

# ECONOMIC INSTRUMENTS TO MITIGATE WATER SCARCITY

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## ABSTRACT

Wholesale prices and retail rate design are the key economic instruments for achieving economically efficient allocation of water. Economically efficient allocation also requires consideration of environmental externalities, natural monopoly, public goods, subsidies for water conveyance systems, and legally valid interests protected by public trust. This book presents the nexus between advances in economic analysis and application of that analysis to water markets and retail rate design. The applications are the basis for recent policy and financial decisions.

## INTRODUCTION

Increasing scarcity of water is a fundamental fact in the southwest United States. Increasing scarcity, to an economist, means that the opportunity costs are rising. *Opportunity cost* means "the sum of sacrifices [direct and indirect] made to obtain a unit of the resource" (Fisher 1981). Put another way, the present allocation among uses imposes costs on current and future potential users.



Wholesale and retail water prices are the primary economic instruments for allocating scarce water. For prices to allocate with efficiency, they must reflect all the opportunity costs, and equal the marginal opportunity cost. Because of the many subsidies, externalities, public goods, and multiple uses of water and water-related investments, the opportunity cost of water is substantially greater than the annual costs of water delivery. Virtually every textbook source of market failure occurs for water. Prices based on the cost of water delivery systems are not economically efficient. Achieving efficient wholesale and retail water prices requires institutional adjuncts to unregulated markets to mitigate the inefficiencies of market failure.

Economists rightly point to the efficiency of markets in allocating scarce resources. Prices moderate demand and provide incentives to invest in additional supply. To allocate water efficiently, the price must equal the marginal opportunity cost. Where water is scarce, marginal cost is greater than historical average cost, and the differential is greater where there are subsidies. A switch from traditional rate designs to marginal cost rates will shift wealth from large water users to small water users. Political pressure resists shifting wealth from those with political clout.

To the extent that prices diverge from marginal cost and to the extent that rigid wholesale water markets retain price differences substantially greater than water conveyance costs, there will be opportunities for gains from increased economic efficiency. In Chapter 9, Dinar, Sunding, and Zilberman develop a new model and estimate the impact on agriculture of reductions in water allocation to agriculture with and without water markets. They show substantial gains from markets. The gains can be substantial enough that the cost of political transformation is overcome. This book highlights modest initial successes with emerging wholesale water markets and with retail water rate design based upon marginal cost.

The material in this book is at the nexus of analytical technique and the political economy of water. The analytical techniques presented in these chapters are at the cutting edge of economic analysis. The applications of economic analysis in these chapters were the basis for legal, political, and financial decisions valued today in billions of dollars.

In the second section of this chapter, the reasons are given why unregulated wholesale water markets will not become the institution for water transfers. The second section also develops issues particular to water that require resolution for water transfer institutions to achieve economic efficiency. The third section describes analytical improvements in urban water demand forecasting, supply planning, and marginal cost calculations. The third section also summarizes the political economy of marginal cost rate design. The fourth section raises boundary issues that connect wholesale water markets and retail rate design.

## EXTERNALITIES AND ENVIRONMENTAL BENEFITS AND COSTS

Institutions have changed in recognition of environmental resource scarcity. Water diversions, transport, storage, and use adversely impact many ecosystems. In Chapter 2, Wegge, Hanemann, and Loomis summarize an economic analysis that was used to incorporate environmental values in the decision by the California State Water Resources Control Board; the board reallocated water reducing the amount taken by the City of Los Angeles to protect the Mono Lake ecosystem. In Chapter 3, Dziegielewski presents a demand forecast model with the capability of analyzing environmentally benign demand-side management programs. In Chapter 4, Rodrigo, Blair, and Thomas include a description of the process for obtaining public input in the supply planning process for the Metropolitan Water District of Southern California. In Chapter 5, Hall evaluates which environmental costs should be included and which should be excluded to correctly calculate marginal cost. In Chapter 6, Hall and Hanemann document the role of water reallocation for environmental goals in the process of redesigning water rates for the City of Los Angeles. In Chapter 9, Dinar, Sunding, and Zilberman evaluate the impact of transferring water away from agriculture to restore water quality and fisheries in response to passage by Congress of the Central Valley Project Improvement Act. In Chapter 10, Miller describes the evolution of water banks in western states as a response to the longest drought in history caused by the shift in ocean currents called El Niño. In Chapter 11, Colby compares water transfers in western states, with particular attention to the relationship between externalities and transactions costs.

### Unregulated Wholesale Water Markets

In Chapter 9, Dinar, Sunding, and Zilberman explain that federal legislation reallocated water from agriculture to protect the San Francisco Bay Delta water quality; protect endangered species, and partially restore the salmon fishery. Farmers accuse environmentalists of stealing "their" water. Fishermen and environmentalists accuse farmers of stealing the water to begin with. Some economists argue that the Coase theorem is applicable: "It doesn't matter whether the water rights are given to fishermen, environmentalists or farmers. Once water rights are secure, let those who want water buy it from those to whom it is given, and the market will allocate the water efficiently." The argument has three basic flaws, each of which is fatal.

The first flaw is that the rights will not be secure. The government that gives water to one group, say farmers, takes it away from another. The lesson learned by everyone is that it pays to capture the political process. Economists who advocate giving the water away have, by their advocacy, made property rights less secure. In Chapter 10, Miller provides an example of inefficient water transfers in Idaho, inefficient partly because of insecure water rights.

The corollary to an unregulated water market is to give the water delivery system to those who paid the interest on the revenue bonds that were issued to build the system. The problem is that the general taxpayer will object because of the subsidies. These subsidies give the general taxpayer a claim to ownership of the system.

Government-owned water monopolies pay no federal or state income tax. They pay no property tax. They collect no sales tax. They issue bonds at lower interest rates because bond holders pay no income tax on interest payments. They build power plants with all of the above subsidies and sell the subsidized power to investor owned utilities at prices that reflect the private market costs and pocket the difference to further subsidize the cost of water delivery. They buy electricity to pump water at night during the off-peak when power is cheap, and sell daytime electricity they generate during the peak period at the highest peak period prices. In the case of the California State Water Project (SWP), the initial funds for the project came from tideland oil sold by the state. The general taxpayer pays portions of the cost of the California Department of Water Resources, which staffs and operates the SWP. Portions of the cost of building dams are also charged to the general taxpayer because the reservoirs provide recreation and the dams provide flood control.

The second flaw is that the water delivery system is a natural monopoly. If privatized and left unregulated, the water delivery utility would strive to vertically integrate and gain ownership of all water sources. If not permitted to own water sources, the utility would be a monopsony buyer of water and a monopoly seller. The remaining choices are either a regulated monopoly/monopsony or government ownership; both choices have rent-seeking behavior and incentives for behaviors that do not minimize cost or maximize efficiency.

The third flaw is that an unregulated water market would not allocate water efficiently for reasons discussed next.

#### Externalities, Public Goods and Multiple Uses

In Chapter 11, Colby describes numerous externalities, public goods, and multiple uses that require consideration for efficient water transfers. In Chapter 10, Miller explains how third-party impacts are taken into account in water transfers through California's water bank. Conjunctive use of ground and surface water, common pool externalities of groundwater, water runoff, and percolation by water consumers are some of the externalities. Public goods and multiple uses include fisheries, navigation, flood control, white and flat water recreation, and wildlife habitat. The economic value of these goods and uses is not trivial. Water transfers, which have both external costs and external benefits, can both interfere with and enhance public goods. Colby develops the relationship between transactions costs and institutions that incorporate economic values of public goods and externalities for water transfers.

## DEMAND FORECASTING, SUPPLY PLANNING, AND RATE DESIGN

In private markets, prices perform three functions. Prices moderate demand. Prices cause suppliers to alter inventory and short-run rates of production. Prices provide incentives for investments to increase productive capacity. Regulated utilities, on the other hand, are granted monopolies in exchange for accepting the obligation to serve and submitting to price regulation. For both regulated monopolies and government-owned monopolies, rates are designed to recoup costs, not to equate demand and supply. Supply planning and investment are instead based upon a reliability target to meet the obligation to serve. Demand forecasting may not even include prices as an explanatory variable.

In Chapter 3, Dziegielewski presents IWR-MAIN, the most advanced model available for long-term forecasting of urban water demand. His model includes water rates and is designed to evaluate the impact of demand-side management programs that water utilities include in integrated resource planning. Among others, the Metropolitan Water District of Southern California (MWD) uses a special version of IWR-MAIN. In Chapter 4, Rodrigo, Blair, and Thomas present the most advanced approach to integrated resource planning now in use by any urban water agency. Their analysis is the basis for MWD's multi-billion dollar supply plan. These advances in demand forecasting and supply planning are the basis for future improvements to methods for calculating marginal cost.

In Chapter 5, Hall synthesizes the literature on marginal cost calculations with an application to the City of Los Angeles. The numerical example is the basis for the water rates now in effect for the Los Angeles Department of Water and Power (DWP). In Chapter 6, Hall and Hanemann present the multiple objectives of marginal cost rate design to achieve economic efficiency and political acceptability. They describe the process that resulted in marginal cost rates for Los Angeles. Russell and Shin summarize principles of public utility pricing and marginal cost calculations from the existing literature in Chapter 7. They present an application, in Chapter 8, to the City of Tucson. Tucson is an interesting example as the first city to implement marginal cost pricing (in the 1970s) and to have a city council voted out of office the following year because of marginal cost water rates.

## BOUNDARY ISSUES

Significant to the outcome of the marginal cost calculation is the boundary circumscribing additional facilities that supply water. Because DWP buys water from the MWD, DWP rate design could reasonably be based either upon the marginal cost to DWP or upon the marginal cost to the MWD. With a small desalination plant under construction, this could be the basis for calculating the marginal cost of water to MWD. The main reason for not basing the long-run marginal cost on the decisions of the wholesaler is finding their supply plan to be economically

sub-optimal, taking into account external as well as private costs. Desalination easily costs \$1,000/AF, not including the cost of air pollution caused by the generation of electricity. In the Los Angeles airshed, the cost of air pollution is substantial. Some prices paid in the southern San Joaquin Valley are as low as \$10/AF. The cost of pumping water over the Tehachapi Mountains is considerably lower than the difference of \$990/AF. Even within the MWD service territory, municipal water agencies have rates as low as \$20/AF. In the near term, the MWD has more cost effective options to pursue than desalination, but the political risks are difficult to assess.

Geophysical, political, and economic uncertainty make supply planning a strategic decision rather than an exercise in cost minimization. Considerable economic and political uncertainty over water availability exists, as well as the impact of environmental constraints. As presented in Chapter 2, in the Eastern Sierra the DWP has been constrained from exporting levels of water that damage nesting grounds in Mono Lake. During the 1970s, at least 260,000 AF/yr were assumed available by DWP. During a drought, with the new environmental constraints, the amount for planning is now assumed to equal 125,000 AF/yr. DWP also purchases water from the wholesale agency, MWD, which in turn imports water from two sources, the Colorado River (Rocky Mountain watershed) and the California State Water Project (SWP—Northern Sacramento Valley watershed). Economic uncertainty is caused by urban and rural economic growth in Arizona that reduced the amount of Colorado River water available to the MWD to 550,000 AF/year (vs. a capacity of 1.2 million AF). As noted by Dinar, Sunding, and Zilberman in Chapter 9, the SWP has been constrained to avoid pumping water across the San Francisco Bay Delta at a rate that causes substantial damage to fisheries, so less water is available for the SWP canal that transports water to Southern California. Moreover, economic growth in various regions served by the SWP has also affected deliveries. The MWD has a contract for delivery of 1.8 million AF of water from the SWP. During the 1991 drought, only 350,000 AF were available. Within the MWD service territory, there has been considerable economic growth in Riverside, San Bernardino, Orange, and San Diego counties. These trends are expected to continue. In response to geophysical uncertainty, the most efficient source of water storage for urban customers may well be temporary fallowing of agricultural fields during drought. However, this source of supply requires developed water markets. In Chapter 10, Miller describes the recent development in western states of institutions called "water banks" to assist during droughts. A partially developed water market is a source of financial uncertainty for large investments, such as those by MWD in surface water storage (or large-scale desalination), which has a substantially higher cost than fallowing agricultural fields.

If institutional changes open up water markets, the marginal cost will fall substantially below average cost, given the investments underway in the absence of such markets. Water rates based on marginal cost will then need to be redesigned.

## REFERENCE

- Fisher, A.C.: 1981. *Resource and Environmental Economics*. Cambridge, UK: Cambridge University Press.