PRICE ELASTICITY OF NATURAL GAS--ITS EFFECTS ON CONSUMERS AND UTILITY COMPANIES

by

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PRICE ELASTICITY OF NATURAL GAS--ITS EFFECTS ON

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PREFACE

"Utility Costs Overwhelm City's Poor . . . . the bill had built up to $264.84, she said, and the gas company wanted $177 before it would start the gas again at her house . . . ."[1]

The excerpt was taken from an article printed in an Austin newspaper and is typical of problems created by higher utility costs occurring across the country. Consumers of energy of all forms, including natural gas, are seeing prices rise much faster than the consumer price index. (See Graph 1, page 65, of the Appendix.) This is causing a reallocation of disposable income to cover these higher energy costs.

It has been generally thought that energy--specifically natural gas for residential use--was to a large extent a necessity, and therefore price inelastic. As will be shown later, this is not the case. Customers are making choices that are resulting in decreased usage of natural gas. This decrease implies that the customers are changing life-styles to less preferable levels[2] or changing forms of energy. The only close substitute to natural gas is electricity, and change-over is neither instantaneous nor does it provide a less expensive energy source. Electricity in Austin,

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[1]John Kelso, "Utility Costs Overwhelm City's Poor," The Austin American Statesman, Sunday, April 10, 1977, p. B-1.

[2]As will be shown later, the most direct method of decreasing demand is to maintain lower room temperatures in the winter and to reduce usage of gas-burning equipment in general. Since this usage was preferable during lower cost periods, the change in the consumption pattern would indicate a less preferable condition.

as in many areas, is generated from natural gas and is, therefore, increasing in cost. Regardless of the reason, there is another entity to be considered--the public utility. A public utility is by definition:

> . . . . an industry furnishing an essential service and operating under grants of public privilege. In short, it is a business affected with a public interest which operates under a franchise or license issued by a governmental agency. Generally a utility has a monopoly or semi-monopoly on its particular service within a clearly defined area although it is not protected from conpetition offered by other forms of energy or service. The utility is subject to public regulation of its accounting, financing, earnings, pricing, and service policies.[3]

The decrease in sales per customer creates a real problem to the utility in generating sufficient "net" revenues to cover costs and provide an adequate return on investment. This problem is further complicated by the regulatory process.

A utility must apply to the appropriate regulatory agency before prices can be changed. These prices are referred to as rates. The area of rates will be covered in more detail in Chapter 1. However, in simple terms, a rate is determined by dividing historical and normalized sales volumes of natural gas into the total revenues required to provide an allowable profit:

$$\text{Rate Per Unit} = \frac{\text{(Required return on plant + operating costs)}}{\text{normalized sales volume in units}}$$

The term "normalized sales volume" is a method used to estimate the sales per customer per year based on historical data but normalized for weather. For example, if the sales per customer for the test year (usually the last 12 months for which data is available) were 80 M.C.F.

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[3]American Gas Association Rate Committee, Gas Rate Fundamentals, (New York: American Gas Association, 1960) p. xviii.

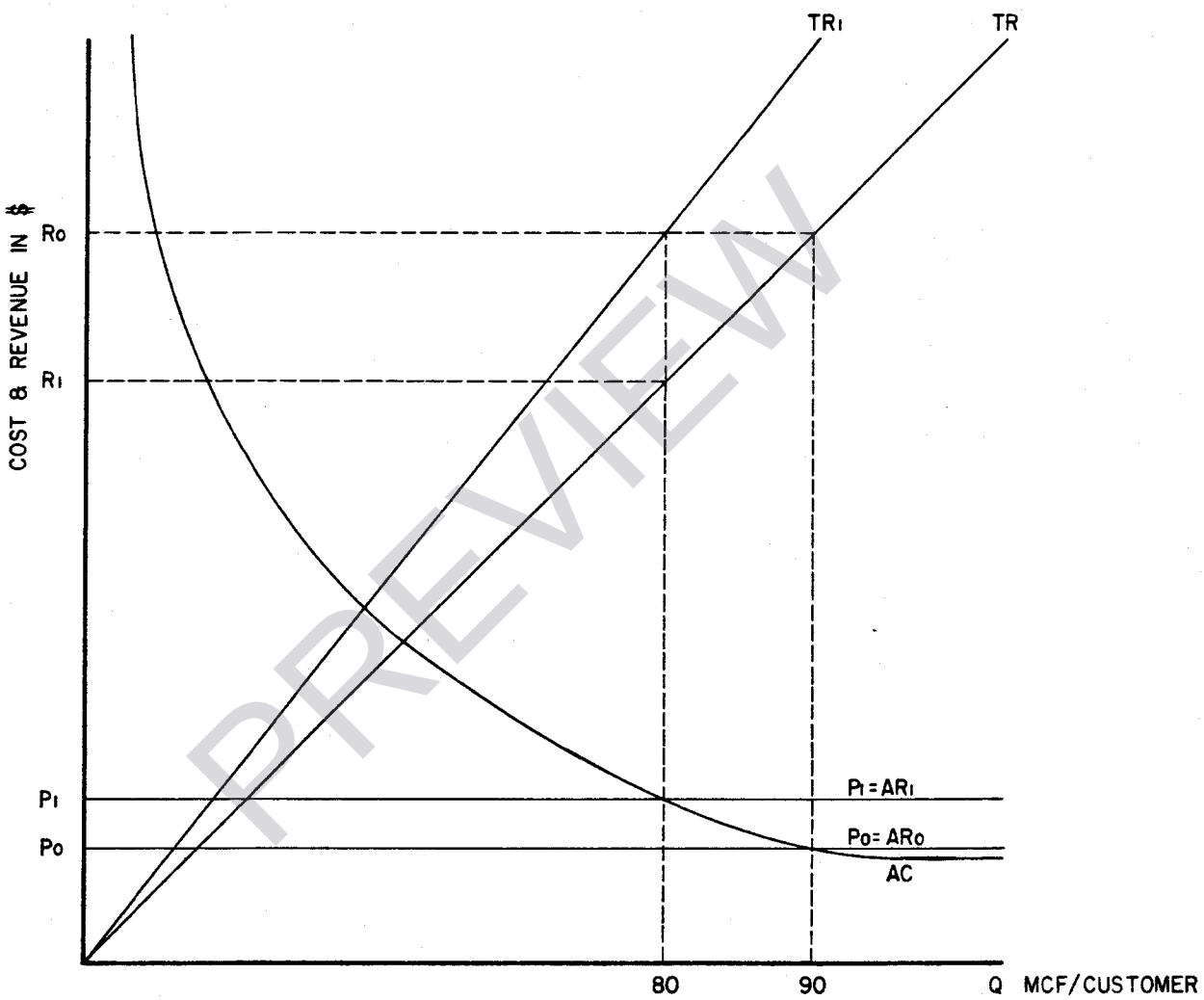
(units) but the weather were warmer than normal, the sales per customer might be increased to 90 units.

The area of rates and rate-making procedures is a complicated area from the standpoint of consistency of method, but this need not be of concern to this paper. If the "normalized sales volume in units" were overstated due to a decrease in demand, the rate per unit would be lower than required. Figure 1 shows how a rate could be established which would be too low to provide adequate revenues. The total cost is established by adding the required return on plant to the total operating costs. The average cost (AC) is the Total Cost divided by the number of units. Assuming 90 units per customer per year, the rate would be set at P_0. This rate would produce a total annual revenue per customer (R_0) equal to $90 \cdot P_0$ and R_0 would be the necessary revenue per customer to provide an allowed return to the company according to established rate-making procedures.

If the actual units per customer were 80 M.C.F./Year the total revenue would fall along the original total revenue curve to R_1. R_1 would be equal to $80 \cdot P_0$ and would be too low to provide an adequate return. Had the consumption been originally set at 80 M.C.F., the rate would have been higher at level P_1. The new rate P_1 would produce a new total revenue curve TR_1 which would provide revenue R_0 at the actual level of consumption. Note that the new rate P_1 would be located on the original average cost curve since the cost of production, in the sense of shifting, will not change in this region due to the decrease in quantity demanded by an individual customer.

The use of consumption based on normal weather may create short run problems for a utility but is not generally detrimental in the long

Figure 1. Rate Per Unit Based on an Average Customer's Annual Consumption of Natural Gas.



run. The shift caused by the weather may increase consumption and therefore tend to balance out over a relatively short period.

Rate-making procedures do not, however, consider the effect of a decrease in the quantity demanded caused by an increase in price. One apparent solution for the companies would be to apply frequently to the regulatory agency using recent sales volumes to set new rates. However, regulatory lag is a common problem. In the state of Texas, natural gas distribution companies have franchises with the cities they serve. Generally, if a city elects to do so, it may exercise first regulatory authority over these companies. The next appeal for a company would be the Texas Railroad Commission and, finally, the courts.

In a recent discussion with the utilities division of the Texas Railroad Commission, information was received concerning the number of rate cases received by the commission by year:[4]

Year	Number of Rate Cases Received
1970	19
1971	12
1972	30
1973	35
1974	60
1975	75
1976	147

Not all of the cases are so-called "burner-tip cases" but most are. Burner-tip cases are cases involving distribution companies where the gas

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[4]Statement of Tom Hill, Hearing Examiner, for Texas Railroad Commission, in a personal telephone interview, Austin, Texas, April 14, 1977.

will be sold to a direct consumer. Some cases are transmission company cases in which the gas will be sold to a distribution company, and these are not of concern for this paper. However, the numbers do illustrate the problem that distribution companies in Texas are having obtaining rates which, by their accounting methods, provide a sufficient return on investment.

Southern Union Gas Company in Austin is one of the companies that is having such a rate problem. The following is a chronological sequence of such a case:

09-01-76	Company filed rate request with City Council
09-30-76	City approved resolution to suspend rate action for 120 days to allow for hearings.
10-01-76	Public notices published by the Company
10-11-76	Public notices published by the Company
10-18-76	Public notices published by the Company
10-25-76	Public notices published by the Company
11-01-76	Public notices published by the Company
11-14-76	Public hearing before City Council
12-30-76	Public hearing before City Council
01-17-77	City's consultants revised report
01-13-77	Council turned down rate increase
01-18-77	Company asked for reconsideration
01-27-77	Reconsideration refused
02-01-77	Company filed appeal with Railroad Commission
02-01-77	Company filed motion for interium rate relief with Railroad Commission
04-11-77	Motion denied by Railroad Commission
06-28-77	Hearing date set by Railroad Commission

It should be noted that the data used for this rate case was year ending 1975 and, therefore, already nine months old prior to the original

filing. Even without this rate increase, the price of natural gas to consumers has increased over the past six years. The prices shown are average prices of natural gas based on average summer and average winter usage. The prices do fluctuate slightly due to the method used to pass on price changes from Southern Union's supplier:

Year	Summer 4 Units	Winter 18 Units	Average Cost
1971	$ 4.63	$17.35	$0.9990
1972	4.63	17.35	0.9990
1973	4.63	22.64	1.2396
1974	6.47	35.23	1.8955
1975	13.26	53.30	3.0255
1976	14.12	62.67	3.4905

At this point it must be noted that Southern Union Gas Company in Austin purchases its product--natural gas--from a supplier and has little or no effective control over its price. The purchase cost of natural gas per unit to the company has increased from $0.205 to approximately $2.00. There are circumstances now under litigation which led to this position. However, they are not relevant to this paper. Many gas distribution companies across the country operate within the same type of environment. They purchase gas from a transmission company at a "city gate" purchase point at some type of contract rate. This is analogous to most retail sellers who buy a product from a wholesaler for resale to the consumer. The exception is that oftentimes a utility cannot even change its rates to pass on these increased product costs without regulatory approval. Briefly stated, the distribution company in this case has not been primarily responsible for the increased product cost and resultant increased

rates which have caused a decrease in sales. However, the company's net revenues are decreasing.

It can thus be seen that both the consumer and the gas distribution companies have been affected by cost increases--each in separate ways. Many consumer advocates, such as the one quoted at the beginning, have felt that the manner in which the cost-of-gas increases have been passed on to the customers in the form of rate increases has had a discriminatory effect on lower-income families and has denied these families access to what they consider a necessity item.

The question of a possible discriminatory effect cannot be answered totally by price elasticity studies, but it can be explored and some questions at least partially answered. In order to accomplish this, it will be necessary to gather data from two separate areas of Austin called billing districts. These are no large areas of Austin that contain all lower or all higher income customers--however, billing district 08 contains many lower-income families. It also encompasses some lower/middle income families, but it can be utilized to examine the effect of gas price increases on lower income customers.

In order to determine whether the effect was greater on lower income consumers than higher income consumers, another billing district was also analyzed. This billing district primarily contained people of middle to upper/middle income. In general, the houses were larger and the gas usage was higher. Empirical demand and coefficient of elasticity curves will be developed for both areas.

There is also information concerning the total gas usage in the City of Austin during this same period of time, and a demand curve will be generated for this total area. There are some statistical problems with

this type of data, but it can provide additional information. The analysis of the data will be accomplished in Chapter 4.

It is, therefore, the objective of this paper to explore the following questions:

1. Is the demand for natural gas a function of price? If so, how will the net revenues of the utility be affected?

2. If natural gas is own-price elastic, is the coefficient of elasticity greater for lower income than for middle to higher income families?

Chapter 1

THE UTILITY--PARAMETERS AFFECTING NET REVENUE

Since a change in quantity demanded or a change in demand may have an impact on the net revenues of a utility, it will be necessary to review some of the parameters that affect net revenues. A decrease in net revenues may have an adverse effect on a utility since, like other businesses in the private sector, they must compete in the money market for short term financing and for long term investor money. The ability of a utility to obtain short term financing is a function of its recorded earning capacity. The ability to attract investor money is a function of historical, or proven, or anticipated returns on investment. A business's ability to record sufficient earnings or supply adequate returns to investors is reflected by its net revenues.

"Net" revenues in this context will be defined as total revenues less total operating revenue deductions and federal income taxes. This definition will provide a net revenue figure, consistent with rate making procedures, that can be compared to the fair value of the plant property.

Rates

A rate is defined as,

"The unit charge or charges made to customers for supplying gas."[5] A non-regulated, perfectly competitive business will establish a price for

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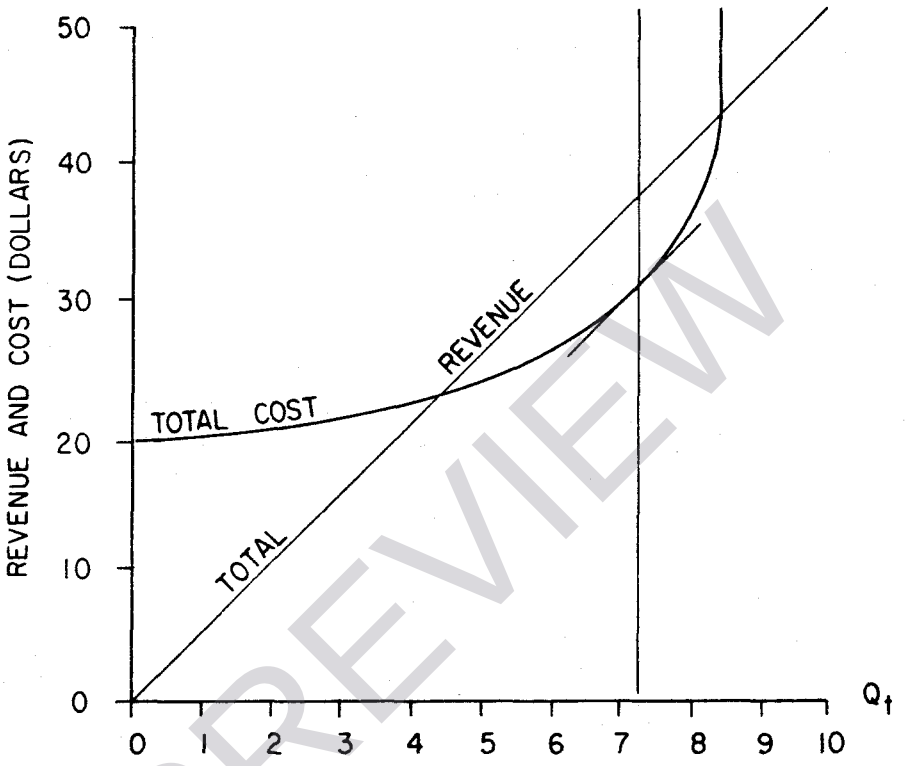
[5]American Gas Association Rate Committee, Gas Rate Fundamentals, p. 345.

a good based on market demand and cost of production. It will then produce and sell a quantity that will maximize its profits. Figure 2 shows this profit maximization by the total revenue-total cost approach.[6]

Figure 2. Non-Regulated Firm--Profit Maximization.



The total revenue is the product of price and quantity and is therefore linear if average revenue is constant at each level of output. Total cost is the combination of fixed cost such as plant investment and variable costs. For this reason there is some cost involved even if no product is sold. The fixed cost per unit becomes smaller as the number of units produced increases. However, as the quantity of output increases, total

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[6]C. E. Ferguson, Microeconomic Theory (Homewood, Illinois: Rich Irwin, Inc., 1972), p. 257.

variable costs increase at a faster rate and cause the total cost to increase. In the long run prices will be set at a point where the long run average cost equals average revenue or price. At this point, long run pure profit will equal zero.

A utility is normally considered a monopoly and is not free to set its rates and quantity of sales at a level that will maximize profits. This is due to regulation. The rationale for regulating is that a competitive total market price does not exist that would automatically equate price to long run average cost and assure that pure or economic profits do not exist.

In the absence of a competitive market price, the task of a regulatory body is to set a price. This price should be so far as is possible the price that would approximate a purely competitive market price, assuring long run, pure profits equal zero. Since price and quantity information that would accomplish this criteria is difficult, if not impossible, to obtain, regulators have directed their efforts to the cost of production of the firms rather than to the market.

The Smyth vs. Ames case of 1898 established what is known as the "fair value" formula.[7] This formula states that a fair value be placed on property held by the utility and that a "fair return" be authorized. The fair value of the property of a utility is referred to as "rate base" and fair return is referred to as "rate of return." The rate of return varies from state to state.[8] The current rate presently being allowed by the Texas Railroad Commission is six to eight percent. The method of deter-

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[7]Gas Rate Fundamentals, American Gas Association, p. 93.

[8]Charles F. Phillips, Jr., The Economics of Regulation (Homewood, Illinois: Richard C. Irwin, Inc., 1969), pp. 269-274.

mining the rate base has been the subject of court cases throughout the years.[9] However, the present method in the state of Texas is a 60% original cost and 40% reproduction cost formula.

The original cost is the total, actual book-cost of the system including buildings, underground piping, etc. This amount is then depreciated by an established method of depreciation. The reproduction cost is the total of all items included in the original cost calculations at today's installed cost, depreciated by observed condition.[10] For example, if 20,000 feet of 2" pipe were installed in 1940 at a cost of $.50 per foot and 2" pipe installed today cost $3.50 per foot, then the cost would be as follows:

Original Cost $			Reproduction Cost $		
20,000' @ .50/ft	=	$10,000	@ 3.50/ft	=	$70,000
Depreciation	=	(3,000)	Observed Condition	=	(17,500)
Total Rate Base	=	$ 7,000			$52,500

Rate Base = .6(7,000) + .4(52,500) = $25,200

This example tends to exaggerate the difference between original and reproduction cost since utilities historically have grown at an increasing rate; that is, the percentage of plant added each year increases, so that the percentage of plant installed as early as 1940 becomes a smaller percentage of the total plant and, therefore, contributes a relatively small amount to the rate base. Also, recall that this reproduction

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[9]Phillips, The Economics of Regulation, pp. 216-269.

[10]The observed condition is actually a study accomplished by physically observing the condition of the system through a random selection of test points.

cost is depreciated by observed condition. Once the rate base is established, the approved rate of return, expressed in percentage terms, times this base, establishes the allowable net revenue.

Total revenue is the product of total unit sales (QS) and the rate per unit. However, the rate per unit is the quantity to be determined. Since the allowable net revenue (NR_A) is known and operating expenses are allowed to be included, we may also express the total revenue (TR) required as:

$$TR = TE + NR_A$$

where TE is the total expense of operation. Therefore the rate per unit R is:

$$R = \frac{TR}{QS} = \frac{TE + NR_A}{QS}.$$

Total operating expenses are known since a firm must keep a record of these expenses. The quantity of sales is generally known on a per customer annual basis. However, this quantity varies depending on the weather. To account for this, the QS generally used is the annual number of units sold during a year per customer, where the weather was normal or average. This area was covered in the preface. However, given these quantities, a rate may be determined that will provide the allowable net revenue to the utility.

Cost of Service

Now that we have established a rate, at least in conceptual terms, it is necessary to see how that rate is allocated. The method of accomplishing this is called "cost of service."

Cost of service,

> . . . . refers to the allocation of the property and expenses among the various classes of customers or loads.[11]

Each customer requires some portion of the total investment in plant and some portion of operating expenses. The amount depends on the customer. For example, a residential customer may, on the average, require 100' of main, 50' of service pipe, a meter, and a regulator. Each of these items is included in the rate base. A large industrial customer may require 5,000' of 6" line, a large meter, and a regulator. However, the residential customer may consume 50 to 100 MCF (units) of gas in a year while the industrial customer may consume thousands of MCF per year. Also, each meter must be read once a month and a bill submitted and a payment received. Therefore, the cost per unit (rate) to serve these customers may vary substantially.

Other considerations such as system demand and time of demand are important factors. While a large industrial customer may require substantial system capacity, this capacity may be demanded during off peak periods, so that no substantial plant addition is required to serve the additional load. For this reason, large users have generally been given a low rate called an interruptable rate.

However, our purpose is to examine residential customers, so our remarks concerning other classes of customers are confined to what has already been said. Residential customers may also vary greatly in their quantity demanded. Most of these customers will have the same size gas service line, meter, and regulator so that the cost to serve each will be

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[11] Gas Rate Fundamentals, op. cit., p. 129.

essentially the same. A larger user will require some additional system capacity, so a slightly higher portion of the total rate base may appropriately be assigned by the quantity of usage.

In general, cost of service studies assign cost among classes of customers--residential, commercial, industrial, and interruptable--rather than among residential customers. However, we can see that if the investment per customer were essentially the same and the operating expenses were the same, then the cost per unit to serve a larger residential customer would be less.

Rate Forms

The most typical form for a rate to take is called Block Meter Rate.[12] Southern Union uses this type of rate schedule:[13]

First	1	MCF	per	monthly	billing	period	@	$3.49		
Next	24	"	"	"	"	"	@	2.52	per	MCF
Next	75	"	"	"	"	"	@	2.27	"	"
Next	200	"	"	"	"	"	@	2.17	"	"
Over	300	"	"	"	"	"	@	2.07	"	"

The "cost of gas adjustment" is an adjustment to cover the increased cost of gas from the supplier. The current adjustment is $.368. As stated in the preface, the cost of gas at the purchase point has increased from $.205/MCF to $2.00/MCF. Southern Union has been allowed to pass these costs, including increased tax and other associated costs, through to the

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[12] Gas Rate Fundamentals, op. cit., p. 179

[13] A copy of the total rate schedule and cost of gas adjustment are shown in the Appendix on pages 86 and 87.

customers. The bills are computed by summing the product of the number of units consumed times the appropriate rate. For example, 10 units of gas would cost:

First	1 MCF	=	$3.49 x 1	=	$ 3.49
Next	24 "	=	2.52 x 9	=	22.68
					$26.17

Then the cost of gas adjustment is added

10 x (.368) + 26.17 = $29.85

As can be seen, the cost of gas per unit decreases in rather large blocks. The reason for this higher charge at lower consumption is the difference in the cost to serve a customer. If only one unit is consumed, all of the operating and maintenance costs are the same as if twenty units had been consumed, and the plant investment is unaffected.

This type of rate form has been the subject of criticism over the past two or three years on the basis that it encourages additional consumption and is, therefore, not conservation oriented. However, since lower income consumers use less gas, it tends to charge them more per unit and this, allegedly, discriminates. Suggested changes have ranged from a flat rate, where one single rate would be charged regardless of usage, to a complete reversing of the schedule. Assuming that the cost of service study is fairly accurate, either of these changes would cause a higher volume user to involuntarily subsidize a lower volume user. This area will be discussed in Chapter 4.

Franchise

Most public utilities operate under a franchise which grants them certain rights. Along with these rights, however, come several responsibilities which affect net income. The most common requirement in a fran-