked, approximated their true water bills. Another 26% did not know their bills because they included it in rent. Only 12% had no idea of their water bill. When the same people were asked if they knew their water rate, only twelve people answered yes and of those, eight were wrong.

Figure 3. Example of a Local Water Utility Bill

SERVICE LOCATION

815 BIEZE ST GRIFFIN GA 30223

DETACH HERE

ACCOUNT NUMBER	PAYMENT DUE DATE	DATE METER READ PRESENT	DATE METER READ PREVIOUS
235403	05-17-96	04/18/96	03/19/96

RETAIN THIS PORTION FOR YOUR RECORDS

TYPE OF SERVICE	METER READINGS PRESENT	METER READINGS PREVIOUS	CONSUMPTION	AMOUNT
PREVIOUS BILL AMT				$ 81.26
WATER	3235	3174	61	10.54
WASTEWATER				12.67
ELECTRIC	6892	6460	432	33.71
FUEL COST ADJ 0.015894				6.87
GARBAGE DISPOSAL				4.12
GARBAGE COLLECTION				11.00
LATE PAYMENT PENALTY				7.88
PAYMENT 04/24/96				89.14-
		ELECTRIC SALES TAX		2.43
		TOTAL AMOUNT DUE		$ 81.34
		AFTER DUE DATE		$ 89.23

AVERAGE DAILY CONSUMPTION: ELECTRIC 14.400 WATER 2.033

NUMBER OF DAYS IN BILLING PERIOD: CURRENT 30 PREVIOUS 32

LAST PAYMENT: DATE 04/24/96 AMOUNT 89.14-

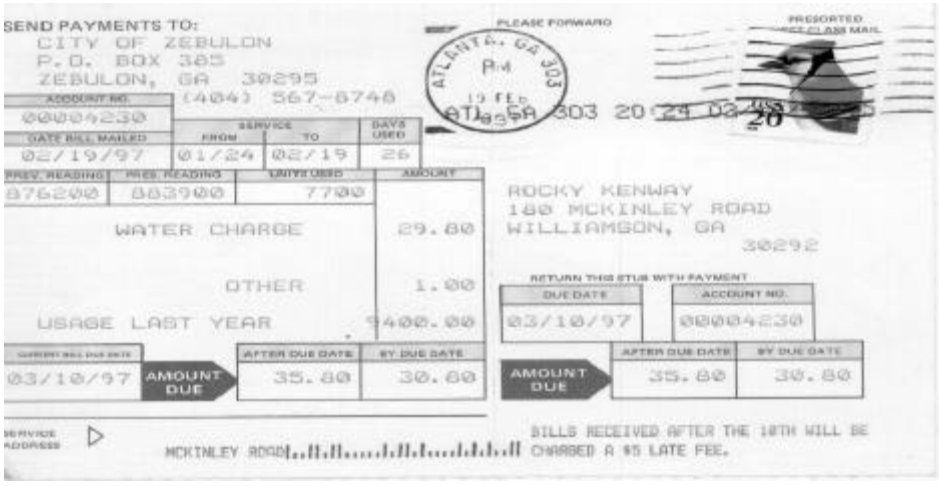
DEGREE DAYS THIS PERIOD: HEATING COOLING

IT'S THE LAW - CALL BEFORE YOU DIG 1-800-282-7411

COMMENTS:
APRIL IS NATIONAL KEEP AMERICA BEAUTIFUL MONTH. RECYCLING DAY AND PROJECT CLEAN SWEEP WILL TAKE PLACE ON APRIL 20TH. RECYCLING DAY ALLOWS YOU TO RECYCLE HOUSEHOLD ITEMS ALONG WITH TIRES AND BATTERIES. PROJECT CLEAN SWEEP IS AN EFFORT TO CLEAN UP, REMOVE LITTER AND BEAUTIFY THE COMMUNITY. FOR ADDITIONAL INFORMATION CALL WADE HUTCHESON AT 228-9900.

(SEE REVERSE SIDE FOR CUSTOMER INFORMATION)

Figure 4. Example of a Local Water Utility Bill



SEND PAYMENTS TO:
CITY OF ZEBULON
P.O. BOX 385
ZEBULON, GA 30295
(404) 567-8748

PLEASE FORWARD

PRESORTED

ACCOUNT NO.	DATE BILL MAILED	SERVICE FROM	SERVICE TO	DAYS USED
00004230	02/19/97	01/24	02/19	26

PREV. READING	PRES. READING	UNITS USED	AMOUNT
876200	883900	7700	
WATER CHARGE			29.80
OTHER			1.00
USAGE LAST YEAR			9400.00

CURRENT BILL DUE DATE		AFTER DUE DATE	BY DUE DATE
03/10/97	AMOUNT DUE	35.80	30.80

ROCKY KENWAY
180 MCKINLEY ROAD
WILLIAMSON, GA
30292

RETURN THIS STUB WITH PAYMENT

DUE DATE	ACCOUNT NO.
03/10/97	00004230

	AFTER DUE DATE	BY DUE DATE
AMOUNT DUE	35.80	30.80

SERVICE ADDRESS MCKINLEY ROAD

BILLS RECEIVED AFTER THE 10TH WILL BE CHARGED A $5 LATE FEE.

While what works in models does affect economic research, consumers clearly do not make water decisions based on marginal price, average price or some price differential. The only information consumers have is their total water bill, usually lagged one month. When an unusually high water bill arrives compared to last months use, a consumer is likely to cut back in the current month but cannot affect the previous use.

Peak Pricing

While customer billing records may have problems with consistency, most water utilities have good production records. Not only are systems required to submit such records to regulators, a utility usually has a meter that tracks continuous flow of finished water to the distribution system. Consequently, it is possible to monitor peak day, hour, week, and month water use.

Griffin and Chang found strong evidence that peak load pricing will evoke a substantial consumer response. Lyman found peak period price elasticity is more than twice the off-peak elasticity. They estimated peak elasticity of about -1.35 compared with an inelastic off-peak elasticity of -.44. Thus, peak prices are more elastic than nonpeak. Lyman also found cross-price effects between peak and off-peak periods. This effect was similar to an income effect where peak charges affect water use in the nonpeak period. For example, peak charges could cause people to buy water efficient durable goods like dishwashers or washing machines that cut off-peak water use. With all else constant, Lyman found that the long-run effect of a variable influencing demand will be 24.5% greater in the peak vs. off-peak period. So appropriate seasonal prices will affect demand, especially peak demand. Lyman concluded that although the literature on conservation pricing focuses on block price schemes, utilities may find it better to consider peak and off-peak effects. Such a suggestion conforms with the idea of marginal cost pricing favored by economists.

Seasonal Elasticity

Seasonal pricing, a form of peak pricing, is also an effective method of using marginal cost to price water. Weber (1993) states that for residential water consumption, seasonal patterns can explain 80% of the variation. Griffin and Chang found that summer residential demands is more price responsive than winter demand. Consequently, price can be a more effective allocative tool in the summer than winter. Thus, when estimating demand functions for a utility, it is important to know seasonal rather than annual demand. The authors found both winter and annual demand to be consistent but summer demand highly variable. Rather than emphasizing the entire demand function, analysts should examine monthly water demand elasticities, which are higher in the summer. Summer price sensitivity can be as great as 30% more than winter price responses.

Weber (1993) notes that seasonal rates can then be implemented to both recover incremental costs of seasonal peak water service and as an inducement to conservation. Weber found summer price elasticity to be between -.2 and -.5 compared with a winter range of -.05 to -.2. Overall, winter and indoor elasticities are very inelastic while outdoor and summer price responses are more elastic, again arguing for seasonal rates.

Seasonality has effects on water demand beyond just pricing. The literature on weather elasticities shows that maximum daily temperatures have an elasticity ranging from .5 to 1.5. The elasticity for rainfall has been estimated to range from -.01 to -.07. Thus, a 10% increase in maximum daily temperature would increase water demand from 5% to 15%, while a 10% decrease in rainfall would increase water demand 1% to 7%. Weber (1993) found deviations of temperature variables have an elasticity between .35 to .55 and for rain, between -.1 and -.2. So if temperatures are 10% above normal a 3.5% to 5.5% increase in water consumption would result, while a 10% increase in rain would cause a 1% to 2% decrease in consumption.

References

Agthe, D. E., B. Billings, and J. M. Dworkin. 1988. Effects of Rate Structure Knowledge on Household Water Use. *Water Resources Bulletin*. 24(3):627-630.

American Water Works Association, 1991. *Water Rates: AWWA Manual M1*. Denver, CO, 81 pp.

American Water Works Association, 1992. *Alternative Rates: AWWA Manual M34*. Denver, CO, 76 pp.

Atlanta Regional Commission, 1992. *Atlanta Region Water and Wastewater Rate Survey*. Atlanta, Georgia, 31 pp.

Boland, J. J. 1993. Pricing Urban Water: Principles and Compromises. *Water Resources Update.* 92:7-10.

Ernst and Young, 1992. *1992 Water and Wastewater Rate Survey*. 45 pp.

Ewing, J. M., 1991. Responsible Policy-Making Leads to Realistic Water/Sewer Rates in Georgia. *In: Proceedings of the 1991 Georgia Water Resources Conference.* University of Georgia, Athens, pp. 83-86.

Foster, H. S. and B. R. Beattie. 1979. Urban Residential Demand for Water in the U.S. *Land Economics*. 55(1):43-58.

Foster, H. S. and B. R. Beattie. 1981. On the Specification of Price in Studies of Consumer Demand Under Block Price Scheduling. *Land Economics* 57(4):624-629.

Griffin, R. C. and C. Chang. 1991. Seasonality in Community Water Demand. *Western J. Ag. Econ.* 16(2):207-217.

Howe, C. W. 1993. Water Pricing: An Overview. *Water Resources Update.* 92:3-6.

Howe, C. W. 1982. The Impact of Price on Residential Water Demand: Some New Insights. *Water Resources Research*. 18(4):713-716.

Hurd, R. E. 1993. *Consumer Attitude Survey on Water Quality Issues.* Denver, CO: AWWA Research Foundation.

Jordan, J. L. 1996. 1994/95 Georgia Water Rates Survey. *Department of Agricultural Economics Faculty Series 96-12.*, University of Georgia.

Jordan, J. L and A. H. Elnagheeb. 1993. Water Pricing in Georgia. *In: Proceedings of the 1993 Georgia Water Resources Conference*, University of Georgia, Athens, Georgia, pp. 153-156.

Levine, J. C. 1994. Equity in Infrastructure Finance: When are Impact Fees Justified? *Land Economics*. 70(2):210-22.

Lyman, R. A. 1992. Peak and Off-Peak Residential Water Demand. *Water Resources Research*. 28(9):2159-2167.

McCarthy, F. and A. Hull. 1991. A Water Authority's Conservation Program - It's Role with the Georgia Water Wise Council. *In: Proceedings of the 1991 Georgia Water Resources Conference*. University of Georgia, p. 97-99.

Moncur, J. E. T. and Y-S Fok. 1993. Water Pricing and Cost Data: Getting the Right Numbers. *Water Resources Update*. 92:35-37

Nieswiadomy, M. L. and D. J. Molina. 1991. A Note on Price Perception in Water Demand Models. *Land Economics*. 67(3):352-359.

Raftelis, G. 1996. *1996 Water and Wastewater Rate Survey.* Raftelis Environmental Consulting Group. Charlotte, NC.

Raftelis, G. 1998. *1998 Water and Wastewater Rate Survey.* Raftelis Environmental Consulting Group. Charlotte, NC.

Raftelis, G. A. 1993. Water and Wastewater Pricing Process. *In Comprehensive Guide to Water and Wastewater Finance and Pricing* (2nd ed.). Chelsea, MI: Lewis Publishers. p. 129-137.

Rubin, S. J. 1994. Are Water Rates Becoming Unaffordable? *J. Am. Water Works Assoc.* (Feb):79-86.

Russell, D. F. and C. P. N. Woodcock. 1992. What Will Water Rates be Like in the 1990s? *J. Am. Water Works Assoc.* p. 68-72.

Taylor, L. D. 1975. The Demand for Electricity: A Survey. *Bell J. of Econ.* 6:74-110.

Thomas, P. M. and P. A. Stevens, 1991. Water Rate Setting Policy for Water Conservation and Peak Load Management. *In: Proceedings of 1991 Georgia Water Resources Conference*, University of Georgia, Athens, Georgia, pp. 93-96.

Weber, J. J. 1993. Integrating Conservation Targets into Water Demand Projects. *J. Am. Water Works Assoc.* (Aug):63-70.

D:\document\jordan\FacultySeries98-16.wpd