WATER SUPPLY ASPECTS OF RIVER AUTHORITIES IN TEXAS

A Thesis

by

SUSHMA KRISHNAMURTHI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2006

Major Subject : Agricultural Economics

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Approved by:

Chair of Committee,	Ronald C. Griffin
Committee Members,	Richard T. Woodward
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ABSTRACT

Water Supply Aspects of River Authorities in Texas. (August 2006)

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Price has been noted to be an important ingredient in any evaluation of future water demands, since it is a signal of cost administered by water wholesalers or retailers. The purpose of this study is to contribute to a better understanding of rates and rate-setting strategies adopted by the river authorities of Texas, and the relevance of economic efficiency for wholesale purveyors of water. Methods employed to accomplish the objectives include collecting sample water supply contracts, surveying rate structures, and surveying authorities' rate-setting objectives.

In its current form the economic theory of pricing emphasizes price establishment by retail water suppliers. There are certain distinctions between wholesale suppliers and retail distributors of water that question the adequacy of the existing theory in its universal application. This calls for a different theory of pricing for wholesale suppliers of water. Therefore, an efficiency-seeking pricing theory for wholesale water purveyors is explored here.

Out of the fifteen existing river authorities in Texas, ten have wholesale supply operations. This study finds that out of the ten authorities that have wholesale operations, some authorities charge the same uniform rate to all their customers, while some charge

a different rate to each of their customers. The fact that some river authorities charge different rates to different categories of customers for the same water is considered economically inefficient. Another element that lends itself to economic inefficiency is the usage of the block rates.

Through a questionnaire, the study finds that river authorities rank revenue sufficiency highest among six objectives pertaining to rate-setting processes. Legality is ranked second and economic efficiency is ranked third among these six goals. Though there are ten river authorities that supply water on a wholesale basis, only eight valid questionnaires responses could be used for the study.

All river authorities involved with the wholesale supply of water commit most of their water supplies to municipal, agricultural, and industrial uses and customers through water supply contracts that contain legal agreements, which are dealt with before the river authority supplies the water to the customer. This study discusses the various similarities and differences between contracts of the ten river authorities that are involved in wholesale supply of water. Out of the ten river authorities, nine responded with their wholesale water supply contracts. One river authority responded with two contracts, therefore there were ten contracts that were studied.

DEDICATION

To Thatha.

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Even from halfway across the world, my parents Uma and G. Krishnamurthi, have provided me with the will to get this thesis done. Their help, care, and guidance is most appreciated.

NOMENCLATURE

ANRA	Angelina and Neches River Authority
BRA	Brazos River Authority
GBRA	Guadalupe-Blanco River Authority
LCRA	Lower Colorado River Authority
LNRA	Lavaca-Navidad River Authority
LNVA	Lower Neches Valley Authority
NRA	Nueces River Authority
RRA	Red River Authority of Texas
SRA	Sabine River Authority of Texas
SARA	San Antonio River Authority
SJRA	San Jacinto River Authority
SRBA	Sulphur River Basin Authority
TRA	Trinity River Authority of Texas
UCRA	Upper Colorado River Authority
UGRA	Upper Guadalupe River Authority

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CHAPTER I

INTRODUCTION

Texas river authorities are a type of large, regional water district that are nonprofit. These river authorities are recognized as government entities of the State of Texas but do not receive any direct funds from the State. The authorities have power and influence in the arena of water management. In fact they control about 25 percent of surface water deliveries in Texas (Harper and Griffin, 1988) and this amount has increased over the years. There are fifteen river authorities in Texas; ten deal with wholesale supply of surface water, one deals with retail supply of water, and four do not function as water suppliers. However, it must be remembered that they are like snowflakes (Leshy, 1983) as they are unlike each other in ways that they operate. These organizations are heterogenous.

The state usually requires that authorities supply water for beneficial uses, such as municipal drinking water, agricultural irrigation, and industrial operations. The water supply contracts of river authorities are the means by which they commit their water supplies to various uses and customers. The contracts establish the legal terms of water use to protect the public's interests. They are a long term commitment by river authorities to supply water to their customers.

This thesis follows the style of the Journal of the American Water Resources Association.

Rate structures are important from an economic point of view. Water scarcity issues all over the world have placed more stress on supply enhancement and demand management techniques of augmenting water. Demand management techniques involve, among other methods, the raising of water rates to motivate people into using water with more thought towards conservation. The theory of economic pricing of water discusses economic efficiency in the pricing of water (Kahn, 1970). It is generally believed that river authorities do not consider economic efficiency to be an important objective when setting rates. Economic theory advocates marginal-cost pricing which has not been adopted by most water supply organizations. Part of this reluctance may be that marginal costs are harder to observe than are average costs.

PROBLEM STATEMENT

The State of Texas could be divided geographically into the east, which is endowed with abundant water resources and the west which is arid. Potential for water shortages in high growth areas have water providers looking for means to augment water supply. Even political leaders and water resource managers understand the importance of water demand. Price has been noted as an important ingredient in any evaluation of future water demands, since it is a signal of cost administered by water suppliers. Economic efficiency is not given much consideration when setting water rates. According to pricing theory, maximum efficiency is obtained when price is equated to marginal cost (Kahn, 1970; Brown and Sibley, 1986). River authorities use the average-cost pricing model rather than the marginal-cost one. It follows that economic efficiency

may not be achieved by river authorities in their rate setting. Price is an important factor that consumers will use in their decisions on the quantity of water they will consume.

OBJECTIVES

Given this problem setting, four objectives are selected to direct the research conducted here.

1) Study water contracts in use by Texas river authorities by identifying important contract characteristics.
2) Determine the various factors affecting key characteristics of the water contracts used by river authorities in Texas.
3) Gauge whether economic efficiency is being advanced by contemporary water contracts through proper signaling of the appropriate marginal values.
4) Assess and compare the rate-setting objectives of Texas river authorities.

PROCEDURES

Methods to be employed to accomplish the objectives employ information from all river authorities about their water supply contracts and rate structures. The primary activities of this research are to pursue the following tasks.

1) Obtain sample water supply contracts of the river authorities that are involved in the wholesale supply of water. Examine these contracts and compile their similarities and differences.
2) Survey the rate structures of river authorities. Process and investigate the variations in rates information and tabulate the findings.

3) Survey the management of river authorities with regards to their rate-setting objectives. Questionnaires will be sent to the river authorities, which will be used to collect information on the rate-setting objectives of the river authorities. Ranking of the rate-setting objectives will be obtained to determine the relative importance of economic efficiency in their rate setting.
4) Explore an efficiency-seeking pricing theory for wholesale water purveyors.
5) Determine whether river authorities have any statutes or policies affecting the setting of rates. Assess whether they are following these statutes and working by established principles. Study rates or whether policy goals need to be changed to achieve economic efficiency.

FORMAT OF THE THESIS

Chapter II considers the existing economic theory of pricing which is applied to retail suppliers of water, providing a review of literature, thus far on pricing. It then proceeds to build a theory of economic pricing for the wholesale purveyors of water. Chapter III provides a description of the data collected from the river authorities regarding contracts and rates. It also tabulates findings which lends itself to easy comparison between river authorities. Chapter IV includes the analysis of the rate schedules, contracts, and rate-setting objectives of river authorities. Chapter V presents the summary and conclusions of this thesis. It discusses the results, conclusions, implications, and limitations of this study and suggestions for further research.

CHAPTER II

ECONOMIC THEORY OF PRICING

INTRODUCTION

All techniques to combat water scarcity are instances of supply enhancement or demand management. The former refers to more traditional measures undertaken to increase the supply of water such as building and enlarging dams and other such capital-intensive alternatives. The latter attempts to control or manage demand by rationing water or raising water rates or educating water users about water conservation.

The price of any commodity is a determinant of its demand; this is also the case with water. It may not be the only determinant of demand, but it may be one of the few that can be controlled. This makes the pricing of water an important demand management tool. The economic theory of pricing that has evolved has been of great use, despite being forsaken for revenue sufficiency more often than not by retailers and wholesalers in rate setting. The theory in practice, however, caters to only a section of the water suppliers, namely the retailers. There are certain distinctions between wholesale suppliers and retail distributors of water. The differences between wholesalers and retailers question the adequacy of the existing theory in its universal application. This calls for a different theory of pricing for wholesale suppliers of water.

This chapter deals with the existing economic theory of pricing that applies to the retailers. It then moves on to enumerate the differences between wholesalers and

retailers. These differences throw some light on the reasons for the need for a new theory for wholesalers.

BASE (RETAIL) WATER PRICING THEORY

Wholesale suppliers of water are different in notable ways from retail distributors of water. "Wholesaling, in an economic sense, includes all activities relating to the purchase and sale of goods where the purpose of the customer is to resell the merchandise or to put the goods to business use" (Haring, 1940). "Retailing includes all the activities involved in selling goods or services directly to final consumers for personal, nonbusiness use. A retailer or retail store is any business enterprise whose sales volume comes primarily from retailing" (Kotler, 2003).

Wholesale suppliers of water don't sell or distribute water to or deal with the final consumer of water. There is a distribution network through which retailers supply final consumers with water. As a result of this direct contact with the final consumer, the water supplied by retailers is always highly processed. Processed water is water that has gone through various stages of filtration, pressurization, and various other forms of processing to be considered fit to use by the final consumer.

These differences begin to explain the need for a theory that also accommodates the wholesale sector of the water supply arena. Further, looking at the base economic pricing theory that retailers use and using the differences helps in building a new theory for wholesalers.

Cost Determinants

According to the conventional theory, costs of supplying water are functionally dependent on the amount of water distributed. The theory has been found to be lacking or incomplete because the costs of supplying water do not rely only on the amount of water distributed. There are fixed costs which are correlated, albeit loosely, with the amount of water distributed. There are also other costs involved in the supply of water that are not related directly to the amount of water delivered, such as conveyance losses or leakage. Another cost function (2) has been introduced to replace the earlier cost function which was dependent only on the water distributed as has been shown in (1).

$$C(W) \tag{1}$$

$$C(\Delta N, W, N) \tag{2}$$

This is explained in equation (1) and (2) where C represents costs, W represents the water delivered overall, N represents the number of connections, and ΔN stands for the number of new connections in the system (Griffin, 2006)

Pricing Water

There are three pricing components to this version of the pricing theory; they are the pricing of new connections, the pricing of water, and the pricing of existing connections. The pricing of water i.e., the volumetric component is explained first, followed by the pricing of connections, new and existing.

If the source of water is renewable, price would be set so that net benefits are maximized which in turn gives rise to the social value of natural water or the marginal value of water. "Maximizing systemwide net benefits subject to a current limit in the

availability of renewable water while using the cost function referred to in equation (2), and realizing that agents adjust their use so that their marginal benefits equal price, the following pricing advice for water is obtained" (Griffin, 2006).

$$P = MC + MVW \tag{3}$$

Equation (3) shows the price when the source of water is renewable, where P is the price of water, MC is the marginal cost of producing that water, and MVW is the marginal value of unprocessed, renewable water.

When considering a depletable source of water, economic efficiency also involves the setting of the price of water so that maximization of the net present value takes place. This gives rise to the marginal user cost, which is the future value of depletable water discounted to the current period. When resources are scarce, greater current use diminishes future opportunities. The marginal user cost is the present value of these foregone opportunities at the margin if the resource is used efficiently. The marginal user cost will grow over time at the rate of discount. This is an important implication of economic efficiency. As when the marginal user cost is incorporated into the price, the consumption will reduce by the economically efficient amount.

$$P = MC + MUC \tag{4}$$

This is noted in equation (4) where P is the price of water, MC is the marginal cost of producing that water, and MUC is the marginal user cost.

There may be periods when the infrastructure for water supply is not enough to fulfill the quantity that is demanded. The inadequacy would be magnified for those water

suppliers growing due to the high capital costs of expansion. All capital investments should be timed in such as way as to achieve dynamic economic efficiency.

"Water supply systems grow in spurts to take advantage of scale economies at the time of construction"(Griffin, 2006). When a project as large as water projects can be is undertaken, it does not cost more to "enlarge things a bit". Given this enlargement, some excess capacity will be created. This will last until demand catches up with this excess capacity and there comes the time for a new expansion. The timing of these periodic expansions affects the net benefits that the clients receive from their supply system as these expansions are capital-intensive (Griffin, 2006).

Initially there will be excess capacity given the investment, until an increase in demand extinguishes this excess and there is need for a new expansion. Through the stage where the supply is exceeded by demand, rationing of water is necessary and it would be prudent to increase the price of water by the marginal capacity cost (Warford, 2003) which ensures the equality of demand and supply as well as the channeling of water to its highest valued uses.

$$P = MC + MCC \tag{5}$$

Equation (5) shows the price when marginal capacity cost is taken into account (MCC). "A pricing system that makes use of the MCC is consistent with optimal project timing, as the optimal scheduling over time depends on the optimal allocation within each period. Any failure on one side of this arrangement will perturb optimal action on the other side. This cost moves with time, either upward or downward, but this is not the case with the marginal value of water or marginal user cost that move upward with time.

The MCC rises when there is a scarcity and demand is high, but falls again with each supply expansion" (Griffin, 2006).

Therefore, the economic theory of pricing yields the retailers the following information:

$$P = MC + MVW + MCC \quad (6)$$

This is the case when the source of water is renewable in nature. And if the source of water is depletable in nature, then the following is true.

$$P = MC + MUC + MCC \quad (7)$$

When there is no scarcity in natural water, the MVW and MUC are both zero. If there is excess capacity, then the MCC is zero. If demand is greater than supply, putting the MVW or MUC in the price decreases the quantity of water demanded, thereby lowering MCC, perhaps to zero (Griffin, 2006).

Besides just the volumetric price that has been accounted for so far, there are two other important components to the water rate. The first is the connections charge that is an initial, one-time payment made by the new consumer who will utilize the connection, which connects it to the water distribution network.

The second component is the meter charge, which is a recurring payment made by all water users. It is measured by taking the difference between the estimated revenues and the estimated costs and dividing the difference by the number of connections. This component could be used by water supply systems to balance their budgets. The difference could be made up using the meter charge (Griffin, 2006).

Economic Efficiency

An important benchmark by which pricing policies may be judged is the contribution those policies make toward economic efficiency. An efficient policy is defined as one that maximizes the net benefits or net present value accruing to the community from a given course of action. Net benefits are the difference between benefits and costs. Net present value is the sum, over the chosen planning horizon, of all net benefits accruing to an action and discounted to current value terms. The proposition stemming from this definition is that the price of any service or commodity should be equated to the cost of producing an additional unit of it, or to its marginal cost.

A related concept that is very important to an understanding of resource allocation is opportunity cost. With a given productive capacity, a decision to produce more of one good implies the decision to produce less of other items. The cost to society of producing anything is made up of other things that must be sacrificed to produce it, or the value of the alternatives foregone. Marginal cost is defined as the cost of producing one more unit of output, or conversely, the cost that is saved from producing one less unit. In the context of water supply, marginal cost has been defined as the cost of savings incurred in providing more or less water service (Mann and Schlenger, 1982).

A basic challenge for an economy is to use these resources to maximum advantage. At any given time the basic economic problem is to make the best or most efficient use of limited capacity (Kahn, 1988, pp. 66). For this to happen requires that the benefit gained from consuming one more unit of a good equals the cost to produce it. That is, the marginal benefits equal the marginal costs as is shown in equation (8).

Benefits can be derived from the demand curve for the good or service provided by the action. Demand curves measure the amount of a particular good people would be willing to purchase at various prices. For each quantity purchased, the corresponding point on the demand curve represents the amount of money a person is willing to pay for the last unit of the good, which is the marginal benefit derived from that unit (Tietenberg, 1999).

$$MB = MC \tag{8}$$

This outcome of $MB = MC$ can be ensured by setting the price of the commodity equal to its marginal cost.

$$P = MC \tag{9}$$

Prices provide signals that guide people's behavior. If they are to make choices that reap the greatest possible benefit from society's limited resources, the prices that they pay must accurately reflect the opportunity costs associated with the commodities they are considering. If their judgments are correctly informed in this way, they will guide scarce resources into those lines of production that maximizes the net benefits or net present value to society as a whole (Kahn, 1988; Hanemann, 1998, pp.149-151).

Could not prices equal average rather than marginal costs? If price had no influence at all on demand, it would not necessarily matter. But, in fact, the demand for all commodities is in some degree, at some point, responsive to price. Then, if consumers are to decide whether to take somewhat more or somewhat less of any item, the price they pay should reflect the cost of supplying somewhat more or somewhat less of the item – the marginal cost. Suppose buyers were charged a price higher than the marginal cost ($P > MC$), they would buy less than the socially optimum quantity.

Welfare could be improved if they consumed more of this good and less of other goods as a whole. Some consumers, who would have consumed more of this good and less of others, will refrain from doing so because the price exaggerates the item's opportunity cost. Conversely, if $P < MC$, they will buy more of the commodity than is socially optimal. Producers are diverting more resources to the production of the commodity than customers would have willingly authorized, had the price fully reflected the marginal opportunity cost (Kahn, 1988, pp. 66-67; Hanemann, 1998, pp.149-151).

Most retailers when setting rates at which they sell water normally use the average cost as this affords them their much wanted revenue sufficiency. When the rate structure and the levels of the rates are adequate in recovering the total costs associated with the provision of that service, revenue sufficiency is said to be had. Since pricing affects future decisions, economists prefer to use costs that are forward-looking and marginal in nature in the setting of rates, rather than what the retailers use. As has been mentioned above, the equating of price and marginal cost leads to the achievement of economic efficiency, but if price were equal to the average cost and not to the marginal cost, economic efficiency may not be achieved. Therefore, it may not be economically efficient to divide the total costs by the water quantity (average-cost pricing) to arrive at the revenue sufficiency pricing by retailers. Average-cost pricing may be economically acceptable when it is equivalent to marginal cost.

As seen in Figure 2.1 price $P_R^{'}$ that is charged by retailers falls short of achieving economic efficiency because it is lower than the economically efficient price P_R^*. Price ought to be set at the point where the marginal cost curve intersects with the marginal

benefit curve at the price P_R^* and the water quantity at W_R^*. This is the point where economic efficiency is achieved. However, the price is set at $P_R^{'}$ where the average cost equals the marginal benefits. This is done because it is at the average cost that retailers break even. This may be the normal case for retailers, where the price set is lower than the economically efficient price. As price is the signal for consumers, an increase in the rates would result in a reduction in consumption.

Economic Efficiency and Cost Recovery

Two-part water tariffs enable retail suppliers of water to achieve both economic efficiency and cost recovery objectives. Cost recovery is synonymous with revenue sufficiency. The essence of the two-part charging is that the consumer is called on to pay two charges, one which varies directly with the amount of the commodity that he consumes and another which does not (Lewis, 1941). An incentive to the use of a two-part tariff is the existence of standing charges which continue whether a firm is operating or not. First, where in consequence of periodical fluctuations in demand, there are regular periods when equipment is standing idle, it is often suggested that the only scientific way to allocate costs to consumers is to use a two-part tariff. And secondly, even where there are no such regular fluctuations, a retailer may find it profitable to use a two-part tariff in order to escape the risks of unforeseen change. By using a nonwater

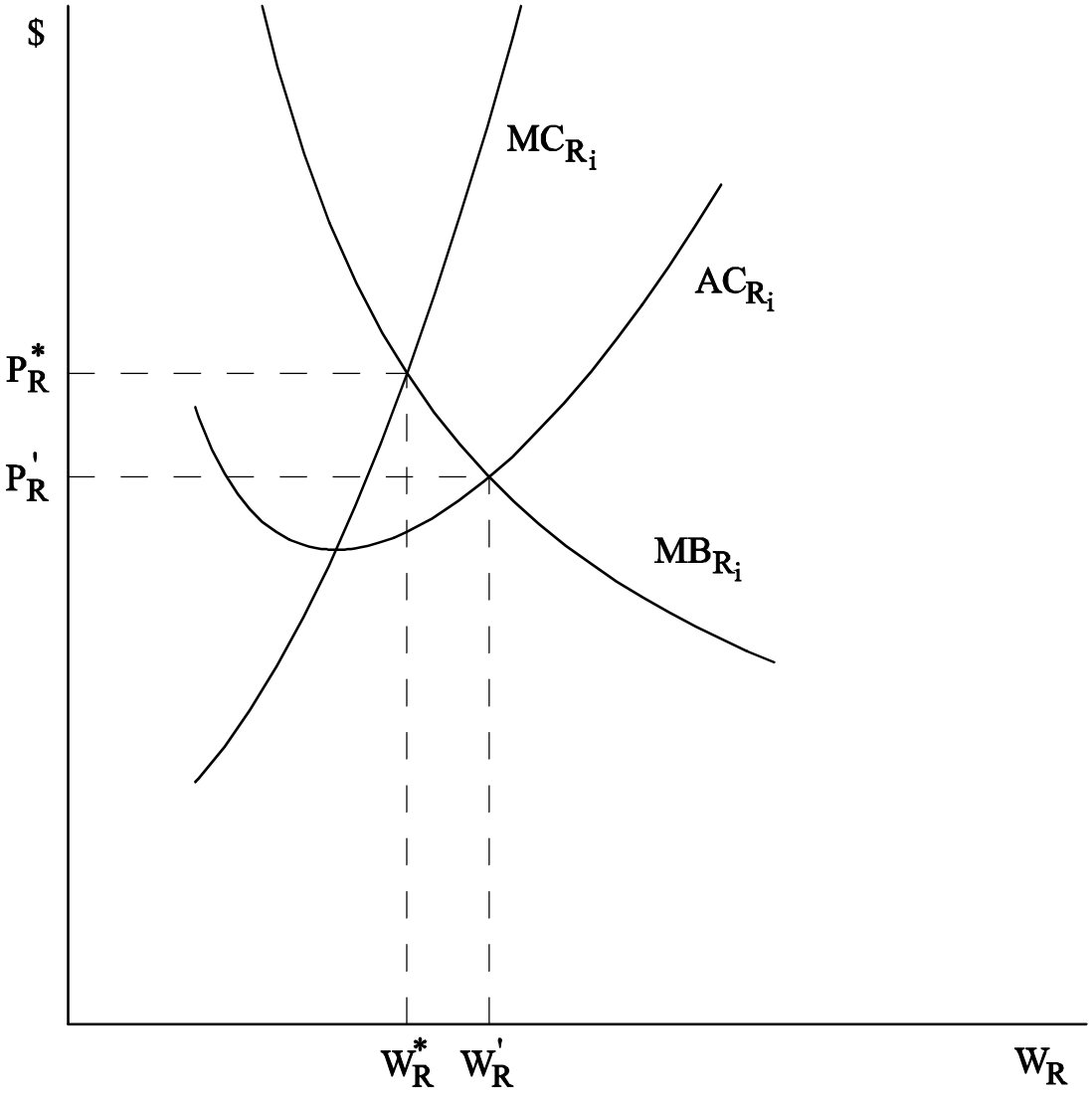

Figure 2.1. Marginal-Cost Pricing for Retailers.

charge to cover the difference between the average cost and the marginal cost, retailers can use two-part tariffs to price water.

Most industries are subject to some degree of regular fluctuation in the demand for their products, the water industry is no exception to this case. There is more demand for water during the dry, hot months. Where the product can be easily stored, these fluctuations in demand need not induce similar fluctuations in production. If the product can not be stored, or the cost of storing it is prohibitive, the result is different; the plant must be large enough to meet the maximum demand and when demand slackens, equipment lies idle. It is then necessary, in computing marginal cost, to distinguish between supplies produced at the peak and at other times.

The two-part tariff might also be used as protection against risks of unforeseen change such as unforeseeable changes in climate. From the retailers point of view the most satisfactory arrangement might be to avoid all risk by getting each potential consumer to pay in advance some portion of the investment costs. If in the aggregate consumers contributed sums sufficient to cover the capital invested, the retailer would be relieved of all risk of loss. This arrangement could be used by the retailer wherein the consumer pays in advance for services that he may never use, like the "take-or-pay" option.

RETAIL VERSUS WHOLESALE

As has been mentioned early on in this chapter, there are some basic differences between retailers and wholesalers in every field. The collective differences between retail

suppliers and wholesale purveyors of water are assembled in Table 2.1. These differences are empirical or observed differences and not theoretical differences. Item 1 in Table 2.1 indicates that wholesalers almost always handle natural water. The water may be processed to some extent as water is captured and stored in a reservoir, but the nature of wholesale treatment is various degrees lower than that of retailers.

The second difference listed in Table 2.1 specifies that wholesalers focus almost exclusively on surface water while retailers may deal with surface and/or ground water. This could be because wholesalers have a comparative advantage when dealing with surface water and a comparative disadvantage when dealing with ground water. Retailers have a comparative disadvantage with procuring surface water as this type of water is normally found in large quantities in its natural state (rapidly flowing). It is also very expensive to attempt to store this surface water after having captured it.

Wholesalers emphasize bulk transmissions and site storage such as reservoirs, whereas retailers emphasize transportation, treatment, tank storage (ground and above ground) and distribution. There is more value-added per-unit to the water with retailing than with wholesaling. As there is more emphasis placed on transportation, treatment, tank storage, and distribution in the case of the retail suppliers, they have higher accounting costs when compared to the wholesale purveyors of water.

Wholesale suppliers of water are more likely to be publicly owned and nonprofit by default. This allows for a greater influence of politics in water rate setting. If the supplier started out as a public entity, there is a tendency to stay public. This may be the case because of inertia. Water providers, whether wholesale or retail were not publicly

TABLE 2.1. Differences between Retail Suppliers and Wholesale Purveyors of Water.

	Retailers	Wholesalers
1.	Sell and distribute water to final consumers	Do not sell or distribute water to final consumers
2.	Handle processed water	Almost always handle natural water
3.	Buy or capture surface and ground water	Focus almost exclusively on surface water
4.	Emphasis on: transportation, treatment, tanks, lakes and distribution • More accounting costs per unit of water. • More value added per unit	Emphasis on: bulk transmission, site storage • Less accounting costs per unit of water • Less value added per unit
5.	Are publicly or privately owned	More likely to be publicly owned and non-profit in nature
6.	Large number of customers	Fewer customers
7.	Charge customers a water bill • No contract instruments available for customers • Can ask customers to pay upfront costs of transmission	Contract with customers • Variety of contract terms available. • Build costs into contracts
8.	Customers do not have take-or-pay option	Customers may have the take-or-pay option

owned to a large extent in the U.S. until the 1900's. This move to public ownership came about due to the income tax exemptions for municipal bonds that were introduced after World War I. Public water suppliers are not required to pay the market rate of interest when borrowing construction funds. As the costs of construction of water supply projects are extremely high more suppliers of water turned public. Also "implications include lower costs for publicly owned infrastructure – recalling that the water industry is extremely capital-intensive – and therefore lower rates for water consumers, unless private operators can counter this advantage with other savings" (Griffin, 2006). Wholesalers are involved in both market and nonmarket activities. These nonmarket activities include the management of water for recreation, environmental habitat, etc. Wholesalers harness water from rivers and create dams and reservoirs for the purpose of supplying water. These large amounts of water are costly to store and are made into lakes, which are then used for the aforementioned nonmarket purposes.

As the number of customers is much larger with a retail supplier of water, there is also a large inventory of meters to check on the retail customers' consumption. Item 6 in Table 2.1 indicates the difference in the case of wholesalers. The overall numbers of customers are low while the amount supplied to each customer is high. The number of meters would also be low. There is also no meter charge involved in the wholesale supply of water. The wholesale customers essentially agree, in their contracts, to bear the costs of installation, operation, and maintenance of meters for the accurate measurement of all water diverted by them. The wholesale customer is supposed to allow the wholesaler access to the meters for the purpose of making meter readings and/or periodic

inspections. Wholesaler's customers are fewer in number compared to a retailer's customers, so they have more power. They may be able to influence prices to a larger extent, that is, each customer affects the revenue of a wholesale purveyor of water. If one of their customers cuts back then there could be a sizable fall in the revenue. The customers of wholesale purveyors of water may have some more control over the setting of prices than the retailers.

Wholesalers tend to have contracts with customers that outline the price and the quantity supplied. Retailers supply water to the final consumer and bill them based on their usage. There are a variety of contract terms that the wholesalers use that retailers do not, due to the absence of contracts. Also retailers more commonly ask consumers to pay upfront some costs of infrastructure through connection fees while wholesalers build these costs into the contract.

Item 8 in Table 2.1 indicates that retailers do not use "take-or-pay" provisions in their dealings with their customers. This is a provision, written into a contract, whereby the consumer has the obligation of either taking delivery of a minimum quantity of water at a specified price or paying the minimum specified amount. If the customer does not use the water, then the same price would be paid. Wholesale customers use take-or-pay provisions. They pay for water that they may or may not use as a safety measure. Retailers do not pay for water that they may or may not use. In case of a drought, the wholesale consumer still has the ability to use the water that may not have been used had there not been a drought, yet was paid for. In case of excess supply of water, the

wholesaler is protected by this option when the consumer pays for the water that is not used.

WHOLESALE WATER PRICING THEORY

In retail systems, the management determines the price structure since there is no free market. In the case of water received from wholesale distributors, the market may be highly restricted because the water suppliers are publicly owned and contract with specific water retailers that also tend to be public authorities. Wholesalers tend to price the water to cover historical construction costs and current operation, maintenance and repair costs (Howe, 1993).

Depicting economic efficiency with wholesalers is different than with retailers due in part to the position and shape of the average cost curve. The price is said to be economically efficient when it promotes patterns and levels of water use that motivate only the most valued uses of the wholesaler's limited water supplies. In the case of wholesale suppliers of water, average costs of supplying the water are normally, but not necessarily larger than the marginal costs of supplying the same water. With retailers it is noted in Figure 2.1 that the average cost may be lower than the marginal cost. However, this is not necessarily a general condition. It would be convenient to price water at the level where the average cost equals the marginal cost. This might not even be possible as the marginal cost curve, MC_H, as shown in Figure 2.2, might be almost flat and not move upward within a relevant range of demand to meet the average cost curve, AC_H, at its minimum point as it does in the case of retailers. The price that is

economically efficient, P_H^*, is lower than the price that is arrived at with average cost pricing $P_H^{'}$. It would be economically efficient to set the water price where the marginal costs are considered. The marginal costs could equal the average cost and this would be the perfect deal, where both economic efficiency and revenue sufficiency is achieved. That is, economists would be content that pricing would be efficient and the wholesalers would also be satisfied as they would be breaking even. Such circumstances are unlikely. Fixing efficiency in the wholesale sector alone does not mean that all is well, as an inefficiency in the retail sector will affect the efficiency, or its achievement in the wholesale sector. "If a distortion exists in one sector – that is, there is some constraint that prevents the first-best optimal conditions from being satisfied in this sector, it is no longer generally desirable to apply the first-best optimality condition in the other sectors" (Laffont,1990). When we have certain constraints that prevent the achievement of a first-best optimum then we are forced to look to a definition of a second-best optimum that takes into account the available political economic instruments (Laffont,1990).

When the marginal costs are lower than the average cost, as is the case is Figure 2.2, a two-part water tariff may be used. Two-part water tariffs have an important role to play in enabling wholesale suppliers of water to achieve both economic efficiency and cost recovery objectives. Economic efficiency requires that wholesale water be priced at marginal cost, which leads to a low water price. If this be the case, then a single-part tariff may not be able to recover the full costs of water supply. If a two-part tariff is used, then the necessary revenues can be raised with a fixed charge without distorting

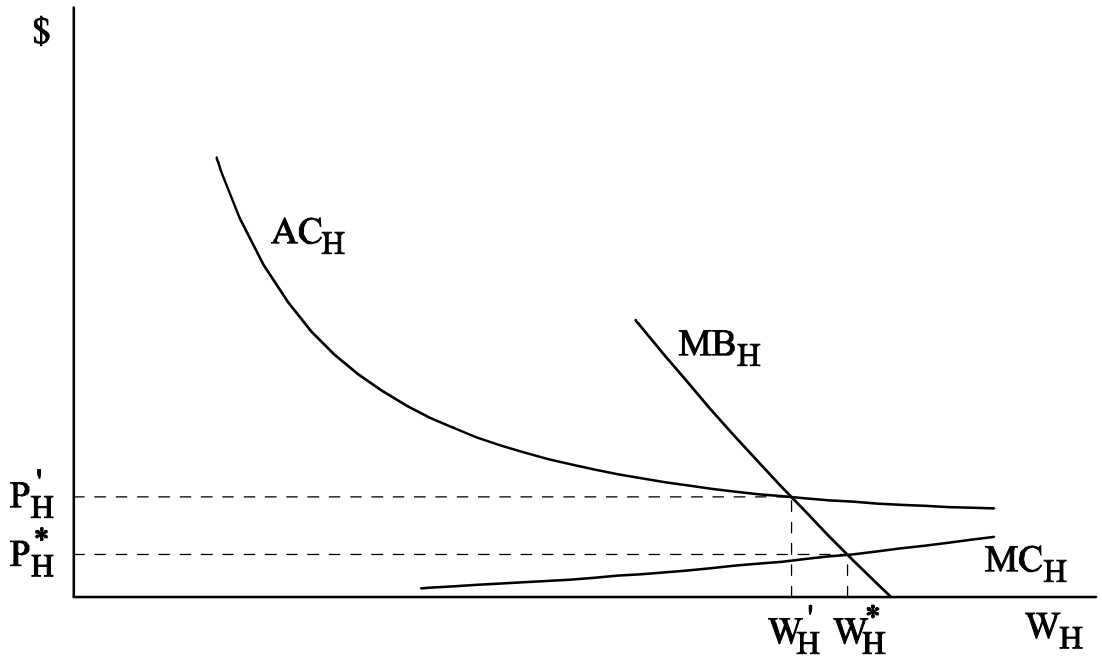

Figure 2.2. Marginal-Cost Pricing for Wholesalers.

the price signal contained in the volumetric charge. These fixed charges could be transfer payments or dues that are not related to the quantity of water consumed.

There are alternative assumptions which can be made in the development of a wholesale pricing theory:

1. Using marginal-cost pricing in both sectors with specific reference to the objective of economic efficiency.
2. Using average-cost pricing in both sectors with specific reference to the objective of revenue sufficiency.

The implementation of the above stated modifications raise differing policy issues. These assumptions and their consequences are discussed in the following subsections.

Marginal-cost pricing in both sectors

Economists aim at achieving economic efficiency which could be arrived at with the help of marginal-cost pricing. Marginal-cost pricing and economic efficiency go hand in hand. Given that the retail supplier demands water from the wholesaler, their marginal benefits and marginal costs would be intertwined. Taking the case of marginal-cost pricing in a scenario where there is just one retailer R_i, this retailer has marginal benefits (MB_{R_i}) and marginal costs (MC_{R_i}).Explanations of labels in figures are given in Table 2.2. This is explained with the help of a diagram, Figure 2.3. The marginal net benefits of the retailer R_i may be measured by the difference between the marginal benefits and the marginal costs. Equation (10) represents the relationship.

$$MNB_{R_i} = MB_{R_i} - MC_{R_i} \qquad (10)$$

Table 2.2. Explanations of Labels on Figures 2.1-2.4.

$P_R^{'}$	Retail Price using Average-Cost Pricing.
P_R^{*}	Efficient Retail Price
$W_R^{'}$	Retail Water Quantity using Average-Cost Pricing
W_R^{*}	Efficient Retail Water Quantity
MC_{R_i}	Marginal Costs of Retailer
MB_{R_i}	Marginal Benefits of Retailer
AC_{R_i}	Average Costs of Retailer
W_R	Retailer Water
MNB_{R_i}	Marginal Net Benefits of Retailer = Marginal Benefits – Marginal Costs.
$P_H^{'}$	Wholesale Price using Average-Cost Pricing
P_H^{*}	Efficient Wholesale Price
$W_H^{'}$	Wholesale Water Quantity using Average-Cost Pricing
W_H^{*}	Efficient Wholesale Water Quantity
MC_H	Marginal Costs of Wholesaler
MB_H	Marginal Benefits of Wholesaler
AC_H	Average Costs of Wholesaler
W_H	Wholesale Water

MNB_{R_i} of all the retailers put together makes up the marginal benefit (demand) function faced by the wholesaler. In this scenario we note that there is one wholesaler who has multiple clients or retailers. The marginal benefits that the wholesaler "sees" (MB_H) is the sum total of the marginal net benefits of all the retailers R_i, that is, ΣMNB_{R_i}. This is noted within equation (11).

$$MB_H = \Sigma MNB_{R_i} \tag{11}$$

As may be seen in the left panel of Figure 2.3, the efficient wholesale price is set where the marginal benefits equal the marginal costs of the wholesaler. That is, price is set equal to marginal cost. This leads to the efficient quantity of water (W_H^*) and the efficient price (P_H^*). To take into account the wholesale price (P_H^*) in the retail sector, marginal costs are shifted upwards by P_H^* in the retail sector. As can be seen in Figure 2.3., the $MC_{R_i} + P_H^*$ curve cuts the MB_{R_i} curve resulting in the efficient price P_R^* and the efficient quantity W_R^*. There is an extension of the P_H^* from the wholesaler's graph to the retailer's graph where it hits the MNB_{R_i} curve. This indicates a difference between the wholesale and retail prices.

As marginal-cost pricing is undertaken a policy issue comes into focus. A problem of revenue sufficiency arises in the case of the wholesaler when marginal-cost pricing is utilized. The rate structure and the levels of rates ought to more than adequately recover the total costs associated with providing the service if the wholesaler should break even. As has been mentioned earlier, most wholesalers are publicly owned

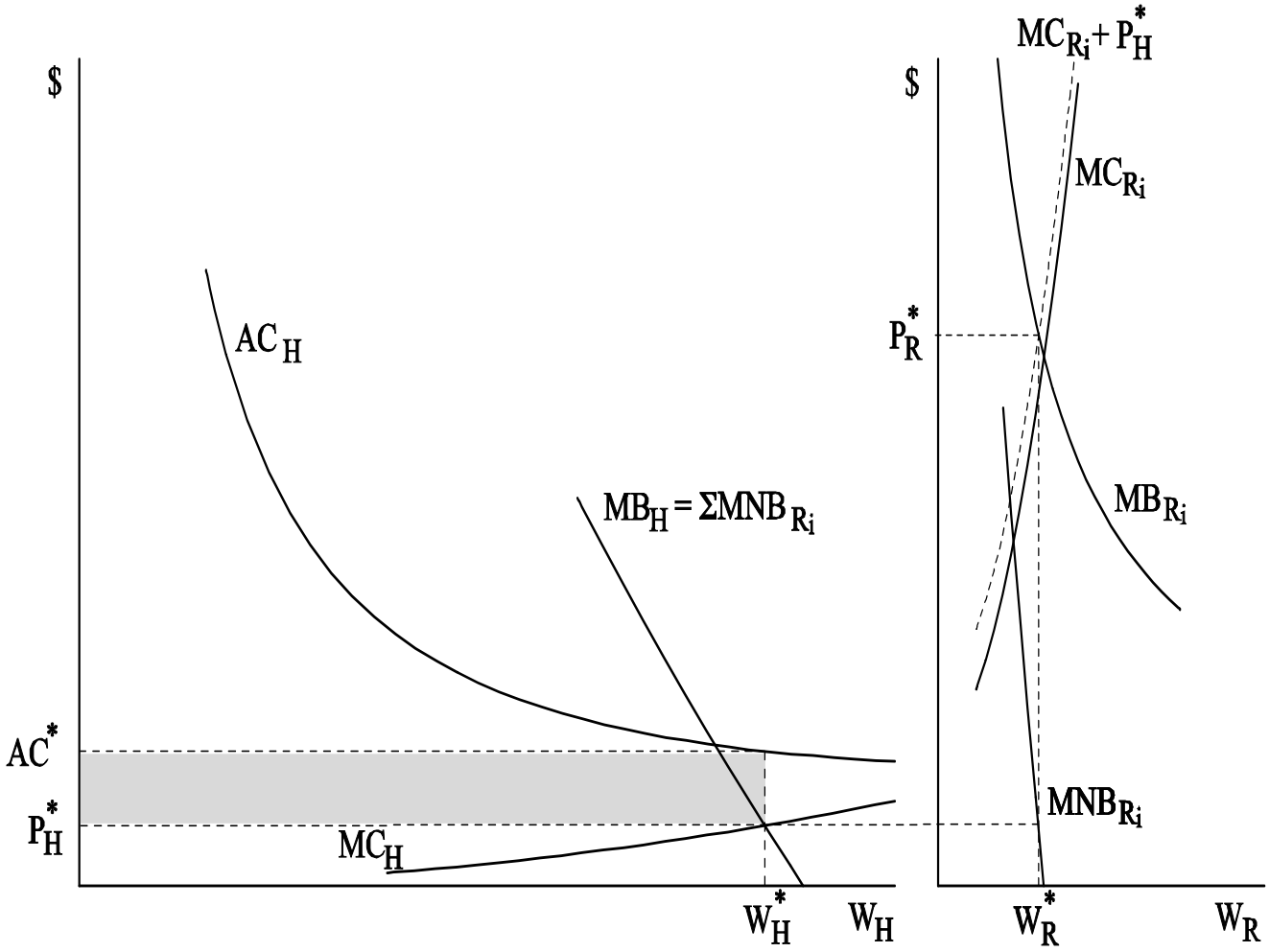

Figure 2.3. Marginal-Cost Pricing in Wholesale and Retail Sectors.

and nonprofit in nature, and one of their important objectives is to break even or cover costs. There may be a revenue shortfall in both wholesale and retail sectors with the usage of marginal-cost pricing, but the issue of shortfall or surplus in the retail sector will be set aside as the main focus of this chapter is wholesale pricing theory. The price set while taking the average cost into account at the efficient quantity of water supplied is named AC* as it is not the point where the average cost curve meets the marginal benefits curve. The revenue shortfall may be significant, and in Figure 2.3 it is the shaded area.

$$\text{Revenue Shortfall} = W_H^*.(AC^* - P_H^*) \tag{12}$$

Solutions for this issue are discussed in a forthcoming section.

Average-cost pricing in both sectors

Figure 2.4, which is a reformulation of Figure 2.3, can guide the alternative situation in which both retail and wholesale sectors rely on average cost pricing. Following the basic layout of Figure 2.3, there is one retailer whose costs and benefits are depicted in the right panel of Figure 2.4. The difference between the marginal benefits and the marginal costs result in the marginal net benefits when marginal-cost pricing is used. In the average cost pricing case we have marginal benefits and average costs as the relevant behavior. The difference between the two leads to the curve marked $MB_{R_i} - AC_{R_i}$ in Figure 2.4. This curve and other similar curves of all the retailers that the wholesaler caters to form the marginal benefit curve of the wholesaler. This may be seen in the left panel of Figure 2.4. That is, we note that:

$$MB_H = \Sigma(MB_{R_i} - AC_{R_i}) \quad (13)$$

Under average-cost pricing the price is set where the MB_H and the AC_H intersect at $P_H^{'}$. The corresponding quantity of wholesale water is $W_H^{'}$. This price and quantity of water that are determined using average-cost pricing are not economically efficient. The price does afford the wholesaler revenue sufficiency, which allows the wholesaler to break even. This being one of the priorities of wholesalers, having achieved it they forget that it is not an efficient price.

To take into account the wholesale price in the retail sector the average costs are shifted upwards by $P_H^{'}$ resulting in the new $AC_{R_i} + P_H^{'}$ curve, as seen in the right panel of Figure 2.4. This produces the retail price where the average cost curve intersects with the marginal benefits curve (MB_{R_i}). The corresponding quantity of retail water is $W_R^{'}$. As was indicated in Figure 2.3, the wholesale price of $P_H^{'}$ is extended from the wholesale graph to the retail one. The AC_{R_i} and the MB_{R_i} curves give rise to the $MB_{R_i} - AC_{R_i}$ curve which has been explained above.

With the usage of average-cost pricing a policy issue arises. In the setting of Figure 2.4 water is underused due to the inefficiency in water use. $W_H^{'}$ is an inefficient level of water use. As may be seen in Figure 2.4, this level of water could be lower than the efficient water level W_H^{*} and the price higher than P_H^{*}. A regulatory policy, average-cost pricing is used for public entities (especially those that are natural monopolies) in which the price received by a wholesaler is set equal to the average total

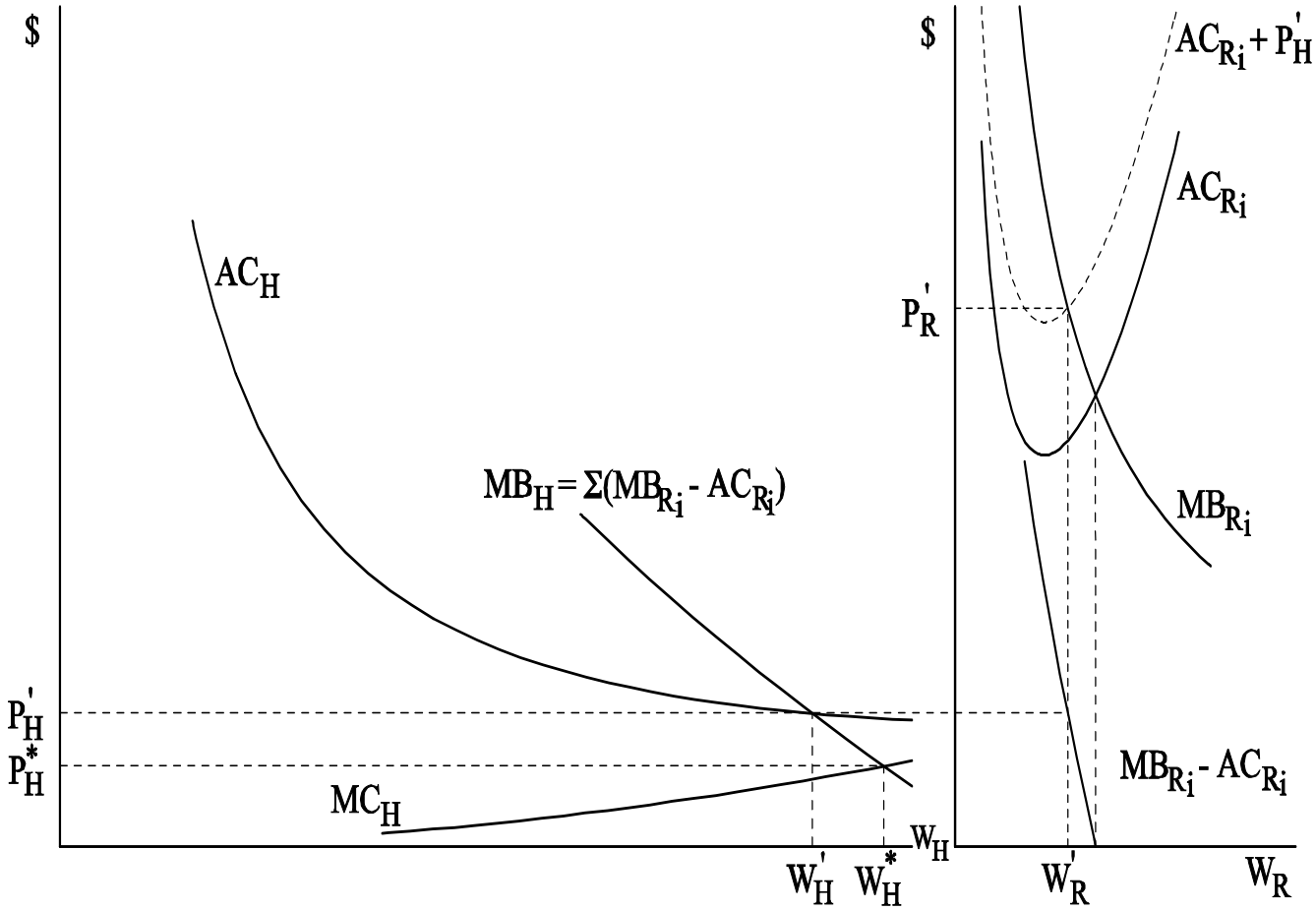

Figure 2.4. Average-Cost Pricing in Both Sectors.

cost of production. The great thing about average-cost pricing is that a wholesaler breaks even. A bad thing about average-cost pricing is that marginal cost is less than average total cost meaning that price is greater than marginal cost. The wholesaler is then not operating according to the price equals marginal cost (P = MC) rule of efficiency. The solution to this policy issue is also dealt with in the next subsection.

Solutions

The policy issues that crop up while using either marginal-cost or average-cost pricing may be solved using certain policy tools accordingly. The inefficiency that occurs with average-cost pricing could be solved by using marginal-cost pricing. Average-cost pricing, restricts consumption to a suboptimal level. As the basic issue is inefficiency, if marginal-cost pricing were to be adopted these problems could be resolved.

On the other hand, marginal-cost pricing leads to a revenue shortfall. This problem that arises with marginal-cost pricing may be solved with the use of a lump sum instrument. This lump sum device should be something that is separate from the volumetric price of water, something that will not detract from economic efficiency while providing the wholesaler with revenue sufficiency. Two-part tariffs could be used to obtain efficiency when the average costs are higher than marginal costs. According to Ng and Weisser (1974) when average costs are above marginal costs as is the case with wholesale purveyors of water, then the use of marginal-cost pricing leads to revenue insufficiency, which cannot be covered with "nonlump sum taxes", as these "taxes" might lead the prices away from their "first best marginal values". With the usage of a

two-part tariff, the balance could be recovered by requesting the consumer pay a "license fee" or a fixed charge which should not be dependent on the quantity of water consumed. Auerbach and Pellechio (1978) define the two-part tariff as that which "involves charging individuals a constant price per unit of purchase and a fixed charge or license fee for the availability of purchasing at the constant price".

This fixed charge would not vary with the amount of water consumed. As it does not change, it will not affect the demand by each consumer, and the consumption will remain at the optimum level where the price equals marginal cost. This fixed charge makes up a large part of the water rate that is faced by the consumer, in this case the retailer. Therefore, the allocation of the shortfall among consumers is an important issue. The easiest approach would be to divide the revenue shortfall by the number of consumers. This would result in a lower average price for large volume users although the marginal price would remain the same for all customers (McNeill and Tate, 1991).

This kind of tariff is referred to as a uniform two-part tariff. Another alternative is to consider for each consumer a personalized fixed part, such that the total fixed parts of all the consumers who buy the commodity cover the total loss. This type of tariff is referred to as a personalized two-part tariff, or simply as a two-part tariff (Vohra, 1990).

These schemes have the following general structure:

$$T(q) = B + B(q) \tag{14}$$

Where T(q) is the total payment schedule as a function of quantity, q, and B and B(q) are the fixed and variable portions of the payment schedule. The marginal cost of q to the purchaser under the two-part pricing formula is $dT/dq = B'(q)$ (Masten, 1988).

Another option in making up the revenue shortfall that arises when marginal-cost pricing is undertaken could be that the wholesaler could receive government money. This money could be given to the wholesaler by the state or the federal government.

TAKE-OR-PAY CONTRACTS

Brooke (1992) defines a take-or-pay contract as one "that requires the buyer to either purchase a minimum volume of product at a set price ("take") or pay for the minimum without taking delivery ("pay"), while retaining a limited right to take delivery in the future". This shifts the risk away from the seller and onto the buyer in case there is any change in the demand. The seller then guarantees the buyer supply of the commodity in question. The buyer has to make the decision on how much of the commodity will be used. If the seller is unable to "meet the take obligation, the shortfall at the average price needs to be paid for over the contract period" (Brooke, 1992).

The take-or-pay clause has been part of long term natural gas contracts since the 1950's as it benefited both producers (sellers) as well as the pipelines (buyers). It helped the producers gain a constant cash flow even when there was no profitable market for gas, and ensured that the pipeline would not be able to use the contract with the producer as an "uncompensated storage agreement" (Medina, 1989), as was the case before its inclusion. The pipeline was ensured a continuous supply while also gaining some flexibility in the quantities of gas that it could draw. The risk was then placed on the buyer rather than the seller, and until the fall in natural gas prices took place in the 80's this clause in their contracts seemed to work well for both parties. After the fall in prices, the market price for gas was lower than the price at which the pipelines were required to

buy the gas. They then tried to get out of the contracts through "negotiation and modification of contracts, settlements and litigation". These actions were largely unable to help the pipelines. Even though the contracts were not beneficial at that point in time, the buyers and sellers still use them in their contracts as they are still "mutually beneficial to both parties" (Medina, 1989, 1991).

Take-or-pay clauses are included in long term contracts because of the "incentives" they produce in getting supplies when demand shifts or other changes take place. Even though critics of take-or-pay provisions claim that the clause is a barrier to the price system by making buyers purchase at higher rates when there are lower priced alternatives present, they are not taking into account that the clause also ensures "efficient responses to changing conditions" (Masten, 1988).

So far the literature on take-or-pay contracts has pointed to these clauses being devices for sharing risk alone. This is not the only use to which these contracts can be put to. DeCanio (1990) explains the "full economic significance of take-or-pay contracts" by directing more attention to the interdependence of these contracts and other contracts that are entered into by both wholesalers and retailers.

Take-or-pay provisions continue to be an important element in the contracts between purchasers of natural resources and their suppliers. In take-or-pay arrangements, purchasers are assured of a steady supply at a negotiated price, and suppliers are guaranteed steady revenue in a long-term contract with little or no risk from declining demand (Schultz, 1997).

SUMMARY

With growing water scarcity and increasing competition across water-using sectors, the need for water savings and more efficient water use has increased in importance in water resources management. The economic theory of pricing suggests economic efficiency would be attained at the point where water is priced at the marginal cost. Enhancing economic efficiency is a broad concept seeking the highest economic value of water use through both physical and managerial measures. While this theory works for a certain slice of the suppliers of water, it does not work for some others, like the wholesalers.

To undertake a wholesale pricing theory as opposed to a retail pricing theory it is imperative to know what the main differences are between the two. These differences are the reasons that call for a wholesale pricing theory. The retail pricing theory was first handled before dealing with the differences to show clearly the need of a wholesale pricing theory.

The theory makes two assumptions, namely usage of marginal-cost pricing in both wholesale and retail sectors and average-cost pricing in both sectors. The assumptions and their solutions were then discussed in some detail.

The solution to the assumption of average-cost pricing in both sectors is the usage of marginal-cost pricing to deal with the policy issue of lack of economic efficiency that arises with this form of pricing. Similarly, the two-part tariff was explained in an effort to deal with the revenue shortfall issue that arises with the marginal-cost pricing scenario.

Even if the wholesaler were to supply water to different customers at different rates, this theory would hold. This is so because the sum of all the marginal benefits accrued by all the retailers it supplies water to makes up the marginal benefit curve for the wholesaler.

Take-or-pay contracts form an important part of long term contracts. Since wholesale purveyors of water deal with long term contracts and also are known to use take-or-pay clauses in their contracts, this clause was also discussed.

We see that water prices, appropriately set and applied at different points of the water supply cycle, perform many valuable functions, namely to allocate existing supplies efficiently by confronting water users with the costs of providing water, to help signal water suppliers when supply augmentation is needed, and to help shape a rational approach to a healthy water environment.

CHAPTER III

DATA DESCRIPTION

Three elements will be covered in this chapter. In accordance with the first objective of the thesis, the first element investigates water supply contracts of those Texas river authorities that are wholesale suppliers of water. Each river authority acts differently in its dealings with its customers and also has different types of customers. Therefore, the water supply contracts that these wholesale purveyors of water have with the customers will be examined.

The second objective of this thesis is to determine the various factors that may affect key characteristics of the water contracts used by river authorities in Texas. The price of a commodity affects the quantity demanded. The demand management angle of using current water supplies more effectively speaks of using water rates as a means to control the use of water (Griffin, 2006). Therefore looking into the rates set by the river authorities, who are the wholesale purveyors of water discussed in Chapter II, for its customers is logical. The second element that will be covered in this chapter is the water supply rate schedules of Texas river authorities.

The last element to be covered in this chapter is the rate-setting objectives of Texas river authorities. The last objective set forth in Chapter I is to assess and compare the rate-setting objectives of Texas river authorities. This rate-setting element addresses

that objective. This chapter deals with only data description. Analysis and interpretation of data is dealt with in the next chapter.

WATER SUPPLY CONTRACTS

All river authorities involved with the supply of water commit most of their water supplies to various uses and customers through contracts. These wholesale suppliers of water have a contract with their customers that contain legal agreements that need to be dealt with before the river authority supplies the water to the customer.

There are fifteen river authorities in Texas, all of which were surveyed for their information on their rates and contracts in early August 2004. Contact information was found on the official websites of each river authority. When the contact information of the person in charge of rates was not available, it was acquired from the person whose contact information was displayed on the website. An e-mail was sent to all the river authorities. Response with their contracts ranged from almost an immediate response to several months. The procedure followed was to send an e-mail reminder to those authorities that did not respond within the first three weeks after the initial e-mail was sent out. Another e-mail reminder was sent out following the lack of response with three authorities. Later, phone calls were made to those authorities that had still not replied with their information.

Out of the fifteen, four river authorities claim to not be involved in water supply operations and one is not involved in wholesale water supply operations. The four are the Angelina Neches River Authority, the Nueces River Authority, the Sulphur River Basin Authority, and the Upper Guadalupe River Authority. The Red River Authority of

Texas is involved in the retail supply of water. The remaining ten river authorities are therefore wholesale suppliers of water. Contracts were obtained from all the authorities except for the Lavaca Navidad River Authority (LNRA). Despite several requests by e-mail and finally by telephone, the authority did not provide their contract terms.

Ten contracts were received from the nine authorities, TRA replied with two contracts. These contracts were examined and the terms in all contracts were tabulated. The number of pages would not be an indication to the length of each contract rather the number of words would be a better indicator of the length. For example, BRA has only 13 pages but has 6,951 words while LCRA has 28 pages, it has 6,728 words. These are the wordiest contracts of the nine river authorities whose contracts were analyzed. The shortest is the contract of GBRA, consisting of 3 pages and 1,254 words. LNVA's contract is slightly wordier at 2,720 words and 6 pages. SARA and TRA's representative city contract have about the same number of pages and words. SARA has 11 pages and 4078 words while TRA has 9 pages and 4089 words. Word counts were not performed for the remaining contracts, because they were not received in an electronic format. Given that each of the contracts has various terms, related features were grouped together and tabulated. This led to the six separate tables labeled as Tables 3.1-3.6. Six groupings are as follows.

- Price and quantity terms
- Water terms
- Environmental terms
- Legal terms

- Dispute and regulation terms
- Construction terms

Not surprisingly, some contract elements are unique to certain authorities.

Price and Quantity Terms

The contract term for the exceedance of contracted quantity in Table 3.1, found its way into the contracts of the Lower Colorado River Authority (LCRA), the Sabine River Authority of Texas (SRA), the Lake Livingston Project part of the Trinity River Authority (TRA) and the Upper Colorado River Authority (UCRA). This term ensures that if the customer's annual diversion is greater than the contracted quantity agreed upon in the contract, then the customer would have to settle on a new standard water supply contract for a larger quantity.

Also, the authority would then be able to charge the customer an extra amount for the additional amount of water diverted by the customer in excess of the contracted quantity. In the case of the Brazos River Authority (BRA), if the customer were to divert more water than is stated in the contract, then the authority’s ability to provide to its other water customers would be affected. In case the customer requires an additional amount of water then he agrees to turn in a "written notice" ahead of time of need. This is also true of LCRA.

The next term of Table 3.1 pertains to "limitation in water quantity", present only in the contract of the Lower Neches Valley Authority (LNVA). The authority is required

TABLE 3.1. Contract Price and Quantity Terms.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Price and Payment of Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Contracted Quantity	✓	✓	✓		✓	✓	✓	✓	✓	
Exceedance of Contracted Quantity	✓		✓		✓			✓		✓
Limitation on Quantity				✓						
Rate Revision		✓					✓			

A : Lake Livingston reservoir; B : A Representative City

to only provide its customers with the water that it has available to it. Also according to the contract, the authority has no obligation to enlarge its water supply capacity so it may supply the customer with more than the contractual quantity. There is also a clause which is highlighted in the contract that claims that in case of "unforeseen and unexpected incidents" that curb the availability of an adequate amount of water, then the available water will be circulated and divided as stated by Section 11.039 of the Texas Water Code (reproduced in Appendix A of this thesis).

The last term in Table 3.1, rate revision, is present only in the contracts of the Guadalupe-Blanco River Authority (GBRA) and the San Jacinto River Authority (SJRA). This term explains that the authorities have the obligation, duty, and the power to revise water supply rates from time to time. These rate revisions may be introduced only after the authority has given the customer advance written notice of the increase in rates.

Water Terms

The first item of Table 3.2, "point(s) of diversion", is present in the contracts of GBRA, LCRA, LNVA, SRA, the San Antonio River Authority (SARA), SJRA, and the representative city section of TRA[1]. This explains the geographical location where the customer may divert water from. There is normally a map also attached to the contract, indicating the location. It may alternatively be called the "point(s) of delivery" or "delivery point", or "delivery of water".

[1] When surveyed for contracts, the TRA provided two separate contracts, one for the City of Ennis and another for Lake Livingston area. The City of Ennis is considered to be a representative city in the dealings of the TRA.

SRA allows the "construction of facilities on and across the authority's land, the customer provides the necessary documents in approving the usage of the authority's land in a manner acceptable to the authority". The facilities used by the customers are also subject to flood damage due to its location near a watercourse. The customer is supposed to recognize the possibility of flood damage and is asked to assume the risk in case such an event does occur. Also, the customer agrees that the use of the facilities shall not cause pollution of reservoirs and other adjoining water bodies. This clause is also found in BRA's contract.

The "metering of diverted water" is a clause present in the contracts of all authorities. The customers agree to bear the cost when they install, operate, and maintain meters for the accurate measuring of all water diverted by them in order to aid authorities in accurately reporting the actual water usage.

The "purpose of use" clause as seen in Table 3.2, is present in the contracts of LCRA, SRA, SARA, and the representative city entity of TRA. LCRA and SARA specify in their contracts that if the authority is selling water to a "municipal institution", the water ought to be used only for municipal purposes by the customer. This is also specified in the contract of SRA, along with the location served by the customer's municipal water system. The contracts of SRA and TRA also mention further sales made by the customer to being made on a retail basis, and the customer is prohibited to sell water on a wholesale basis.

"Area of use" is sometimes mentioned along with the "purpose of use". In the case of LCRA there are two separate entries for the purpose of use and the area of use.

TABLE 3.2. Contract Water Terms.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Point(s) of Diversion		✓	✓	✓	✓	✓	✓		✓	
Facilities for Diverting Water	✓				✓					
Metering of Diverted Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Purpose of Use			✓		✓	✓			✓	
Area of Use			✓		✓	✓			✓	
Availability of Water	✓		✓		✓					
Operations of Dams and Reservoirs			✓							
Interbasin Transfer	✓		✓							
Water Conservation/Drought Contingency Measures	✓	✓	✓	✓	✓	✓		✓	✓	

A : Lake Livingston reservoir; B : A Representative City

The "area of use" for LCRA is restricted to a certain area containing a given number of acres and this area is described in maps. SRA, SARA and the representative city entity of TRA have a combination of the purpose and area of use entry.

The "availability of water" section in BRA, LCRA and SRA contracts state that the authorities will make an amount of water that is not exceeding the contractual amount, available to the customer from the authority's water supply per fiscal year. The customer also does not acquire any property right other than its "diversion and use under the terms of contract" (LCRA).

LCRA is the only authority to have the "operation of dams and reservoirs" section in the contract as listed in Table 3.2. The right of LCRA to "maintain and operate its several dams on the Colorado River and at any time in the future to impound and release waters is required to be recognized by the customer in the contract". Also there is no obligation upon LCRA to "release or not release any of the stored waters at any time or to maintain any waters at any specified level".

The last term in Table 3.2, the "water conservation/drought contingency measures" clause is present in the contracts of all the authorities except for SJRA and UCRA. Here the customer agrees to implement the water conservation program and drought contingency measures in accordance with the water conservation plan of the river authority. Also the customer has to agree that if they provide water to a third party that will in turn sell the water to the final consumer, the requirements with reference to water conservation will be met through contractual agreements between the customer

and the third party providing for the "establishment and implementation of a water conservation program in compliance with law".

Environmental Terms

The "nonpoint source water pollution abatement" section is present only in the water supply contracts of BRA and LCRA, as seen in Table 3.3. In this case the customer agrees to execute a nonpoint source water pollution abatement program in agreement with the nonpoint source pollution abatement plan of the authority. The authority may from time to time adopt rules and regulations relating to the abatement of nonpoint source water pollution and the customer is "required to amend its plan as necessary to reflect such pollution abatement rules" (LCRA). There is also a stipulation in the contract of the BRA under the "quality of water" term, that the customer is "required to implement water quality protection measures which include a nonpoint source water pollution abatement program in accordance with a nonpoint source water pollution abatement plan".

The "quality of water" clause may be found in most of the authorities' contracts. This may be seen in Table 3.3 which also indicates that UCRA is the only river authority that does not have this clause in its contract. This clause may have a different meaning in each contract. With BRA, this section requires that the "customer comply with the water quality standards of Texas in the diversion, use, reuse, or discharge of water made available by the authority. With GBRA this clause is interpreted as "the type of water being supplied as being untreated water as it occurs in the Guadalupe River at the point of diversion". LCRA uses this section to decline liability. It "makes no representation as

TABLE 3.3. Contract Environmental Terms.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Nonpoint Source Water Pollution Abatement	✓		✓							
Quality of Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Sewage Regulations										
Wastewater Treatment			✓						✓	
Environmental Quality										✓
Development and Water Quality Regulations			✓							

A : Lake Livingston reservoir; B : A Representative City

to the quality of the water supplied under the contract and the customer is to release LCRA from any impairment in the quality of water supplied under the contract caused by any acts or omissions on the part of the LCRA". LNVA has a combination of both GBRA's and LCRA's quality of water sections. SRA's contract has a variation which explains the quality as being that of "raw water, i.e., non-potable, raw and untreated". The mentioned terms are as per SRA's contract and could be considered differently by different authorities. SARA's contract states the quality of water as being the quality of drinking water, provided that the "customer does not hold the authority responsible for the quality, the treating and testing of the water". SJRA's contract puts forth a slightly different agreement. The "authority will take measures to maintain the quality and prevent pollution of the water. It also will make it known to the customer in case there are any unforeseen permanent changes in the water quality which might adversely affect the customers".

The representative city section of TRA has a different approach to the "quality of water" term. Here the customer is required to cooperate and assist the authority in developing and implementing plans to maintain and improve the quality of water. The quality of water stipulation in the Lake Livingston Project contract of TRA is different in that it refers to the quality as being "non-potable, raw and untreated water". The authority also "disclaims any warranty as to the quality or suitability for use by the customer. The customer is required to agree that any variation in the quality of the water will not entitle the customer to avoid its obligations to pay for the water".

The "sewage regulations and wastewater treatment" sections may be found in LCRA and TRA contracts. The "customer agrees to obtain all approvals required by all applicable local, state, or federal agencies for any sanitary sewage systems which collect sewage derived from water diverted" (LCRA).

The "environmental quality" segment is found only in the contract of UCRA. The contract stipulates that "during any construction, operation, and maintenance by the City of Miles [*the authority's one and only customer*], of any facility, specific actions will be taken to control environmental pollution which could result from such activity and to comply with all federal, state, and local laws concerning environmental pollution".

LCRA is the only authority having any information on the "development of water quality regulations" within its contract. This may be seen listed in Table 3.3. Here the "customer agrees to provide LCRA with written verification that all the plans and designs of improvements to be constructed by the customer are in compliance with federal, local and state laws, before the actual diversion of water takes place".

General Provisions

All nine authorities have the "term of the contract" or the agreement present in the contract. This fact may be noted from Table 3.4. The beginning and end date of the contract may be found under this section. Some state the number of years for which the contract is in force.

The "termination of contract" is also stated by all authorities with either a separate clause for the same or by stating the end date for the contract in the clause for the term of the contract. This is the case with BRA, LNVA and SARA. GBRA's contract

TABLE 3.4. Contract General Provisions.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Term of Contract	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Termination of Contract		✓	✓		✓			✓	✓	
Notice	✓		✓	✓	✓	✓	✓	✓	✓	
Assignment of Contract	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Compliance with Filing Requirements			✓					✓		
Previous Contract			✓							
Indemnification			✓		✓			✓	✓	
Force Majeure	✓		✓	✓	✓	✓	✓	✓	✓	
Representations and Warranties			✓							
Amendment			✓							
Binding Effect			✓							
Severability	✓		✓		✓	✓		✓	✓	
Equity					✓					
Pledge of Revenue					✓				✓	
Waiver	✓			✓	✓	✓			✓	
Delinquent Payments								✓		
Annual Adjustment		✓								
No Third-Party Beneficiary			✓	✓	✓	✓	✓		✓	
Return Flows					✓			✓	✓	
Payment of Taxes								✓	▪	

A : Lake Livingston reservoir; B : A Representative City

states that the customer may terminate the contract at any time for any reason by giving the authority written notice of termination. LCRA states in its contract that "the contract may be terminated if a customer who is current on all payments may terminate the contracts by giving an advance notification in writing past the expiration of 5 years". Or, LCRA may terminate the contract when it finds that the customer has failed to comply with the terms and conditions of the contract by failing to make payments. Also the contract may be terminated if the customer fails to follow the conservation plan or the nonpoint source pollution abatement plan. If the customer fails to comply with the sewage regulations and development of water quality regulations, the contract may also be terminated. Any other requirements not plainly stated in the contract that were not met by the customer would also lead to termination. The contract may also be terminated immediately by LCRA upon the declaration of bankruptcy by the customer.

SRA's contract states that if the authority decides to terminate the contract, then the authority will provide an advance written notice to the customer. TRA's Lake Livingston contract mentions the contract being terminated upon the "mutual written consent of both the customer and the authority". The contract of the city section states that if TRA decides to terminate the contract then it should deliver written notice to the customer.

LCRA refers to the "notice" clause in its contract as the notice under the contract being "transmitted by certified mail, with the return receipt requested and being effective on the date received". LNVA states the notice section as "any notice required or authorized to be given under the terms of the contract will be in writing and will be

delivered in person at the office address". With SRA, "all notices, payments and communications (collectively called notices) required by the contract are required to in writing and be given by hand-delivery or by depositing the notice in the U.S. mail, postage prepaid, registered or certified, with return receipt requested, and addressed to the party to be notified". This is also the same for BRA, SARA, SJRA, the representative city section, and the Lake Livingston Project of TRA. This may be noted in Table 3.4.

The "assignment of the contract" is a clause present in the contracts of all the river authorities. Grismore (1933) discusses this term as follows.

> The early common law took a strictly logical view in regard to the assignability of contract rights and duties. Since a contract is essentially a personal relationship voluntarily entered into by the parties to it, it follows as a logical deduction that one of the parties should not be allowed to destroy that relationship by introducing a third person into it in his place without the consent of the other party. In order that some measure of choice in regard to the person at the other end of a relationship created by the contract may be retained it has become common practice for the parties to incorporate in the contract a clause prohibiting or at least restricting its assignment.

According to BRA, the contract may be assigned by the customer only with the written consent of the authority. Similarly, with the GBRA, the customer may not assign the contract without the prior written consent of GBRA. The customer of LCRA may "assign the contract only upon obtaining the approval of the authority in accordance with

the requirements for substantive amendments of contracts in LCRA's Water Sale Contract Administrative Rules". SRA's contract has something very similar to that of BRA, wherein the authority also provides consent for the customer to assign the contract to the USA for collateral. With SARA, "neither party may assign the contract without the prior written consent of the other party except to a successor of the duties of that party". SJRA's contract is similar to that of SARA, so also is that of TRA (both sections) and UCRA.

LCRA and the Lake Livingston Project of TRA are the only authorities that make mention of "filing plans" in their contracts. According to the contract of TRA, "before diverting water the customer should file and have approved by the authority, detailed plans and specifications for the diversion structure. A narrative description of the location, size, and maximum diversion rate of the facility and a vicinity map showing the location of the diversion structure and place of use shall be attached as an exhibit to the contract. A legal description of the point of diversion should be provided including the bearing and distance from a known survey point and the latitude and longitude in degrees, minutes, and seconds. The cost of diversion facilities and costs associated with the operation and maintenance will be required to be borne by the customer". LCRA agrees to "file a copy of the contract with the Executive Director of the Texas Natural Resource Conservation Commission, the customer is required to understand that the effectiveness of the contract is dependent upon compliance with the substantive rules and procedural rules for water rights of the Texas Natural Resource Conservation Commission".

The only authority to have a clause pertaining to "previous contract" within its contract agreement is LCRA. It stipulates that "upon the effective date of the contract that certain Water Sale Contract between LCRA and the customer shall be null, void, and of no further legal force and effect".

Indemnification is a clause present in LCRA's contract, as well as those of SRA, and TRA. This may be noted in Table 3.4.

> The customer is supposed to indemnify and save the authority from any and all claims to which the authority may be subjected by reason of any injury to any person or damage to any property resulting from any actions (or failure to act) of the customer under the contract except to the extent caused by the authority's gross negligence or willful misconduct (LCRA).

The authority will also save the customer from any claims to which the authority may be subjected by reason of any injury to any person or damage to any property resulting from or in any way connected with any actions (or failure to act) of the authority under this contract.

One of the common terms that the authorities share, except for GBRA and UCRA, is that of force majeure. The term "Force Majeure", according to LCRA, means:

> Those situations or conditions which are beyond the control of the authority or the customer and which, after the exercise of diligence to remedy such a situation, render the authority or the customer unable to carry out the contract. Such force majeure includes but is not limited to acts of God, strikes, lockouts, acts of the public enemy, orders of any kind

> of the government of the United States or of the State of Texas or any civil or military authority, insurrections, riots, epidemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, civil disturbances, explosions, breakage or accidents to machinery, pipelines, canals, or dams, partial or entire failure of water supply insofar as each of the foregoing are beyond the reasonable control of the party in question. The authority will not be held liable or responsible for any damage that may be caused by its inability, after the exercise of diligence, to make the supply of water available to the customer due to any force majeure.

Both LCRA and the customer "represent and warrant" to the other that "the contract will be duly executed by an authorized officer and constitutes a valid and binding contract, enforceable against according to its terms".

With LCRA alone do we find the "amendment" section. "The contract may not be modified or amended except by an instrument in writing signed by authorized representatives of the parties". The same is also true with the "binding effect" clause. The "terms of the contract is binding upon, and inure to the benefit of, the parties and their permitted successors and assigns" (LCRA).

"Severability" is found in most contracts except for those of GBRA, LNVA, SJRA, and UCRA. This may be noted from Table 3.4. In the event that any provision of the contract is held invalid by any court, the parties should negotiate an "equitable adjustment" to the provisions of the contract.

> The provisions of the contract are severable and if for any reason any one or more of the provisions in the contract is held invalid, illegal or unenforceable in any respect, the invalidity, illegality or unenforceability will not affect any other provision of the contract and the contract will remain in effect and be considered invalid, illegal or unenforceable provision had never been contained in the contract (LCRA).

A clause referring to "equity" is found only in SRA. Here "the customer acknowledges that it will accrue no equity or any other interest in the contract or any other assets of the authority as a result of payment or other performance of the customer under the contract".

"Pledge of revenue" is present in the contract of the representative city section of TRA. Here the customer is required to acknowledge that all the payments that will be made by it are the necessary "operating expenses" and that all these payments will be made from the revenues of the "water system". The customer also "agrees throughout the term of the contract to operate and maintain its water system and to fix and collect rates and charges for water services to be supplied by its water system so that it will produce revenues in an amount equal to all of its payments under the contract".

According to BRA, the "waiver" section states that "any waiver at any time by any party of its rights with respect to default under the contract shall not be deemed a waiver of such rights with respect to any subsequent default or matter". This is the same for LNVA, SRA, SARA, and the representative city section of TRA.

The "delinquent payments" section is present only in the contract of the Lake Livingston Project of TRA. "All amounts due and owing to the authority by the customer, if not paid when due, bear interest at the rate of ten (10) percent per annum from the date when due until paid". If any amount due and owing by the customer to the authority is placed with an attorney for collection, the customer pays the authority the attorneys' fees, in addition to all other payments, including interest.

"Default in payments" is a common term in most of the contracts. It is found in the contracts of BRA, LCRA, SRA, SARA, and TRA. All amounts due and owing to the authority by the customer according to the contract are billed and paid monthly. "If not paid when due, such amounts bear interest at the maximum rate allowed by law, from the date when due until paid; provided that such rate shall never exceed the maximum rate as otherwise permitted by law" (BRA). If any amount due by the customer is placed with an attorney for collection by the authority, then the customer shall pay the authority, including interest, the authority's collection expenses and any related court costs and attorney’s fees.

The "annual adjustment" section is present only in the contract of GBRA. "The customer agrees to pay GBRA, an amount equal to the raw water rate times the number of acre-feet by which the total amount of water diverted at the point of diversion in the previous calendar year exceeds the annual commitment, provided, however, that nothing in this section shall be construed as obligating GBRA to supply in any year more water than the annual commitment".

With the "no third-party beneficiary" section, as seen in Table 3.4, the parties enter into the contract for their benefit and agree that "nothing shall be considered to confer any right, privilege or benefit on any person or entity other than the parties". This clause is present in the contracts of LCRA, LNVA, SRA, SARA, and the representative city section of TRA.

The "return flows" segment can be found in the contracts of SRA, as seen in Table 3.4, and both sections of TRA. Here the customer acknowledges that some of the water supplied to it by the authority may be returned to the watercourses as return flows. The authority believes that the most economical means for meeting some of the future demands of the authority's customers may involve the use of return flows to extend or augment the yield of the authority's reservoirs. The customer agrees that the authority has the right to make whatever reuse of the water the authority deems desirable. "The customer receives no compensation, credit, or off-set for making return flows available to the authority according to the contract" (SRA).

Another segment that is unique to one of the authorities is the "payment of taxes" segment in the contract of the Lake Livingston project of TRA. That is, "in the event any sales or use taxes, or taxes of any similar nature are imposed on gathering, taking, sale, use, or consumption of the water received by the customer, the amount of such taxes are required to be borne by the customer". In addition to all other charges, and whenever the TRA is required to pay, collect, or remit any such taxes on water received by the customer, then the customer is required to reimburse TRA.

Dispute and Regulation Terms

The clause for "dispute resolution" is found only in the contract of LCRA. This may be seen in Table 3.5.

> In the event any dispute, controversy or claim between or among the parties arises under this contract including, but not limited to, a Dispute or Controversy relating to the effectiveness, validity, interpretation, implementation, termination, cancellation or enforcement of this contract, the parties shall first attempt in good faith to settle and resolve such Dispute or Controversy by a) mutual agreement, b) arbitration, c) emergency relief, or d) survival.

SRA, and the representative city section of TRA have clauses that deal with disputes but not so much about their resolution.

The "failure to deliver" segment is unique to the contract of the Lake Livingston Project section of the TRA. Here, the customer understands that the authority has made commitments of water available to authority under Certificate of Adjudication No. 08-4248, as amended, prior to the effective date of the contract. "The customer agrees that in the event of water shortage, the authority shall incur no liability for the reduction or termination of sales of water".

The "actual damages" clause is found only in LCRA's contract. Here, neither party shall be liable or have any responsibility to the other for any "indirect, special,

TABLE 3.5. Contract Disputes and Regulations Terms.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Dispute Resolution			✓							
Default in Payments	✓		✓		✓	✓		✓	✓	
Failure to Deliver								✓		
Actual Damages			✓							
Regulatory Bodies				✓						
Regulatory Requirements		✓			✓	✓			✓	

A : Lake Livingston reservoir; B : A Representative City

consequential, punitive or delay-related or performance-related damages including, without limitation, lost earnings or profits. Such limitation on liability shall apply to any claim of action, whether it is based on whole or in part on contract, negligence, strict liability, tort, statute or any other theory of liability".

The clause for "regulatory bodies" is present only in the contracts of LNVA, TRA, and SJRA, as seen in Table 3.5. Here, the "contract is subject to all valid rules and regulations and laws applicable passed by the United States, the State of Texas and any municipal or other government body or agency or by an authorized representatives or agent of any of them, having lawful jurisdiction" (LNVA).

The "regulatory requirements" section of the water supply contracts are related to the regulatory bodies segment and is found in the contracts of GBRA, SRA, SARA and the city section of TRA. The "contract is subject to all applicable federal, state, and local laws and any applicable ordinances, rules, orders, and regulations of any local, state, or federal governmental authority having jurisdiction. The contract is specifically subject to all applicable sections of the Texas Water Code and the rules of the Texas Commission on Environmental Quality, or any successor agency" (SRA).

Construction Terms

City of Miles, as the only customer of UCRA, is required to reimburse UCRA during any month of the contract all those charges assessed the UCRA by the City of San Angelo for electrical pumping of water delivered to the City of Miles. The City of Miles is solely responsible for construction and maintaining its pipelines and connection at the point of water delivery from UCRA to its well field and pump station. Both of

TABLE 3.6. Contract Construction Terms.

Terms	BRA	GBRA	LCRA	LNVA	SRA	SARA	SJRA	TRA		UCRA
								A	B	
Reimbursement for Electrical Pumping Construction and Maintenance										✓
										✓

A : Lake Livingston reservoir; B : A Representative City

these provisions may be seen in Table 3.6.

WATER SUPPLY RATE SCHEDULES

Acquiring the rates used by Texas river authorities in the wholesale supply of water was done in the same manner as that of the water supply contracts. All fifteen river authorities were surveyed for their water supply rates via e-mail early August 2004. A reminder was sent to those river authorities that did not respond with the information. This was repeated one more time before the authority was called and the information was requested of the person in charge of such information. Ten river authorities involved in wholesale water supply replied with their rates. These rates are categorized into municipal, industrial, and agricultural rates. After collating the information and tabulating it, a draft of the table was e-mailed to the ten river authorities that are involved in wholesale water supply for verification in June 2005. Along with the different rates which are identified in Table 3.7, a separate column indicates whether a block rate structure is being applied. These normally include increasing, decreasing, or uniform rates. With a decreasing block rate, the buyers will find that the price of water paid within each block is constant but as the consumption of water increases to a higher block, the price falls. With the increasing block rate structure the opposite is true. With a uniform rate all increments of water provided are priced equivalently. A "D" in Table 3.7 indicates a decreasing block rate structure is used by the river authority. None of the authorities reported an increasing block rate structure.

A reserve rate is a rate set for any water that is reserved for future use. This amount helps the river authority in paying development costs and the other water

resources management costs for water that is stored or reserved for future use. The customer pays for a quantity of water in the present that is intended to be used in the future. None of the river authorities, other than LCRA, make any mention of possessing a reserve rate.

BRA used to have a reserve rate that has been removed recently. However, these reserve rates may continue to exist within its 'legacy contracts'. These contracts have been set up for as a long as forty years, with customers paying the same water rate as set at the time of contract being signed the first time. These contracts were set up years ago with no thought given to inflation. BRA may be charging its regular customers what it might be losing due to its legacy customers. Interruptible water is that water which is available to the customer only if there is enough left over after the firm water customers' requirements are met. This is an insecure supply of water. If there were to be any shortage of water, then it would be interruptible water customers who would be the first to be cut off. As the water availability has a lower probability so also is its value. LNVA's agricultural customers use interruptible water. LCRA's customers also have the option to use interruptible water at a lower rate, or pay the uniform rate of $105 that it charges all its customers.

Some authorities apply the same rates to all three classes. GBRA, LCRA and TRA have the same uniform rate for all three user types. Other authorities have the same water supply rate for municipal and industrial purposes and a different rate for agricultural users. The Toledo Bend Division of SRA has this rate structure. It may be noted that SRA agricultural users pay almost a fourth of what other customers pay.

TABLE 3.7. Wholesale Water Rates for 2004 (per Acre-Foot).

River Authority	Municipal Purposes	Industrial Purposes	Agricultural Purposes [a]	Reserve Rate	Block Rates [b]
1. Angelina Neches	-------Not engaged in water supply operations-------				
2. Brazos	------$45.75------				
3. Guadalupe-Blanco	$88	$88	$88		
4. Lavaca Navidad [c]	------$93.87------				
5. Lower Colorado [d]	$105	$105	$105	$52.5	
6. Lower Neches	$51.35	$56.19	$15 [e]		
7. Nueces	------Not engaged in water supply operations------				
8. Red River	------Not engaged in wholesale water supply operations------				
9. Sabine					
Gulf Coast Division [f]	0 - 250,000 gal $46.77 - $96.77	0–250,000 gal $54.8-$106.5			
	250K – 500K gal $46.5	250K – 500K gal $54.5	$9.25		D
	500K – 1000K gal $43.2	500K – 1000K gal $51.3			
Toledo Bend Division [g]	0 - 250,000 gal $40.32 - $80.64				
	------250K – 500K gal $40------		$9		D
	500K – 1000K gal $36.7				
10. San Antonio	$84				
11. San Jacinto	0 – 10,000,000 gal $73.7				
	10,000K – 20,000K gal $65.5				
	------20,000K – 50,000K gal $61.4------				
	50,000K – 150,000K gal $57.3				
	150000K – 300000K gal $55.3				D
12. Sulphur	------Not engaged in water supply operations------				
13. Trinity [h]	$75	$75	$75		
14. Upper Colorado [i]	$140				
15. Upper Guadalupe	------Not engaged in water supply operations------				

[a] Some of the reported agricultural rates pertain solely to interruptible rates. Consult the footnotes for individual river authorities to see.

[b] Block rates are marked "I" for an increasing block rate structure or "D" for a decreasing block rate structure.

TABLE 3.7 Continued.

[c] Lavaca Navidad River Authority provides interruptible water supply to its customers at half the firm water rate at $46.94.

[d] Customers pay $105.00 per acre-foot for firm water supply and $4.50 per acre-foot for interruptible water supply, subject to availability on a semi-annual basis. They also pay a reservation charge = amount of water used in calendar year minus quantity allowed per year contracted for, and that difference is billed at $52.50. If the amount of water exceeds the quantity allowed per year then a fee of $200 per acre foot is assessed.

[e] Lower Neches Valley Authority(LNVA) provides interruptible water to only its agricultural customers at $15.00

[f] The rest of the rate schedule is as follows:

Municipal Customers		Industrial Customers	
1000K – 2000K gal	$40	1000K – 2000K gal	$47.74
2000K – 4000K gal	$37.4	2000K – 4000K gal	$45.16
4000K – 7000K gal	$35.16	4000K – 7000K gal	$42.9
7000K – 11000K gal	$33.54	7000K – 11000K gal	$41.29
11000K – 16000K gal	$31.93	11000K – 16000K gal	$39.67
16000K – 22000K gal	$30.96	16000K – 22000K gal	$38.38
22000K or more gal	$30.64	22000K or more gal	$38.06

[g] The rest of the rate schedule is as follows:

Municipal & Industrial Customers	
1000K – 2000K gal	$33.54
2000K – 4000K gal	$32.25
4000K – 7000K gal	$30.32
7000K – 11000K gal	$28.7
11000K – 16000K gal	$26.77
16000K – 22000K gal	$25.80
22000K or more gal	$25.48

[h] This rate applies to the Lake Livingston Project alone.

[i] Has only one customer: City of Miles.

SARA does not supply water to industries or agricultural users. As noted previously, UCRA supplies water only to the City of Miles. The rate quoted in Table 3.7, is the only one for the authority. SJRA does not have any agricultural customers and has the same rate for both its industrial and municipal customers. LNRA has the same rate for both its municipal and industrial customers and does not have an agricultural clientele.

The rate that is displayed for TRA raw water is $75/AF. However, this rate is applicable only to TRA's Lake Livingston Project. The authority also owns water rights in other reservoirs, but those are Corps of Engineers (COE) lakes. TRA serves as a local sponsor for these lakes and sells the water to other entities on a pass-through basis. That is, the amount that COE charges TRA for the local sponsor's share of the debt and the annual operations and maintenance costs are passed on to TRA's customers. These costs vary from year to year depending on COE expenses at each reservoir each year. Also TRA has been phasing in a new rate over the past several years. Following a rate study in 1999, it was determined that the Lake Livingston raw water rate should be $95/AF. They hope to have their targeted rate in place by the end of year 2006 (Robert Stevens, TRA).

From the information provided by the authorities, it was evident that SRA and SJRA both had decreasing block structures. This may be said for these river authorities because of the schedules of rates that were provided. Other river authorities did not provide schedules giving rates according to the quantities. Hence, it can not be said that they have block rate structures.

STATUTES AND POLICIES

There is one statute that river authorities are required to follow that affect the setting of rates. The only direct reference to rates is made in Title 6, Chapter 222, Section 222.011 of the Texas Water Code. This chapter in the Texas Water Code is titled "Lower Colorado River Authority", meaning that this one reference to rates and charges is meant only for LCRA and not for the other authorities. This section has been reproduced in Appendix 2 of this thesis. This section clearly states that "the fees and charges must be reasonable and nondiscriminatory and sufficient to produce revenues adequate…". This indicates the importance of revenue sufficiency. There is nothing mentioned here about any other objectives such as economic efficiency, simplicity, equity and fairness, or resource conservation. If any other objective is implicitly supported to any extent, it is legality.

Title 2, Chapter 13 of the Texas Water Code, titled "Water Rates and Services" also refers to fair wholesale rates for wholesale water supply to water districts, but this is not applicable to river authorities as this refers to the sale of water by municipalities.

Chapter 291, Subchapter B of the Texas Commission on Environmental Quality (TCEQ) Rules refers to "Rates, Ratemaking, and Rate/Tariff Changes", and river authorities are only subject to these rules when they take on retail water supply activities (Mr. Bill Smith, TCEQ). Subchapter I of the same chapter refers to "Wholesale Water or Sewer Service", which deals with petitions to rate reviews, and "appeals by retail public utility concerning a decision by a provider of water or sewer service".

WATER SUPPLY RATE-SETTING OBJECTIVES

A questionnaire was sent to all those authorities involved in the wholesale supply of water. This questionnaire requested the authorities to rank and assess six objectives according to their importance. The questionnaire has been reproduced in Appendix 3. There were several authorities that did not respond to the questionnaire the first time it was sent. An e-mail reminder was sent to those that had failed to respond with the completed questionnaire. A copy of the questionnaire was then mailed out again to those authorities that requested another copy.

The authorities were requested to rank the six objectives: revenue sufficiency, economic efficiency, simplicity, equity and fairness, legality, and resource conservation, according to their importance relative to the other objectives. The most important objective was requested to be ranked 1 and the least was supposed to ranked 6. The authorities were also requested to assess the objectives according to their importance either as most important, somewhat important, a concern, rather unimportant, or irrelevant. Rankings and assessments of the rate-setting objectives were obtained to further examine the importance of economic efficiency in river authorities' rate-setting strategies.

The objectives were defined to the authorities in the following manner.

- Revenue Sufficiency: The rate structure and the levels of the rates should adequately recover the total costs associated with providing the service.

- Economic Efficiency: The rate structure should promote patterns and levels of water use that motivate only the most valued uses of the authority's limited water supplies.
- Simplicity: The rate structure should avoid unnecessary complexity and be readily understandable to water users and others who are expected to make decisions based on water prices.
- Equity and Fairness: The rate structure should treat equals equally. Water customers should perceive rates as fair.
- Legality: The rate structure should be consistent with rate setting standards and other applicable laws; i.e. the rates should be legally acceptable.
- Resource Conservation: The rate structure should promote conservation of scarce water resources.

Out of the ten river authorities that were originally contacted, one was unable to furnish the information due to legal difficulties. One other river authority felt that all the objectives were equally as well as most important and so ranked all of the six objectives as 1. The authority also assessed all the objectives as most important. There were only eight legitimate responses that could be used in this inspection. Rankings provided by river authorities are displayed in Table 3.8. Assessments are shown in Table 3.9.

SUMMARY

The fifteen river authorities of Texas were contacted for their rate structures, sample water supply contracts, and their ranking and assessment of six rate-setting

TABLE 3.8. Rankings of Rate-Setting Objectives.

	River Authority							
Objective	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Revenue Sufficiency	1	3	1	1	1	1	2	2
Economic Efficiency	6	4	5	3	2	4	3	4
Simplicity	3	6	6	6	6	5	6	5
Equity & Fairness	5	2	4	5	5	3	5	3
Legality	2	1	3	2	4	2	1	1
Resource Conservation	4	5	2	4	3	6	4	6

TABLE 3.9. Assessments of Rate-Setting Objectives from Most Important to Irrelevant.

	River Authority							
Objective	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Revenue Suffieicncy	1	1	1	1	1	1	1	1
Economic Efficiency	3	1	2	2	1	3	2	3
Simplicity	1	2	2	3	2	3	4	3
Equity & Fairness	2	1	1	3	2	2	3	1
Legality	1	1	1	3	1	2	1	1
Resource Conservation	1	1	1	1	1	3	2	2

1 = Most Important
2 = Somewhat Important
3 = A Concern
4 = Rather Unimportant
5 = Irrelevant

objectives. Out of the fifteen river authorities, four did not deal with wholesale water supply, and one of them dealt with retail water supply and not wholesale which is pertinent to this thesis. The findings from the responses were further tabulated. The variations between the rates and contracts of the ten authorities were examined.

Given that each of the contracts has various terms, related features were grouped together and tabulated. The six groups were price and quantity terms, water terms, environmental terms, legal terms, dispute and regulation terms, and construction terms.

The rates information that was requested was also collated and tabulated. Three different purposes were obtained from the rates schedules of the river authorities: municipal, industrial, and agricultural. Besides these purposes, there were reserve rates as well as increasing, decreasing, and uniform rates discussed. Some charge the same uniform rate to all their customers, while some do not. Some charge a different rate to each of their customers. When requested to rank six rate-setting objectives in the order of their importance by the authority, one of the ten authorities involved in wholesale water supply was not able to respond as it was experiencing legal problems. One other authority ranked all the six rate setting objectives as equally important. The six objectives were revenue sufficiency, economic efficiency, simplicity, equity and fairness, legality, and resource conservation. The authorities were required to rank these objectives from 1 through to 6. They were also requested to assess each objective most important, somewhat important, a concern, rather unimportant, or irrelevant. Their responses were tabulated to enable comparison.

CHAPTER IV

RESULTS

INTRODUCTION

This chapter is divided into three sections. The first section analyzes the rate-setting objectives described in the last chapter. The second section discusses the inferences that may be drawn from rate schedules provided by those river authorities that are involved in the wholesale distribution of water. The third section discusses those water supply contract terms that have some economic significance.

WATER SUPPLY RATE-SETTING OBJECTIVES

Given the size of the sample, quantitative analysis of objective rankings and assessments is restricted to the calculation of the mean and the variance. Revenue sufficiency is ranked the highest by five out of eight authorities on an average. Two authorities rank it second in the list of objectives and one ranks it third. The variance is 1.125 for revenue sufficiency. This shows that there isn't that much of a spread between the rankings made by the river authorities. The variance from the mean is small. Economic efficiency has a varied importance with the river authorities. This may be seen by the different rankings that the authorities give it, ranging from second to sixth. One authority ranks it second, two authorities rank it third, three authorities rank it fourth, one authority ranks it fifth, and one sixth. The variance for economic efficiency is 7.507.

This shows a larger spread, and this is seen in Table 3.8, where the river authorities have marked economic efficiency ranging from second to sixth.

Simplicity is ranked the lowest of the six objectives by five out of the eight authorities. Out of the remaining three authorities, two rank it fifth and one ranks it third. Equity and fairness is ranked fifth by four authorities, fourth by two, third by two, and second by one authority. It has the highest variance for the rankings assigned by river authorities.

Resource conservation, like economic efficiency has a varied ranking. It has been ranked from second to sixth. It is ranked second by one authority, third by one, fourth by three, fifth by one, and sixth by two. Legality is ranked highest by three authorities, second highest by three authorities, third by one, and fourth by another authority.

The objective that river authorities rank second when setting rates is legality. While revenue sufficiency is ranked as most important by some river authorities, there were several who also ranked legality as most important. There is a .5 difference in the means between the revenue sufficiency objective and the legality objective. There is a variance of 2 for the legality objective.

The objective that the river authorities rank on an average as third, as shown in Table 4.1, is economic efficiency. Even though this objective is ranked third, it was a by a very small difference between this objective at 3.875 and the equity and fairness objective which is exactly 4. The variance for equity and fairness is 21.125. The spread or the variance from the mean is rather high only one river authority actually ranked the objective fourth.

TABLE 4.1. Ranking of Rate-Setting Objectives by River Authorities of Texas.

	Rank							
Objective	**1**	**2**	**3**	**4**	**5**	**6**	**Mean**	**Variance**
Revenue Sufficiency	IIIII	II	I				1.5	1.125
Economic Efficiency		I	II	III	I	I	3.875	7.507
Simplicity			I		II	IIIII	5.375	14.445
Equity & Fairness		I	II	I	IIII		4	21.125
Legality	III	III	I	I			2	2
Resource Conservation		I	I	III	I	II	4.25	9.031

The objective that the river authorities rank fourth on an average is equity and fairness. This objective could possibly be considered almost as important as the economic efficiency objective as it comes in fourth by only .125 on an average.

The objective that the river authorities rank fifth on an average, as may be noted from Table 4.1 is resource conservation. The variance for this objective is 9.031. The spread from the mean was not so much hence the variance was not too high. The differences in the averages between the three objectives, of economic efficiency, equity and fairness and resource conservation are very little. The difference between the objective that authorities rank fourth, and the resource conservation objective was .25 on an average.

The simplicity objective was obviously not considered very important while setting rates. The variance for this objective is 14.445. As there were only two authorities that ranked the objective fifth, the spread from the mean was rather high. Given the fact that the river authorities are nonprofit in nature, it is to be expected that revenue sufficiency would be the most important objective.

Assessments of the six objectives as ranked by river authorities are displayed in Table 4.2. The average is taken of each objective's assessment as most important to irrelevant, and the results are tabulated in Table 4.2. This assessment information discloses how river authorities feel about each objective according to its importance whereas the prior ranking of objectives indicates relative importance. All authorities assess revenue sufficiency as most important, while economic efficiency is assessed most important only by two authorities out of the eight reporting. An equal number of

TABLE 4.2. Assessments of Rate-Setting Objectives by River Authorities.

	Rate					
Objective	**1**	**2**	**3**	**4**	**5**	**Mean**
Revenue Sufficiency	IIIIIIII					1
Economic Efficiency	II	III	III			2.125
Simplicity	I	III	III	I		2.5
Equity & Fairness	III	III	II			1.875
Legality	IIIIII	I	I			1.375
Resource Conservation	IIIII	II	I			1.5

1: Most Important

2: Somewhat Important

3: A Concern

4: Rather Unimportant

5: Irrelevant

authorities assess economic efficiency as somewhat important and a concern. Simplicity is assessed as most important by one authority. Again an equal number of authorities assess simplicity as somewhat important and a concern, and one authority assesses it as rather unimportant. Equity and fairness has three most important assessments by the authorities, three somewhat important assessments, and also is assessed a concern by two authorities. Six authorities assess legality as most important while one assesses it as a concern and the other as somewhat important. Resource conservation is assessed most important by five authorities, somewhat important by two authorities, and a concern by the remaining authority. Resource conservation is assessed as most important by five authorities out of eight, and when compared with the earlier rankings this seems inconsistent. Resource conservation is ranked fifth in order of relative importance in Table 4.1. However, when taking into account the assessments made by the authorities, resource conservation looks to be an objective that the authorities consider very important.

WATER SUPPLY RATES SCHEDULES

It may be noted that those authorities that have different rates for each customer actually have a higher rate for their industrial customers, for example, LNVA and the Gulf Coast Division of SRA have a higher rate for their industrial customers. The common element between LNVA and the Gulf Coast Division of SRA is that industrial users pay the highest amount per acre foot of water and agricultural users pay the least. As shown in Table 3.7, LNVA and both the sections of SRA have a very low rate for their agricultural customers while GBRA, LCRA, and TRA have a much higher rate for

their agricultural customers. However, LNVA's lower rate involves interruptible water provided to its agricultural customers while its municipal and industrial customers receive firm water. This may not be the case with SRA. While there are block rate schedules for SRA's municipal and industrial customers, agricultural customers have one rate.

When the draft of Table 3.7 was sent to the river authorities for verification, UCRA requested that they be treated like ANRA or NRA as not engaging in wholesale supply operations. As they do supply water, albeit to only one customer, they are still technically considered to be a wholesaler supplier of water in Texas. Therefore they remain in Table 3.7 and the analysis. The highest rate set for industrial customers by those authorities involved with the wholesale distribution of water is by LCRA. The lowest rate set for the industrial customer is by BRA. LCRA has the highest rate for agriculturists, while the Toledo Bend Division of SRA has the lowest rate for its agricultural customers.

There are differences in rates between authorities because of regional disparities lending itself to a scarcity or abundance in the supply of water. As the quantity available for supply increases or decreases, so also will the price of water, like any other commodity. It would not be efficient to charge the same uniform rate throughout the state of Texas, as the costs of each authority differ given their location. However, charging different rates to different customers by the same authority is not economically efficient. It must be kept in mind that ex ante prices could be the same even though ex post prices may differ with those river authorities that charge a uniform rate to all their

customers. The theory set forth in Chapter II clarifies this. One rate should be used rather than the three different rates used for the three different types of customers. However, there is the case of different rates that could be allowed when it comes to reserve rates and lower rates for interruptible water supply. If a city is paying a lower amount so it may lay some claim to water for its future use, this would not necessarily indicate inefficiency. The same would be the case with interruptible water. The value of interruptible water is lower than firm water as it is an undependable supply and the customer may be left with no water. As this is not the same water as firm water, interruptible water can be priced lower without harming economic efficiency.

The inefficiency or lack of attention to economic efficiency that arises from using different rates to different customers for the same water does not come as a surprise as we can see how the authorities rank economic efficiency in Tables 4.1 and 4.2. However, given that the authorities do not want be running at a loss, or reprimanded for not being legally compliant, the objectives of revenue sufficiency and legality might be constraints. It may be the case that given the two constraints, they are actually putting economic efficiency ahead of all other objectives. Another element that lends itself to economic inefficiency is the usage of the block rates. None of the authorities use increasing block rate structures, but two authorities use decreasing block rate structures. These decreasing block rate structures are inefficient because they might encourage excessive water usage rather than water conservation. In fact, they provide a price incentive to increase water usage, leading to waste.

The rate that agriculture is charged by SRA and LNVA is much lower than the other authorities that have agricultural customers. LNVA's rate is low because the water available for their agricultural customers is interruptible. However, both the divisions of SRA have a low rate, yet the rate is not meant for interruptible water. The water used for irrigation purposes is metered at $9.25 or $9 per acre foot. Irrigation water for agricultural purposes, including supplemental irrigation, will be supplied on "water used" basis, subject to negotiation depending on quantities, frequency, location, etc.

WATER SUPPLY CONTRACTS

Tabulations as shown from Table 3.1-3.6 were made to ease the comparison process, showing exactly where the authorities were similar and where they were dissimilar. There are various terms in these contracts. Some of the contracts are lengthy while some of them are short. They tend to have certain similarities. Some of the contracts may be explained using different terminology, but they boil down to the same meaning.

The price of the water and the contracted quantity of water were found to be a common element in each and every contract furnished by the authorities as shown in Table 3.1.

A potentially important clause that is missing from most authorities' contracts is that of "rate revision". The only authorities that do have this clause in their contracts are GBRA and SJRA as shown in Table 3.1 in Chapter III. As informed by the management of BRA, the authority is now facing a problem of what they term as their 'Legacy Rates.' These rates were set on the contracts and could not be changed for over thirty-five to

forty years. BRA is currently unable to increase rates of these particular customers as these users are entitled, according to their contracts to a contracted quantity of water at a price set some time ago. Nor do these rates account for inflation. Therefore the revenue that is required in the performance of the authority's statutory functions is generated at by passing the burden on to customers without legacy contracts. Economic efficiency is likely to be thwarted in this case.

The costs of metering of diverted water in all the contracts are borne by the customers. This is similar to those of water utilities or the retailer suppliers of water.

SUMMARY

Rankings of the rate-setting objectives by the river authorities are analyzed. Revenue sufficiency is ranked the highest on an average. Legality is ranked second by the authorities. Economic efficiency is ranked third overall on an average. The authorities rank equity and fairness fourth and resource conservation fifth. Simplicity is ranked the lowest by the authorities, as it is ranked sixth by five authorities, incidentally the same number of authorities that rank revenue sufficiency the highest.

None of the authorities find the objectives irrelevant when the objectives are assessed from most important to irrelevant. All authorities assess revenue sufficiency to be most important. Economic efficiency is assessed as most important by two authorities, somewhat important by three authorities, and a concern by three authorities. Simplicity is assessed low, earning one 'rather unimportant' assessment, while earning one most important assessment, three somewhat important and a concern assessments. Equity and fairness is assessed most important and somewhat important by three

authorities each. The remaining two authorities assess equity and fairness as a concern. Legality is assessed most important by six authorities, somewhat important by one and a concern by one authority. Resource conservation is assessed by five authorities as most important, somewhat important by two authorities, and a concern by one authority.

There are differences in metered water rates between authorities because of regional disparities lending itself to a scarcity or abundance in the supply of water. The fact that some river authorities charge different rates to different categories of customers for the same water is economically inefficient. However, there are other rates such as reserve rates and the rates set for interruptible water that may be different from the firm water rate. This would still remain efficient because the water that is being supplied is not the same.

CHAPTER V

SUMMARY AND CONCLUSIONS

RESTATEMENT OF PROBLEM

Potential for water shortages in high growth areas have water providers looking for means to augment water supply. Even political leaders and water resource managers understand the importance of water demand. Price has been noted as an important ingredient in any evaluation of future water demands, since it is a signal of cost administered by water suppliers. Price is an important factor that consumers will use in their decisions on the quantity of water they will consume. Economic efficiency is not given much consideration when setting water rates. According to pricing theory, maximum efficiency is obtained when price is equated to marginal cost (Kahn, 1970; Brown and Sibley, 1986). River authorities use the average-cost pricing model rather than the marginal-cost one. It follows that economic efficiency may not be achieved by river authorities in their rate setting.

RESTATEMENT OF OBJECTIVES

The primary objective of this study is to determine the rates structure and rating policies of the wholesale suppliers of the State of Texas. More specifically the following were the objectives of this study:

1) To study water contracts in use by Texas river authorities by identifying important contract characteristics.

2) To determine the various factors affecting key characteristics of the water contracts used by river authorities in Texas.

3) To gauge whether economic efficiency is being advanced by contemporary water contracts through proper signaling of the appropriate marginal values.

4) To assess and compare the rate-setting objectives of Texas river authorities.

FINDINGS

Wholesale Pricing Theory

With growing water scarcity and increasing competition across water-using sectors, the need for water savings and more efficient water use has increased in importance in water resources management. The economic theory of pricing suggests economic efficiency would be attained at the point where water is priced at the marginal cost. Enhancing economic efficiency is a broad concept seeking the highest economic value of water use through both physical and managerial measures.

We see that water prices, appropriately set and applied at different points of the water supply cycle, perform many valuable functions, such as allocating existing supplies efficiently by confronting water users with the costs of providing water, helping signal water suppliers when supply augmentation is needed, and shaping an economically rational approach to a healthy water environment.

While this theory works for a certain slice of the suppliers of water, it does not work for some others, like the wholesalers. There are certain distinctions between wholesale suppliers and retail distributors of water. The differences between

wholesalers and retailers question the adequacy of the existing theory in its universal application. This calls for a different theory of pricing for wholesale suppliers of water

The retail theory uses three components to determine the price of water, that is, the pricing of new connections, the price of water distributed, and the pricing of existing connections overall. These three instruments are not applied by wholesale purveyors of water. Wholesalers rely almost exclusively on volumetric rates. Here there is only one instrument. The wholesale supplier of water also has a variety of contract terms available for customers.

Depicting economic efficiency with wholesalers is different than with retailers due in part to the position and shape of the average cost curve. The price is said to be economically efficient when it promotes patterns and levels of water use that motivate only the most valued uses of the wholesaler's limited water supplies.

There are alternative assumptions that can be made in the development of a wholesale pricing theory:

1. Using marginal-cost pricing in both sectors with specific reference to the objective of economic efficiency.
2. Using average-cost pricing in both sectors with specific reference to the objective of revenue sufficiency.

As marginal-cost pricing is examined, a policy issue comes into focus. A problem of revenue sufficiency arises in the case of the wholesaler. With the usage of average-cost pricing a different policy issue arises. As long as average costs are declining, water is underused due to the inefficiency in water use.

The policy issues that crop up while using either marginal-cost or average-cost pricing may be solved using certain policy tools. The inefficiency that occurs with average-cost pricing may be solved by using a revising form of marginal-cost pricing. Marginal-cost pricing leads to a revenue shortfall. This problem that arises with marginal-cost pricing may be solved with the use of a lump sum instrument. This lump sum device should be something that is separate from the volumetric price of water; something that will not detract from economic efficiency while providing the wholesaler with revenue sufficiency.

Water Supply Rate-Setting Objectives

This study reveals that on being requested to rank six objectives: revenue sufficiency, economic efficiency, simplicity, equity and fairness, legality, and resource conservation according to their relative importance, the river authorities show a strong preference for revenue sufficiency by almost unanimously ranking it the highest. The objective of undergoing this exercise is to ascertain the relative importance of economic efficiency to the river authorities in comparison with the other five objectives. This objective is ranked third out of the six objectives. Legality is ranked second higher when compared to economic efficiency. Equity and fairness, resource conservation, and simplicity are ranked fourth, fifth, and sixth respectively. It is found that revenue sufficiency and legality are considered more important to authorities when setting rates, than economic efficiency.

The choices that the authorities are given are to assess the six objectives are most important, somewhat important, a concern, rather important, and irrelevant. This study

reveals that assessments made by the authorities show that none of the authorities find the objectives irrelevant. All authorities assess revenue sufficiency to be most important. Economic efficiency is assessed on an average as fifth out of the six objectives.

Water Supply Rate Schedules

This study reveals that some authorities charge the same uniform rate to all their customers like BRA, GBRA, LCRA, LNRA, and TRA. Some charge a different rate to each of their customers like LNVA, SRA, and SJRA. SARA and UCRA do not have any industrial and agricultural customers.

Besides the water rate, LCRA also has a reserve rate. Some authorities also have another rate for interruptible water. LCRA has this rate for all its customers, while LNVA has this rate for only its agricultural customers. LNRA provides all its customers with interruptible water at half the rate of firm water.

There are differences in metered water rates between authorities because of regional disparities lending themselves to a scarcity or abundance in the supply of water. The fact that some river authorities charge different rates to different categories of customers for the same water is economically inefficient. However, there are other rates such as reserve rates and the rates set for interruptible water that may be different from the firm water rate. This would still remain efficient because the water that is being supplied is not the same.

Another element that lends itself to economic inefficiency is the usage of the block rates. None of the authorities use increasing block rate structures, but two authorities use decreasing block-rate structures. These block-rate structures are

inefficient because they might encourage excessive water usage rather than water conservation.. In fact, they provide a price incentive to increase water usage, leading to waste.

Water Supply Contracts

All river authorities involved with the supply of water commit most of their water supplies to various uses and customers through contracts. These wholesale suppliers of water have a contract with their customers that contain legal agreements that need to be dealt with before the river authority supplies the water to the customer.

There are various terms in these contracts. Some of the contracts are lengthy while some of them are short. They have some similarities. There are some terms that may be explained using different terminology but they boil down to the same meaning. There are some terms in contracts that are unique to a particular authority. The number of pages of each contract would not be an indication to the length of each contract rather the number of words would be a better indicator of the length.

A potentially important clause that is missing from most authorities' contracts is that of "rate revision". The only authorities that do have this clause in their contracts are GBRA and SJRA.

LIMITATIONS

The number of river authorities in Texas are not even close to what would be considered a good sample size for statistical analysis. Out of the fifteen, only ten could be considered as part of this study. It was not possible to perform much quantitative

analysis given the small sample size. Since each one of the river authorities is unlike the other, it was hard to compare them.

FUTURE RESEARCH NEEDS

The efficiency-seeking theory that was developed for wholesale suppliers of water could be more mathematically oriented. Although this study had some significant findings in rate differences, contracts, and rate setting objectives of river authorities, there are areas in which future research could be very beneficial. Hopefully this study helps initiate more research in the wholesale as the retail area of water pricing has been worked on extensively.

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APPENDIX I

SEC. 11.039. DISTRIBUTION OF WATER DURING SHORTAGE.

(a) If a shortage of water in a water supply not covered by a water conservation plan prepared in compliance with Texas Natural Resource Conservation Commission or Texas Water Development Board rules results from drought, accident, or other cause, the water to be distributed shall be divided among all customers pro rata, according to the amount each may be entitled to, so that preference is given to no one and everyone suffers alike.

(b) If a shortage of water in a water supply covered by a water conservation plan prepared in compliance with Texas Natural Resource Conservation Commission or Texas Water Development Board rules results from drought, accident, or other cause, the person, association of persons, or corporation owning or controlling the water shall divide the water to be distributed among all customers pro rata, according to:

(1) the amount of water to which each customer may be entitled; or

(2) the amount of water to which each customer may be entitled, less the amount of water the customer would have saved if the customer had operated its water system in compliance with the water conservation plan.

(c) Nothing in Subsection (a) or (b) precludes the person, association of persons, or corporation owning or controlling the water from supplying water to a person who has a prior vested right to the water under the laws of this state.

Amended by Acts 1977, 65th Leg., p. 2207, ch. 870, Sec. 1, eff. Sept. 1, 1977; Acts 2001, 77th Leg., ch. 1126, Sec. 1, eff. June 15, 2001.

APPENDIX II

§ 222.011. RATES AND CHARGES.

(a) The board shall establish and collect rates and other charges for the sale or use of water, water connections, power, electric energy, or other services sold, furnished, or supplied by the authority. The fees and charges must be reasonable and nondiscriminatory and sufficient to produce revenues adequate to:

(1) pay all expenses necessary to the operation and maintenance of the properties and facilities of the authority;

(2) pay the interest on and principal of all bonds issued under this chapter as the interest and principal become due and payable;

(3) pay the principal and interest on any legal debt created by the authority;

(4) pay all sinking fund and reserve fund payments agreed to be made with respect to bonds and payable out of those revenues, as the payments become due and payable; and

(5) fulfill the terms of any agreements made with the bondholders or with any person on their behalf.

(b) Out of the revenues that may be received in excess of those required for the purposes specified in Subsection (a), the board may:

(1) establish a reasonable depreciation and emergency fund;

(2) retire, by purchase and cancellation or redemption, bonds issued under this chapter; or

(3) apply the excess revenues to any corporate purpose.

(c) The rates and charges of the authority may not be in excess of what is necessary to fulfill the obligations imposed on the authority by this chapter or other law. Nothing in this chapter shall be construed as depriving this state of its power to regulate and control fees or charges to be collected for the use of water, water connections, power, electric energy, or other service; provided, however, that this state pledges to and agrees with the purchasers and successive holders of the bonds and other written evidence of indebtedness issued under this chapter that this state will not limit or alter the power vested in the authority to establish and collect fees and charges that will produce revenues sufficient to pay the items specified in Subsection (a), or in any way impair the rights or remedies of creditors or bondholders, or of any person on their behalf, until the bonds and other written evidence of indebtedness, together with the interest on the bonds or indebtedness and the interest on unpaid installments of interest and all costs and expenses in connection with any action or proceedings by or on behalf of the bondholders and all other obligations of the authority in connection with the bonds are fully met and discharged.

Added by Acts 2003, 78th Leg., ch. 996, § 1, eff. Sept. 1, 2003.

APPENDIX III

RATE-SETTING OBJECTIVES BY RIVER AUTHORITIES

Please check the appropriate box on the right of the objective. Also, rank the objectives from 1 to 6, where 1 would be ranked the highest and 6 the lowest, in the box provided on the left of the objective. An explanation of each objective has been provided below for your perusal.

Rank		Most Important	Somewhat Important	A Concern	Rather Unimportant	Irrelevant
☐	Revenue Sufficiency	☐	☐	☐	☐	☐
☐	Economic Efficiency	☐	☐	☐	☐	☐
☐	Simplicity	☐	☐	☐	☐	☐
☐	Equity & Fairness	☐	☐	☐	☐	☐
☐	Legality	☐	☐	☐	☐	☐
☐	Resource Conservation	☐	☐	☐	☐	☐

Revenue Sufficiency: The rate structure and the levels of the rates should adequately recover the total costs associated with providing the service.

Economic Efficiency: The rate structure should promote patterns and levels of water use that motivate only the most valued uses of the authority's limited water supplies.

Simplicity: The rate structure should avoid unnecessary complexity and be readily understandable to water users and others who are expected to make decisions based on water prices.

Equity & Fairness: The rate structure should treat equals equally. Water customers should perceive rates as fair.

Legality: The rate structure should be consistent with rate setting standards and other applicable laws; i.e. the rates should be legally acceptable.

Resource Conservation: The rate structure should promote conservation of scarce water resources.

VITA

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