ALTERNATIVE APPROACHES TO RATE DESIGN IN THE TELECOMMUNICATION INDUSTRY

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I INTRODUCTION

The pricing of the products or services provided by a public utility such as an electric power or telephone company may be usefully decomposed into two problems. One is the overall level of prices charged by the utility. The other is the structure of relative prices, that is the prices charged for different services, to different classes of customers, or for different levels of use.

A substantial measure of agreement has been reached with regard to the first problem. It is widely if not generally accepted that the overall level of prices charged by a public utility should provide the firm with a total revenue that covers all costs including the cost of capital. The last is a return on capital that allows the utility to raise the capital needed to meet the demand for service. Not only is there agreement in principle on the goal of regulatory policy with regard to the overall level of prices, but there is also substantial agreement on the implementation of the policy. Aggregate revenues and costs other than the cost of capital can be measured with a high degree of accuracy, and differences in expert opinion on how one measures a public utility's cost of capital

are relatively modest.[1/] The only grounds for questioning this solution to the problem of determining the overall level of prices is the fear that cost plus pricing does not provide utility managements with adequate incentive for efficient operations. What may be considered an alternative policy, therefore is the above policy with regulatory lag.

Historically, there have been two broad approaches to the problem of relative prices or rate design as it is sometimes called. One approach is cost and the other approach or principle in rate design has been welfare defined in some way.

The advocates of cost as a basis for setting relative prices, however, have not been able to reach agreement on the appropriate cost concept and how it should be measured. Economists have typically advocated the use of marginal cost on the grounds that it results in the most efficient allocation of resources. However, if average and marginal costs are not equal regardless of the level of output, which is typically the case, marginal cost conflicts weith the overall level of prices criterion set forth earlier. Baumol and Bradford have established how prices should depart from marginal costs to satisfy the constraint that total revenues equal total costs including the cost of capital with

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1/ For a comprehensive treatment of the subject see M.J. Gordon, The Cost of Capital to a Public Utility, East Lansing, Michigan State Press, 1974, and

the optimality criterion in setting price the same as that used to justify marginal cost pricing.

The very formidable problems in developing marginal cost prices or the Baumol-Bradford modifications to marginal cost prices have led to the advocacy of a considerable simplication that may be called incremental cost pricing. However, serious measurement problems remain, and the fear that the utility may exploit the measurement problems to serve other goals in pricing plus simple and powerful equity considerations provide a rationale for fully distributed or average cost as a pricing principle.

Part II below will carefully examine the arguments both theoretical and practical for and against each of these cost based pricing principles. In addition, a section will be devoted to peak load pricing, a special case of marginal cost pricing that is particularly relevant to public utilities due to their very large capacity costs and the uneven use of this capacity over the day, week and year.

Part III will be devoted to two pricing principles in which cost does not determine price. One principle, which is called market development pricing, is shown to be optimal from the viewpoint of the owners and management of the utility. Another principle, which is called social welfare pricing, goes beyond the rationale for marginal cost pricing in recognizing equality

in the distribution of income among others as goals of public policy.

Part IV begins with an attempt to develop the policy implications of balancing the arguments for and against each of the pricing principles developed earlier. The conclusions reached are then applied to a number of specific pricing policy problems. They are, the pricing of residential exchange service, the terms under which a utility should be allowed to engage in other lines of business, and the pricing of international toll calls.

II COST BASED PRICING POLICIES

1. Marginal Cost Pricing

When economists treat the subject of relative prices on a theoretical level, there is wide agreement among them that the price of each product should be equal to its marginal cost of production. At first glance this position has considerable intuitive merit. It is reasonable to assume that the customer of a public utility takes the price charged as independent of the quantity he consumes. In that event he buys the quantity that equates the value to him of the marginal unit purchased with its price, which is the cost to him. Consequently, if the price is above (below) the marginal cost of production, it cost more (less) to provide the consumer with the unit than its value to him.

It can then be shown that if price is equal to marginal cost for all other products purchased by consumers, a price different from marginal cost for the utility service results in an inefficient allocation of resources. Specifically, a price above marginal cost means that a consumer of this service could be made better off without making anyone else worse off by giving him an additional unit of the service and reducing his consumption and the production of all other products by an amount equal to the marginal cost of producing a unit of the service. Conversely, with price below marginal cost for the service,

a consumer is made better off with no harm to anyone else, if his consumption is reduced by one unit, and the resources freed are used to provide him with the quantities of all other products that cost the same amount to produce.

However, it does not follow that setting the price of the service equal to its marginal cost will make its consumers better off and leave all other consumers as well off as they would be under some other price. As indicated earlier, a necessary condition for this conclusion is that the prices of all other products and of all factors of production are equal to their marginal costs. Insofar as this condition is not satisfied, and it is a very strict condition, we cannot say whether the above change in the consumption menu of the utility consumers will or will not have the intended consequences.[1/]

There is an even more difficult problem. The consumer of a utility service is made better (worse) off by an increase (decrease) in his consumption of the service when marginal cost is below (above) the price of the service. However, a regulatory agency does not determine the consumption decisions of its customers directly. The desired change in consumption can only be accomplished by changing the price of the utility service. A change in the price of this service with all other product prices left unchanged will also involve a transfer of income between the owners and customers of the utility.

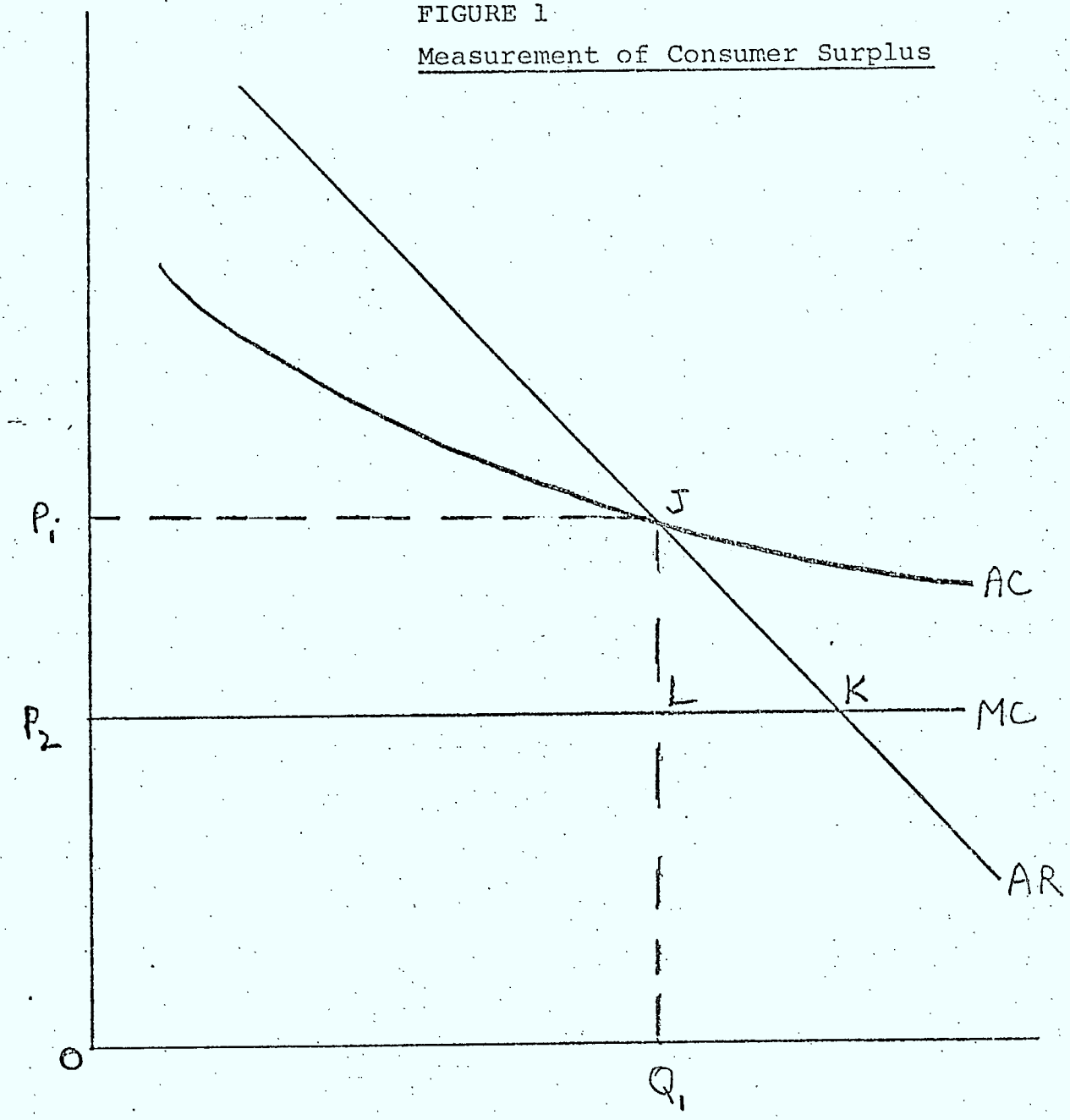
1/ E.G.Furnbotn and T.R.Savings, "The Theory of the 'Second Best' and the Efficiency of Marginal Cost Pricing" in Harry M. Trebing, Ed., Essays on Public Utility Pricing and Regulation, Michigan State University, 1971, pp. 31-59.

The problem is illustrated in Figure I where MC is the marginal cost of the product, AC is the average cost, and AR is the demand curve for all consumers treated as one person for simplicity. Let the price be initially equal to average cost at the output where AC and AR intersect. The consumer buys the quantity Q_1, at price P_1, and the area under the demand curve to the left of Q_1 is the value of what he receives. The consumers net benefit or consumer surplus is the area under the demand curve to the left of Q_1 less P_1JQ_1O, which is what he pays for Q_1. A reduction in price to P_2=MC increases consumer surplus by $P_1JK_2P_2$. However, the reduction in the price from P_1 to P_2 causes the owners of the firm to suffer a loss or reduction in their welfare equal to P_1JLP_2. Consumers are better off, the owners are worse off. The sum of producer and consumer surplus is increased by the triangle JLK, but we cannot say whether society is better or worse off on balance without making interpersonal comparisons of welfare. If MC were an increasing function of output so that AC=AR at a price below MC, a change in price from AC to MC would involve a transfer of income from consumers to owners.

The theoretical literature on relative prices, nonetheless looks on price equal to marginal cost as "Pareto optimal" on the grounds that there is a tax or subsidy on each member of society which, when combined with a change in the price of a

FIGURE 1

Measurement of Consumer Surplus



product from any other figure to its marginal cost, will increase the welfare of one or more memebers while leaving everyone else as well off as they were before.

It would seem difficult to question a policy that makes one or more persons better off while leaving everyone else as well off as before. However, no one pretends that the taxes and subsidies necessary to make everyone as well or better off under Pareto optimal prices than they would be under any specified set of other prices can in fact be determined and levied. The informational requirements of the policy are staggering. The required tax or subsidy will vary from one person to the next depending on his demand and supply conditions for every product and factor of production and the demand and supply conditions of all other persons. If anyone had this information, we could dispense with the price system altogether and distribute outputs and tasks by administrative fiat. No one even suggests let alone attempts the determination of the required taxes and subsidies. All we have is the knowledge that a set of taxes and subisdies exist which could make one or more persons better off and leave no one worse off with Pareto optimal prices than with a set of different prices. Note, however, that with each set of alternative prices a different set of taxes and subsidies is required, and the alternatives to a price equal to marginal cost are quite numerous.

There is an alternative defense for marginal cost pricing that is both less demanding and less satisfying than the one presented above. There also is another and more prosaic objection to marginal cost pricing. Both are taken up in the following section.

2. The Baumol Bradford Solution

What are the consequences of setting the prices charged by a utility equal to marginal costs even though we must abandon the taxes and subsidies needed to insure that no one is worse off than he would be under some other set of prices? If the utility operates under conditions of decreasing costs, an overall price level equal to marginal cost will result in a loss and the capital required to meet the demand for service will not be supplied. If the utility operates under increasing costs, an overall price level equal to marginal cost will result in a return on capital in excess of that required to meet the demand for service. In the former case a subsidy is required to obtain the desired output. In the latter case a tax is required if excess profits to the owners of the utility are considered undesirable. We will not consider whether marginal cost pricing plus a company subsidy or tax, depending on whether the utility operates under decreasing or increasing costs, is optimal policy.[1/] The problem is difficult to resolve on a theoretical level, but it may be rejected on the more prosaic grounds that accepted public policy is to not use taxes and subsidies to control the profits of a public utility. Rather as stated at the outset, prices charged in the aggregate should cover all the costs incurred by

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1/ A problem posed by the policy is to find a tax or subsidy that does not cause some other price to depart from the marginal cost of the product or service.

a utility including its cost of capital.

Our problem is, therefore, the optimal structure of relative prices charged by a utility with all prices in the aggregate satisfying the constraint that total revenues are equal to total costs including the cost of capital. Baumol and Bradford provide a solution to this problem under the assumption that prices equal to marginal costs would be optimal if the constraint were not binding. They showed that:

> Pareto optimal utilization of resources in the presence of an absolute profit constraint requires (considering substitution effects alone) that all outputs be reduced by the same proportion from the quantities that would be demand at prices equal to the corresponding marginal costs. The rule takes an even simpler form in the event cross elasticities of demand are zero. It then requires that each price be set so that its percentage deviation from marginal cost is inversely proportionate to the item's price elasticity of demand. According to this result, the social welfare will be served most effectively not by setting prices equal or even proportionate to marginal costs, but by causing unequal deviations in which items with elastic demands are priced at levels close to their marginal costs. The prices of items whose demands are inelastic diverge from their marginal costs by relatively wider margins. 1/

On the assumption that cross elasticities of demand are relatively unimportant we will concentrate on the simpler and more informative rule. It states that price should be very close to marginal cost for a utility product or service with a demand that is highly price elastic, and the price should exceed marginal cost by a wide margin for products subject to inelastic demand.

1/ W.J. Baumol and D.F. Bradford, "Optimal Departures from Marginal Cost Pricing," American Economic Review, (June 1970) pp.

This rule is valid if consumer surplus can be used to make interpersonal comparisons of welfare. That is the welfare of the utility's consumers in the aggregate is maximized by the Baumol-Bradford rule for setting relative prices, if increasing one person's consumer surplus by $10 and reducing another person's consumer surplus by $9 increases their combined welfare.

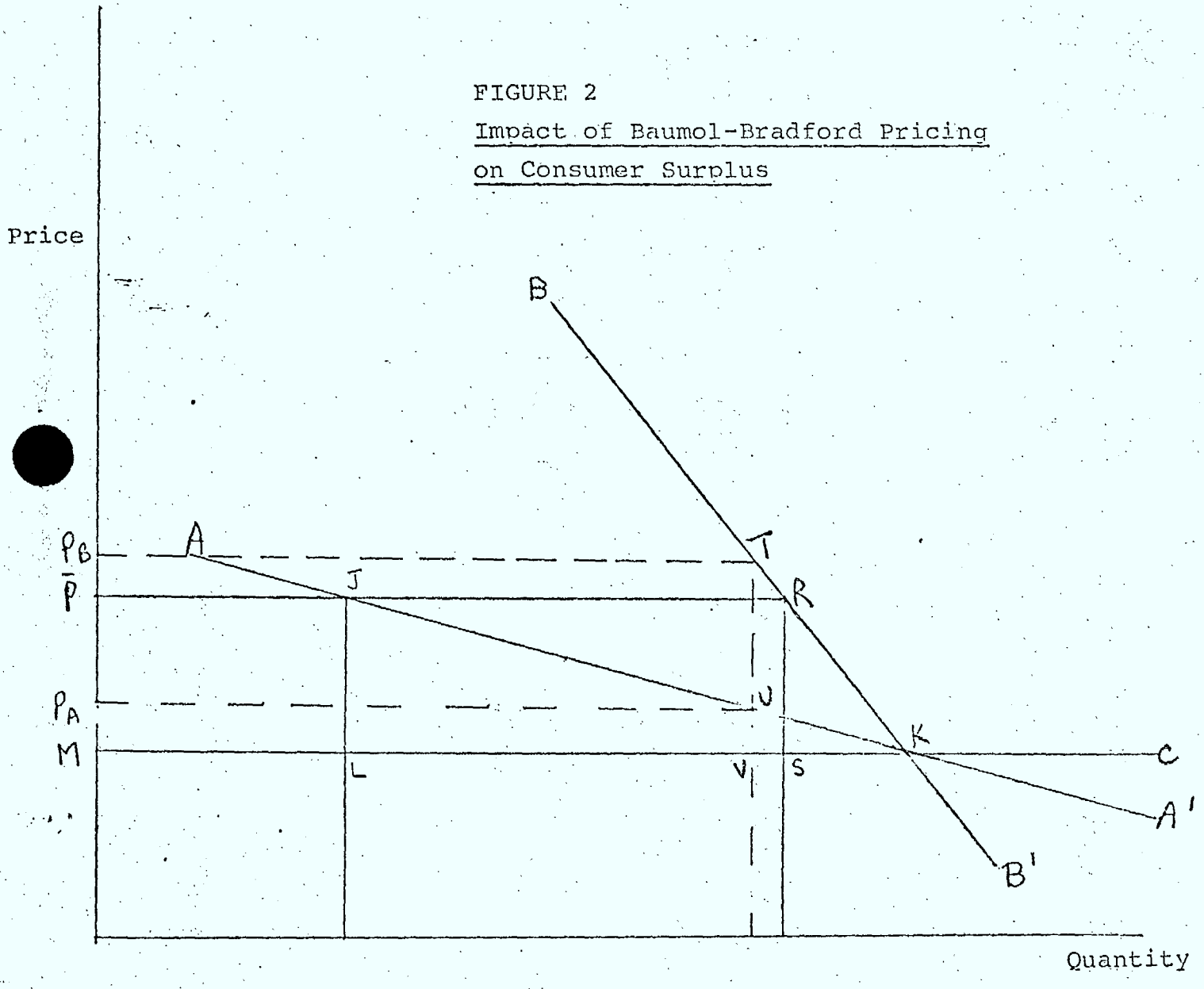
To illustrate the argument that leads to this conclusion and make precise what is meant by consumer surplus, assume that a utility provides two services A and B. The demand curves for the two products are AA' and BB', and the marginal cost for both is the MC curve in Figure 2. To simplify the exposition Figure 2 is drawn so that both demand curves intersect the MC curve at the same point K.

Assume that the utility must have a revenue in excess of the marginal cost of producing A and B equal to the sum of the rectangles $\bar{P}$JLM and $\bar{P}$RSM. A price for both services equal to $\bar{P}$ will generate the required revenue and charge the consumers of both services prices that bear the same relation to marginal cost.

Raising the price of A from M to $\bar{P}$ reduces consumer surplus by $\bar{P}$JKM and raises producer surplus by $\bar{P}$JLM. There is a net reduction in the sum of producer and consumer surplus of JLK. The analogous geometry for service B results in a reduction of the sum of producer and consumer surplus of only RSK.

FIGURE 2

Impact of Baumol-Bradford Pricing on Consumer Surplus



The reason why the same percentage rise in the price of B as of A results in a smaller reduction in consumer-producer surplus is the greater price elasticity of demand for A. It follows that a larger rise in the price of B and a smaller rise in the price of A can generate the same income to the utility and a smaller reduction in consumer surplus. Specifically a rise in the price of B to P_B and a rise in the price of A to P_A generates the same utility income and reduces consumer-producer surplus by only TVK plus UVK.

The prices P_A and P_B result in the same percentage reduction in the output of both services and they minimize the reduction in consumer producer surplus that provides producers with the required net income. However, the price of B is considerably higher than the price of A, and it is clear that consumers of B are worse off and consumers of A are better off with prices P_B and P_A than they would be under a price of $\bar{P}$.

A simple numerical example may further illustrate the issue. Assume that ten loaves of bread and one pound of steak both have a marginal cost of production of $3.00. Also, assume that as a consequence of government policy bread sells for twenty cents a loaf and steak sells for $4.00 per pound. Finally, assume that if the government policy is changed to make the prices of bread and steak both equal to their marginal costs, ten Mr. Smiths each reduce their consumption of bread by one loaf, and

Mr. Jones consumes one more pound of steak. The ten loaves of bread that the Smiths give up are worth only $2.00 to them and the steak that Mr. Jones acquires is worth $4.00 to him, and consumer surplus in the aggregate is increased.

A further consequence of the change in the relative prices of ten loaves of bread and a pound of steak to $3.00 each is that the Smiths pay a lot more for the bread they continue to consume and Mr. Jones pays a lot less for the steak he continues to consume. It is perfectly clear that setting prices to maximize consumer surplus without regard for the distribution of income may be an elegant rationale for making the rich richer at the expense of the poor.

The conclusion that follows is that marginal cost pricing or the departures from marginal cost pricing to satisfy a profit constraint advocated by Baumol and Bradford maximize consumer welfare only if consumer welfare is independent of the distribution of income among consumers. This is a very brave statement. The primary defense for the statement is that every set of relative prices involves a different distribution of income, and unless we abstract from the distribution of income, there is nothing economists can say about the relative merits of different sets of relative prices.

What this means is that maximizing consumer surplus in the aggregate has some merit when the distribution of income is about

equal or when the decision maker is indifferent to the distribution of income. The first condition does not hold and the second one does not seem reasonable. Information about the consumers of a utility's various products or services might well persuade an intelligent and responsible regulatory body to depart from the Baumol-Bradford solution to the problem of relative prices.

It remains true that where Baumol-Bradford pricing is neutral with regard to the distribution of income, it provides a desirable criterion in setting relative prices. However, the practical problems of implementation may be even more damaging than the distribution of income objections just raised. To set the price of each service equal to its marginal cost or to arrive at the Baumol-Bradford relation between price and marginal cost, one must estimate the functional relation between the total cost of providing all telecommunication services and the output of the particular service for all possible output levels of every other service.

In addition, the relation between the demand for each service and its price must be estimated. This is adequate if the demand for each service is independent of the prices of all other services, which of course will rarely be true. With non-zero cross elasticities of demand, the demand for each service

is a function of its price and the prices of all other services. In short, this pricing policy requires the estimation of a company's total cost as a function of the output of each service for all possible combinations of the output of all other services and the estimation of the demand for each service as a function of its price and all other prices. It can be stated quite categorically that this is an impossible task without simplifications of the problem which are so gross as to make the conclusions reached highly questionable.

3. Incremental Cost Pricing

The formidable measurement problems involved in implementing marginal cost pricing and the Baumol-Bradford modification of marginal cost pricing has led to the advocacy of a simplification that will be called incremental cost pricing here. Briefly, the rule is that the price of a service is satisfactory if it provides some margin of profit over all costs that would not be avoided if the service were eliminated. Baumol stated the rule as follows:

> An operation is a benefit and not a burden to the firm if it permits the firm to serve the customers for its other services more cheaply. If that service brings in to the company more than it adds to the company's cost of operation, then it makes a net reduction in the fixed cost burden which the company must somehow meet if it is to discontinue in operation. Thus, the operation must be beneficial if the service's total revenues exceed its total avoidable cost -- the outlays that the company would save if this part of its operation were closed down.[1]

This pricing principle is not advocated for all utility services. It is proposed only for what are called competitive services, those which might conceivably be eliminated without eliminating telecommunication service for all practical purposes. Local exchange service and perhaps long distance toll

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[1] W.J. Baumol, "Rate Making: Incremental Costing and Equity Considerations," in Harry M. Trebing, Editor, Essays on Public Utility Pricing and Regulation, Michigan State University, Press, East Lansing, Michigan, 1971. pp. 137-50.

services are considered basic services and would not be priced in this way. Services such as WATS, PBX equipment, and data transmission are considered competitive services.

The second point to note is that incremental cost pricing is not a rule for arriving at the price of a service. It is a rule for deciding whether or not a price is satisfactory. A price that covers incremental cost plus some margin of profit is satisfactory, while a price that fails to provide a positive contribution to covering the costs of other services is unsatisfactory. Depending on the cost and demand characteristics of the service a lower or a higher price may provide a larger profit contribution, but there is no requirement that the price maximize the service's profit or contribution to covering the cost of other services.

There also is a measurement problem in implementing the principle. The costs that may be avoided by eliminating the service depend on the time horizon used. Costs that are fixed in the short run are variable in the long run. In the very long run the incremental costs of providing the service should not differ from the fully distributed or average full cost of providing the service. Given the high proportion of fixed and joint costs in telecommunication services, one can obtain practically any desired cost figure by the appropriate choice of time horizon.

A related measurement problem is the identification of all the costs required to provide the service. There are two approaches to the identification of the cost incurred in providing a service. One is to take all the costs incurred by a firm and assign them on a fully distributed or incremental cost basis to all the services or to an unassigned residual. The other approach is to take a particular service and solely ask what costs are incremental to that service. The latter approach runs the serious risk of failing to identify all the costs that are incremental to the service.

Incremental cost pricing has been advocated by telecommunication carriers in order to provide an acceptable rationale for pricing certain services at prices below their fully distributed cost. Reasons why a company might wish to do so are presented later in the section on market development pricing. We have just seen how the problems of cost measurement, both the time horizon used and the identification of costs can lead to the underestimation of costs. Demand measurement poses a similar problem. The requirement that price covers incremental cost plus a profit should be interpreted to mean that incremental revenues cover incremental costs plus a profit. Incremental revenues on a competitive service are equal to the service's total revenues only if there is no cross-elasticity of demand with other services. If the elimination of the service will increase the demand for other services the incremental revenues

are the total revenues less the reduced revenues on the other services. The profit contribution of the service is its revenues less the incremental cost of providing the service and the increased profit on other services that would be earned by eliminating this service. Hence with incremental cost pricing as with marginal cost pricing, it is necessary to estimate the variation in revenue and cost on other services as a consequence of changing the output and price of the service in question.

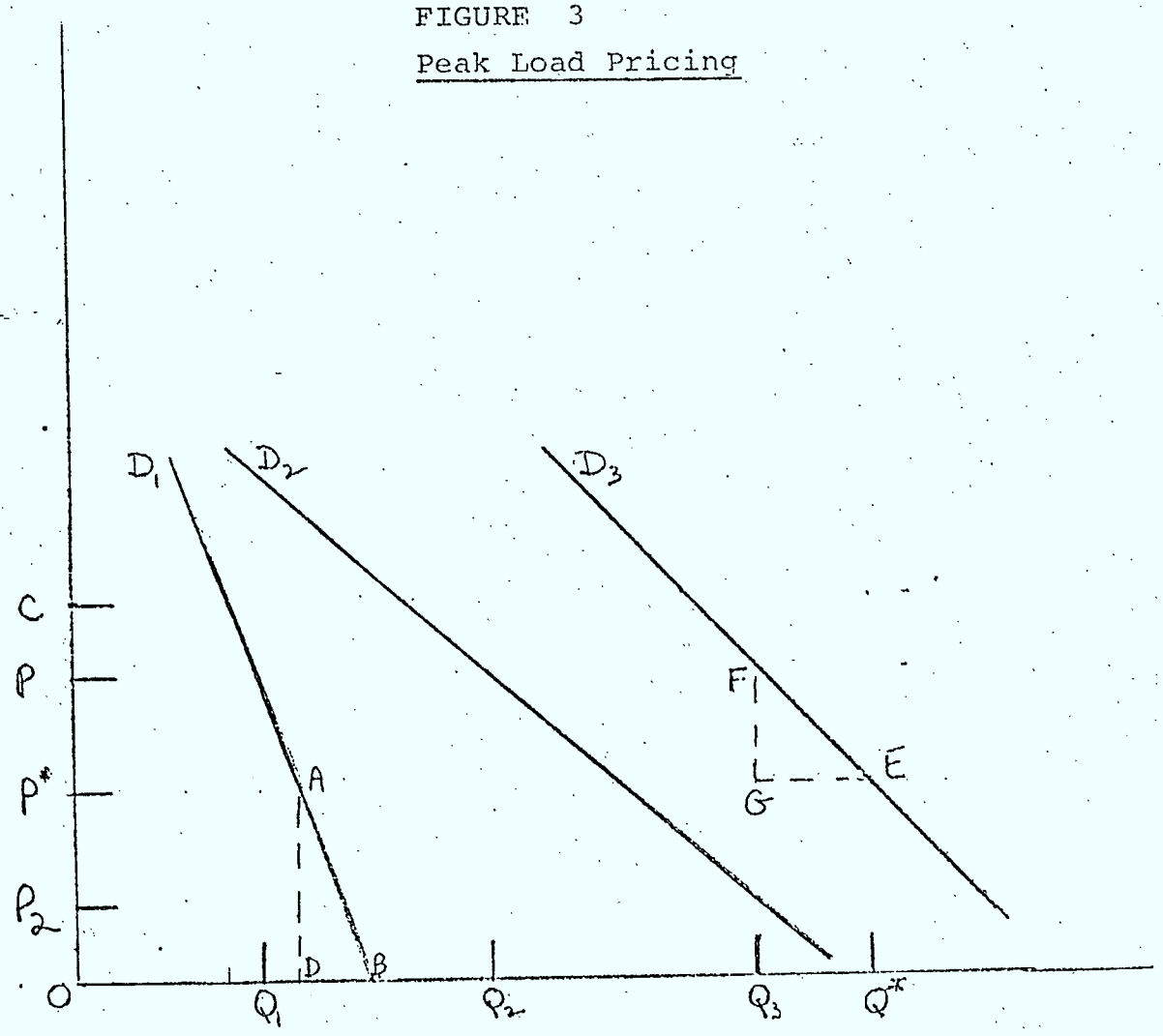
4. Peak Load Pricing

Public utility operations typically require a very large investment in plant facilities, and the use of these facilities may vary widely over the course of the day, week or year, particularly if the price charged is independent of the time of use. With the facility idle or underutilized part of the time the capital cost of the off-peak use of the facility is zero on an incremental cost basis. Charging a different price depending on when the facility is used may be justified on grounds of equity as well as the efficiency arguments of marginal cost pricing.

To illustrate the problem, assume that a day may be divided into three equal periods, and a unit of capacity may be used in each of the three periods. Also, let the relation between the quantity purchased and the price in each of the three periods be as represented by the three demand curves in Figure 3. For instance, in period one Q_1 is the quantity that would be purchased at a price P and the revenue that would be generated by sales during that period is PQ_1. For simplicity we assume that all costs other than the depreciation and required return on the plant facility are zero, and the cost of the facility per unit of capacity is C.

FIGURE 3

Peak Load Pricing



If the price of the service is set at P, the period 3 demand and the required capacity will be equal to Q_3. The capacity cost will be CQ_3, and the contribution to covering capacity cost and profit in the three periods will be the sum of PQ_1, PQ_2 and PQ_3. Under the assumed demand conditions and the price P, total revenue exceeds the capacity cost CQ_3. A reduction in price will raise the demand more or less in each period, and the rise in demand during period 3, the peak period, will increase capacity cost by C times the increased demand during the peak period. Total revenue will rise or fall depending on the elasticity of demand in the three periods, but under reasonable assumptions with regard to elasticity of demand total revenue will fall with price or increase less rapidly than the capacity cost of meeting the demand. Hence, there is some price P^* at which total revenue is equal to capacity costs at a capacity which satisfies period 3 demand.

A policy of setting price equal to average full cost results in a price of P* in each period. At that price capacity cost will be CQ_3^* and total revenue will be $P^*[Q_1^* + Q_2^* + Q_3^*]$ equal to CQ_3^*. At any other price total revenue will be above or below total costs. It is also clear that at a price of P^* output is substantially below capacity in periods 2 and 3.

Steiner and Boiteaux proposed the following solution to the peak-load pricing problem.[1/] Set the price for sales in each

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[1/] Peter O. Steiner, "Peak Load Pricing Revisited" in Harry M. Trebbing, op. cit., pp. 3-21 and M. Boiteaux, "Peak Load Pricing" Journal of Business, 1960, pp. 157-79.

period so that it results in the maximum use of the facility up to capacity. To illustrate, if a capacity of Q_3 is available, set the price in each period at the intersection of the period's demand curve and the vertical line at Q_3. Since there is no positive price at which demand in period one equals Q_3, the price in period one is zero, and the price in periods two and three are P_2 and P respectively.

The revenue generated under the above prices are Q_3 P_2 plus Q_3P. If these revenues are above the capacity costs, Q_3C, the existing capital stock combined with the Steiner-Boiteaux pricing rule generates a return in excess of the cost of capital. A rise in the capital stock combined with a reduction in the prices in periods 2 and 3 will reduce the excess return. Under reasonable assumptions with regard to the elasticity of demand, there is some stock of capital at which the Steiner-Boiteaux prices generate total revenues equal to total costs including the cost of capital.

This set of prices satisfies two pricing criteria. One is the total revenue equal to total cost criterion. The other is the efficiency in the allocation of resources criterion of maximizing consumer surplus. Both a uniform price P^* and the three prices, zero, P_2 and P generate revenues equal to the cost of the capacity that they require but the latter set of prices is superior. The reduction in price below P^* for periods one and two increases use without increasing capacity cost while

the higher price in period three reduces the capacity requirement and cost.

The increase in consumer welfare from the Steiner-Boiteaux price discrimination may be demonstrated as follows. Reducing the period one price from P^* to zero increases the welfare of period one consumers by the area of P*ABO. The welfare of other consumers or the owners is reduced by the loss in revenue from the price reduction, which is P*ADO. The net gain is the triangle ADB. Notice that there is no cost to society of providing the additional output to the period one consumers, since they are using excess capacity. A similar calculation would show that there is a net gain to society from reducing the period 2 price from P^* to P_2.

Raising the price to period 3 consumers from P^* to P reduces their welfare by the area of PFEP*, but others gain the transfer of income equal to the area PFGP* so that the net loss is only FGE. However, the price increase reduces the capacity requirements from Q^* to Q_3 and eliminating the cost of providing this capacity increases social welfare by $C(Q^*-Q_3)$. This exceeds the area FGE so that this price change is also socially beneficial.

It is clear that peak load pricing is highly beneficial both by increasing off peak use and by reducing the peak period demand. The primary objection to the policy apart from the technological problem of implementing it is the price discrimination that results. There is a transfer of income from period 3

users to period one and two users. This is desirable in its own right if it reduces unequality in the distribution of income. If the income transfers do not increase the unequality in income distribution, the other benefits justify the price discrimination.

A dramatic illustration of the benefits to be obtained from peak load pricing is illustrated by the introduction of lower rates for long distance toll calls during the evening. Insofar as evening calls are by low income users, in part because of the lower price, these reduced rates improve the distribution of income as well as improve the efficiency of the use of the telephone system.

A less extreme form of price discrimination among peak and off peak users of a utility can be beneficial to all users of the system. Starting from a uniform price of P* for all three periods, assume that a reduction in the period one price materially increases the period one sales. One factor in this increase not recognized in Figure 3, where the demand curves were drawn on the assumption that the demand in each period is independent of the price in the other periods, is the shift in demand from periods 2 and 3 to period 1. We now have higher revenue from period 1 sales and reduced capacity cost due to the shift in the period 3 demand curve. The total revenues equal capacity cost requirement can now be satisfied with a reduction in the periods 2 and 3 prices as well as the period one price.

Clearly, a reduction in the off peak price that also permits some reduction in the peak period price is beneficial to everyone. Advocates of a uniform price to all users cannot object to this type of price discrimination. The only objection is that it does not bring about as large an increase in consumer surplus as the Steiner-Boiteaux pricing rule. It should also be noted that peak period prices below off peak prices are also possible. The policy is highly inefficient from a consumer surplus viewpoint, and its impact on the distribution of income depends on the circumstances. The rationale for this policy is that it maximizes the capacity required to meet the demand for service. The circumstances under which a firm would follow such a policy are discussed in a later section.

5. Fully Distributed Cost Pricing

To the layman the equitable solution for the problem of pricing each service is to set each price equal to the fully distributed or average total cost of the service. With prices in general set so that they cover total costs numerous arguments can be advanced why it is inequitable to have some prices above and other prices below full cost. However, telecommunications perhaps more than any other is any industry of joint costs and fixed costs. For the most part costs are common to two or more services and independent of the level of output, so that the average full cost of any service may be determined only by means of a set of rules for allocating the fixed and joint costs among services.

It is possible to devise a set of accounting rules for the allocation of joint costs which result in a precise and objective determination of the fully distributed or average full cost of each product. However, there are two strong objections to setting prices in this way. One objection is that prices set in this way may not satisfy other highly plausible criteria or goals in setting relative prices. The other objection is that a wide range of accounting rules may reasonably be adopted for the allocation of the joint costs. The allocation of the joint costs and the structure of relative prices that results will also vary over a wide range.

There is widespread agreement among economists with regard to either or both of these undesirable features of fully distributed joint costs. Bonbright concludes a chapter on the limitations of fully distributed costs with the observation that the formula adopted will depend "not on principles of cost imputation but rather on types of apportionment which tend to justify whatever rate structure is advocated for non-cost reasons."[1/] Kahn states that "Space does not permit any systematic summary of the various, often extraordinarily complex methods employed to distribute costs in this fashion."[2/] After voicing the objections raised above Baumol stated that "I know of no economist of outstanding reputation who differs substantially from the basic position I have just taken."[3/]

There is a third objection to average full cost that is without much merit. The allocated fixed or joint cost component of average full cost depends on the level of output, so that a price based on an allocation of fixed cost based on one level of output will not be equal to the actual full cost if the output level proves different than output presumed in the allocation. However, the demand for telecommunication

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1/ J.C. Bonbright, Principles of Public Utility Rates. Columbia University Press, New York, 1961, p. 368.

2/ A.E. Kahn, The Economics of Regulation: Principles and Institutions. Vol. I. John Wiley, New York, 1970, pp. 150-51.

3/ W.J. Baumol, "Rate Making: Incremental Costing and Equity Considerations" in Harry M. Trebing, Ed. Essays on Public Utility Pricing and Regulation. Michigan State University Press, East Lansing, 1971, pp. 137-50.

services can be predicted with a high degree of accuracy, and the demand for most services is not very sensitive to the price charged. Under these circumstances the actual sales of each service is unlikely to depart materially from the predicted level, and allocations of cost based on predicted output will rarely be seriously in error.

Notwithstanding the objections raised earlier to the use of average full cost in pricing utility services, it remains the most widely used concept in regulatory practice insofar as regulatory agencies concern themselves with relative prices of different services. One of the reasons for the popularity of the principle is the aforementioned intuitive appeal of the concept of laymen. The accountant's view that fully distributed average cost is the only actual and true cost is not easily refuted. William H. Melody's strong support for the principle can be interpreted to provide additional grounds for its use.[1/]

Recall that once the principle is adopted and the rules for allocating costs are precisely specified, the price of each product or service is determined with very little margin of error. Hence, the freedom of the company to set or change relative prices to advance the company's goals is effectively eliminated. If the regulatory agency lacks the resources to obtain the data

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1/ For one presentation of his position see W.H. Melody, "Interservice Subsidy: Regulatory Standards and Applied Economics" in Harry M. Trebing, Ed. Essays on Public Utility Pricing and Regulation. Michigan State University Press, East Lansing, 1971, pp. 167-210.

needed to arrive at the prices which implement its goals, the public interest is served best by so restricting the freedom of action of the utility management.

I am sure that Melody would accept departures from fully distributed costs or in the words of Bonbright definitions of fully distributed costs which realize goals considered socially desirable. However, departures from the principle are not really necessary. Recall that a wide variety of rules, each leading to a different cost figure for each service are compatible with the principle. Hence, if other considerations make a different structure of relative prices more desirable than the existing one, the rules for allocating costs can be changed to make the cost figures compatible with the desired set of prices. However, the burden of proof is on the proponents of the alternative structure of prices. The objective independent determination of marginal costs for a telecommunication company is practically impossible. Hence, adopting marginal cost as the pricing principle gives the company complete freedom in adopting whatever relative prices structure that serves its own interests. With average full cost the pricing principle, the regulatory agency is able to exercise some control over the structure of relative prices.

III OTHER PRICING POLICIES

1. Market Development Pricing

One alternative to the cost based principles in setting relative prices discussed previously may be described by the term market development pricing. Under this principle relative prices are set to achieve some desired rate of growth in the aggregate demand for the output of the utility. To illustrate the concept assume that the utility has just one service that is priced by means of a two-part tariff. There is a flat monthly charge for access to the service and a charge per unit of the service used. Assume also that the demand for access to the service is completely price inelastic, while the demand for the use of the service depends on the price. This demand at any point in time and its rate of growth over time are both functions of price. Given the price of use there is some price for access that will generate total revenues equal to total costs, and there will be some rate of growth in demand over time. A lower price for use combined with a higher price for access also generates total revenues equal to total cost, raises the demand for use in the short run and raises the rate of growth in the demand for use in the long run.

Market development pricing is not concerned with the costs of the firm's various services. Selling one product below cost has no adverse influence on profits, since the prices of one or more other products are raised to keep the regulated rate of profit unchanged. The practice is commonly referred to as cross-subsidization. The only concern is with differences in the price elasticity of demand among the services. By reducing prices on elastic demand services and raising them on relatively inelastic demand services, revenues are kept equal to total costs, and over a wide range any desired level and rate of growth in demand can be achieved.

There are two important reasons why a public utility finds it advantageous to engage in market development pricing. First, as Averch and Johnson[1/] have shown, when a utility is allowed a return on capital in excess of its cost of capital, growth in the company's capital stock increases the value of the company's stock and the welfare of its stockholders. The reason is that the excess of the allowed rate of return on the additions to the capital stock accrue to the existing shareholders. By increasing the aggregate level of demand, market development pricing raises the level and rate of growth in capital requirements.

1/ Averch, H. and Johnson, L.L. "Behavior of the Firm under Regulatory Constraint." American Economic Review, (December 1962) pp. 1053-69.

The second reason why a utility may be expected to follow a policy of market development pricing is management's interest in its own welfare. Williamson[1/] among others has noted the reasons why a management prefers a company that is growing at a rapid rate to one that is experiencing little if any growth. The level and growth in compensation and prestige of the management is positively correlated with the level and growth in the company's size. A company in which subordinate levels of management have ample opportunities for advancement is more attractive to manage than one in which promotion takes place only as a consequence of retirements. A widely held belief in management is that the vitality, strength and success of a company are positively correlated with its rate of growth. For these and other reasons a utility management will adopt to the extent allowed a structure of relative prices that facilitates the rate of growth in demand that it considers satisfactory.

There is a related and perhaps even more important class of circumstances under which market development pricing takes place. Telecommunication services may be put in two classes: (1) those for which the utility has an undisputed monopoly; and (2) those for which other firms may compete for all or a fraction of the market. With regard to the latter services a rise in price may not merely reduce consumer demand somewhat. It may also invite other firms to capture a share of or the total

market. The considerations raised earlier would lead a utility to price its competitive services low enough to exclude other firm's from entering their markets regardless of the costs of providing the services.

In additon a telecommunications utility may well believe that entry of other firms into segments of the market that it serves may have long run strategic consequences that are highly undesirable. The failure of the railroad industry to deal effectively with competition from the trucking industry when the latter was of no great immediate importance proved to be a tremendous strategic error on the part of the railroads. All have been severely damaged and many have been destroyed. Such possibilities remote as they may seem at the moment argue for pricing competitive services to preclude competition regardless of the relation between the prices charged and the costs of providing the services.

On the other hand market development pricing may well represent an even more serious threat to the long run survival or security of a public utility. To see why this is so consider the consequences for an unregulated and a regulated company of pricing a monopoly service to maximize profits. By definition a higher or lower price would result in a smaller profit. An unregulated company would simply set the price at the high

monopoly level and reap the excess profits. An upward shift in production costs or a downward shift in demand would not destroy the company unless profits were reduced below a normal return on its capital.

A public utility, however, cannot simply raise price to the monopoly level since it is not allowed to earn more than a prescribed return on its capital. The public utility must offer another product or service at a price below cost. Covering the losses on this competitive service forces the price of the monopoly service up towards its monopoly level. Recall that this policy raises the aggregate level of demand and the capital base, which is profitable to the owners and/or the management. What happens now if a rise in costs or a fall in demand reduces profits below the required return on capital. The price of the monopoly service cannot be raised to restore profits to their former level, because that price is already at the profit maximizing level. Perhaps a rise in the price of the competitive service will solve the problem by reducing the demand and the loss on the service. However, insofar as the costs are fixed, the reduction in demand will further reduce profits.

By contrast, the utility that has not engaged in market development pricing is in a far better position to face an unfavorable shift in costs or demand. With the price of the monopoly service well below the profit maximizing price, a rise in the

price will raise aggregate revenues and at worst leave total costs unchanged. The utility is able to maintain its return on capital in the face of the unfavorable shift in costs or demand.

2. Social Welfare Pricing

It is generally accepted that access to the telephone system by all households is socially desirable. Accordingly, it is common practice to charge rural subscribers a price for access to the system that does not fully reflect the difference in cost between rural and urban subscribers. Equality in the distribution of income is another generally accepted goal of public policy, and setting relative prices to reduce the inequality in the distribution will be called social welfare pricing.

What pricing policies increase social welfare depend on how the demand for various categories of telephone service is related to the distribution of income among telephone users. A very large fraction of the country's households have one phone, and only very small fractions have no phone or have two or more phones. Hence, the demand for access to the system is quite independent of the household's income. By contrast, the demand for the use of the system by households, particularly where the charge per unit of use is large as in long distance calls, is income elastic. That is the demand for long distance calls is highly correlated with the level of income.

Business demand for telephone service may also be looked on as household demand ultimately, because the products of business are priced to reflect their costs of production including the costs

of telecommunication. Since the consumption of products in general is correlated with income, household consumption of telephone service to business is correlated with income. Consequently, telephone service to business is a class of services to households that is income elastic.

Social welfare pricing would therefore lead to low prices for access to the system and for basic exchange service in general. It would also lead to relatively high prices in relation to cost for long distance and business services. It is evident that social welfare pricing has opposite consequences for the structure of relative prices than the alternative policies of market development pricing or the Baumol modification of marginal cost pricing. The price inelasticity of demand for access to the system leads to a high price in relation to cost under the market development and Baumol pricing policies. The income inelasticity of demand for access to the system leads to a low price under social welfare pricing. Since long distance and business demand are both income and price elastic, social welfare leads to relatively high prices while the alternative criteria lead to low prices.

Spokesmen for the telephone industry would appear to be supporters of a policy of social welfare pricing. In the 1973 Annual Report of the New York Telephone Company, the President wrote:

> Under the regulated common carrier principle, which has served the country well for many years, we have been able to keep basic telephone rates lower than they otherwise would be, through the contribution of revenue from premium services. In similar fashion, revenues from high volume, low cost long distance routes have helped cover the high costs involved in serving sparse routes in less populated areas.[1]

Mr. Edward B. Crossland a Senior Vice President at AT&T has testified before a United States Senate Committee that the company's pricing policies have "... fastened universal service by providing favorably low rates for the residential consumer."[2] He expressed the fear that the introduction of competition in providing telephone service "... will limit the use of overall pricing structures to achieve broader social goals. Simply stated, the small residential user will pay more; some big business users will pay less."[3] Mr. Crossland went on to present data to support his contention that the average cost of basic residence service is substantially larger than the revenue produced by the service.

Bell Canada's statements on the subject appear to reflect a similar policy. In a Memorandum on Rates in connection with a 1971 application for a revision in its rates the company

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[1] 1973 Annual Report of the New York Telephone Company, p. 3.

[2] Statement of Edward B. Crossland before United States Senate Committee on the Judiciary, Subcommittee on Antitrust and Monopoly, July 31, 1974, p. 19.

[3] Ibid., p. 20.

stated that "Telephone rate structures should be designed to encourage the maximum number of residences and businesses to be connected to the telephone network." Later on in the same memorandum the company illustrates the value of service principle in rate making as follows: "the value of service to a business customer is greater than to a residence customer. ... By offering residence service at lower rates in acknowledgement of this principle, the service is placed within the financial capabilities of more people."[1/] The concern here, however, is with the overall benefit of the system to all users and not serving low income consumers as an end in itself.

However this apparent support for social welfare pricing may be due to a confusion between it and some of the popular defenses of marginal cost pricing. If the price of a long distance or business service is set equal to its marginal or incremental cost, the service's revenue, the argument runs, covers its cost. If the service is priced somewhat above its cost, it makes some contribution to basic services and reduces their prices below what they otherwise would be.[2/] However, consumers of the basic services would be much better off if the process was reversed, and their services were priced at marginal cost plus some

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[1/] Bell Canada, "Memorandum on Rates", Application of November 5, 1971 for Revised Tariffs of Rates.

[2/] See Baumol and Bradford op. cit., pp. 277-78. The argument is made more explicitly in W.J. Baumol, "Rate Making: Incremental Costing and Equity Considerations," in Harry S. Trebing, op.cit., pp. 137-50.

increment to contribute to the reduction in the prices of long distance and business services. These other services would then bear the residual burden of covering the total costs of the company.

If marginal cost and demand could be measured with any degree of accuracy, social welfare pricing would not constitute the charity of pricing services with a high income elasticity of demand at something in excess of marginal cost. Rather, they would be priced to equate marginal revenue with marginal cost. In other words these services would be priced to maximize the profit on them, and this profit would be used to reduce the prices of basic services for which demand is income inelastic. A price that equates marginal cost with marginal revenue is substantially higher and contributes a much larger profit than a price that is something in excess of marginal cost.

The case of social welfare pricing can be made even stronger by recognizing the political process under which regulation operates. The decision to make an industry a public utility is a decision to have it operate in the public interest. Private ownership need not conflict with this objective, since regulation limits profits to the return on capital necessary to attract capital and public ownership is not likely to result in a material reduction in the company's true cost of capital. With profits limited to the utility's cost of capital all profits in excess of this minimum return are passed on to the consumer in the form

of lower prices than an unregulated monopoly would charge.

The relative price problem is the problem of how the monopoly profits should be distributed among consumers. If we assign one vote to each consumer in electing a regulatory commission, the correct behavior of the commission is quite clear. Services for which the demand is practically the same per consumer, that is basic services, should be sold at the lowest possible price. Services for which the demand varies among consumers with their income should be sold at prices which maximize profits, with the profit used to subsidize the basic services. With every consumer voting in his own self-interest a majority of consumers will vote for a regulatory commission that follows this pricing policy. The minority of the consumers that are large users of the competitive services are of course exploited by the majority under this policy. However, the degree of exploitation is limited by the availability of alternative sources of supply for the competitive services. There is a limit to the prices that may be charged for competitive services, and a case can be made for charging such prices unless they can be shown to be socially undesirable.

Making it possible for all households to have access to the system and equality in the distribution of income are not the only non-cost criteria for setting relative prices. Two

others of a broad nature are an acceptable rate of growth in investment in the industry and the most effective contribution to the performance of the economy as a whole.

The size and capital intensity of the telecommunications industry make the rate of growth in investment in the industry an important factor in the cost and availability of capital for other industries. We have seen that the structure of relative prices and the method of pricing (usage versus flat rate pricing) can have a material influence on the rate of growth in demand for service and in the investment required to meet the demand. It is therefore desirable to project the rate of growth in demand and the capital requirements to satisfy that demand. If the projections threaten a disproportionate burden on the capital markets, changes in the structure and method of pricing that restrict the rate of growth should be considered.

An even broader consideration in pricing telecommunication services is the performance of the economy as a whole. Clearly, there are strong limits on the extent to which other pricing policies can be subordinated to this criterion, and no specific policies follow from accepting this criterion in, the abstract However, there are special circumstances where this criterion does lead to concrete policy conclusions. Some of them, including Northern Electric and international toll rates, will be examined later.

IV POLICY IMPLICATIONS

1. Reconciliation of the Principles

The previous pages have presented a number of principles that may be used in setting relative prices. Some of these principles are not compatible while others may or may not be compatible with each other depending on the pricing problem under consideration. To complicate matters further there is no clear case for the superiority and univeral application of one among these principles. Our task then is to arrive at the optimal basis for integrating or choosing among them.

One solution to the rate design problem from the viewpoint of the regulatory agency is to leave the problem to the utility and to only concern itself with the overall level of prices and revenues. A good case can be made for this solution. We have seen how difficult it is to correctly measure costs for each type of service in the telecommunications industry. These difficulties confront a company with a large and informed staff that has direct access to the data generated by the company's operations. The difficulties are compounded for a regulatory agency which has considerably less staff resources to devote to the problem and which must work through the company staff to gain access to the required input data. It is highly questionable whether a

regulatory or other independent staff can adequately audit the findings of the company in the area of rate design, let alone carry out its own investigations of rate design issues.

If a telecommunications utility acting in its own interest could be expected to come up with rate design decisions that serve the public interest, leaving the problem to the company would clearly be in the public interest. The devotion of considerable resources to cost and other studies of questionable value would thereby be avoided.

However, our examination of the reasons why a firm might be persuaded to adopt market development pricing makes its unlikely that a utility acting on its own interest will solve the rate design problem in the public interest. It is unlikely to have much concern for equality in the distribution of income. Its desire to maintain a satisfactory rate of growth and restrict the entry of other firms into its domain are likely to result in excessive growth, high prices for basic services, and low prices for competitive services.

In concerning itself with the problem of rate design, however, a regulatory agency must proceed with considerable caution. The agency does not have the freedom to set prices de nouveau. At any point in time the agency faces an existing structure of relative prices plus the fact that other things the same change

is undesirable. It is particularly undesirable if the reduction in some prices is compensated for by increasing other prices. The gain to those who benefit from the change is unlikely to match the loss to those who are damaged, and the disapproval of those who lose is typically more vocal than the approval of those who gain. Hence, the political considerations which justify resisting change are quite proper, and the social tensions created by radical change should only be risked if the benefits are material. There should be significant inefficiency or inequity in the existing rate design.

Confronted with the responsibility for a utility's rate design, a regulatory agency is easily persuaded to adopt cost as the basis for deciding what the rate design should be. The next steps are the establishment of a set of rules for determining the cost of each service and the development of the service costs under these rules. We have seen, however, that a fully distributed cost system can produce a wide range of cost figures for each service depending on the rules for allocating fixed and joint costs that are adopted. Similarly, by the appropriate choice of time horizon and other aspects of the problem formulation, a wide range of marginal cost figures can be obtained for each service. Consequently, unless the existing rate design departs radically from any sensible cost considerations, it should be possible to adopt procedures in measuring average or marginal cost which result in cost figures that are compatible with the

existing rate design. Undertaking an elaborate and expensive study with the sole purpose of justifying the status quo does not appear to be a sensible use of the resources employed.

A cost study that does not have as its objective the maintenance of the existing rate design can easily come up with cost figures that call for material changes in the structure of relative prices. Insofar as the regulatory agency and the utility are identified with the cost study, consumers of services that are priced above cost will be even more insistent that the inequity in the rate design be corrected. Consumers of services that will be increased in price if the cost study is implemented are unlikely to be reconciled to the change. They will question the principles and methods employed to measure costs, and they will argue the merits of non-cost considerations in rate design that are violated by the proposed changes.

The regulatory agency will find itself in the center of a very lively controversey. Furthermore, given the manner in which the cost data were developed, it is quite likely that the only defense for the rate design changes which follow from the cost data will be the abstract principle that departures in price from cost are undesirable. The limitations of the cost data and the limitations of cost as the sole consideration in pricing mentioned earlier will leave the agency in a highly vulnerable position.

What then should a regulatory agency do to meet its responsibilities in the area of rate design. First, the cost revenue, output, facility investment and other data that grows out of the normal operations of the company should be collected in as much detail as possible, and it should be reported to the agency and made public, each to the maximum degree feasible. This will increase the ability of the company and agency staffs and of outside groups to identify areas where a change in prices or the method of pricing a service may improve the performance of the system. The next step is the development of cost, revenue, output, investment and related data that are addressed to the problem under consideration. The general purpose costing system designed to establish the cost of each service is unlikely to be relevant for any specific pricing problem.

To illustrate, consider the problem of pricing a vertical service such as a Centrex system. The investment, installation and maintenance cost of such a system should be easy to establish with a relatively high degree of accuracy. Clearly, the monthly charge should at least recover these costs plus a fair return on the capital employed, if the demand for the system is growing. Should the charge be higher? What should be the related charges per line and per call on the system? The higher the package of charges for the system's use, the greater the profit contribution per system installed. Raising the package of charges beyond some

level will reduce the profit contribution of the service through the adverse impact on the growth in demand. However, in arriving at the optimal price the impact of the price on the demand for other services that are close substitutes must be given adequate consideration. As the price for this Centrex system is reduced, it is substituted for other systems that perform similar functions. The correct calculation of the incremental profit on a lower price for the Centrex system requires the deduction of the foregone profits on the substitute systems being replaced. Furthermore, the foregone profit is gross profit before deducting interest and depreciation on the equipment that would be retired. Pricing a service so low that its growth is at the expense of substitute services is desirable only if it is exceptionally profitable. Otherwise the capital requirements for the expanding service and the foregone profits including retirement losses on the alternative services increase the revenue requirements for the basic services.

The goals of the analysis described above are to maximize the contribution of the specialized service in question to the support of basic services and to avoid excessive growth in the company's capital requirements. The prices that result are likely to be different from and superior to the prices that would follow from a general purpose cost system designed to measure the

cost of all services. The examination of other issues in rate design in the sections that follow will further illustrate the recommended approach to the problem.

2. Residential Exchange Service

As stated earlier among the public policy goals in pricing telephone services are universal access to the system and equality in the distribution of income. These goals are served by a low price for residential exchange service. However, what is a low price and how low the price should be are not readily determined. Clearly, cost is the upper limit on the price, but the cost concept that is relevant and how the cost should be measured are extremely difficult problems. These questions have not been answered notwithstanding the fact that the primary emphasis in research on telephone service pricing has been on cost.

A satisfactory resolution of the problems of cost measurement would be most desirable. It would provide a basis for judging the success of a company in holding the line on the charge for residential exchange service. Until these cost measurement problems are solved, however, other criteria must be sought out to evaluate performance. One of them is a comparative analysis of the rates charged by a company with those charged by other companies. Bell Canada is used below for illustrative purposes.

Table I presents the local exchange rates for Bell Canada, the New York Telephone Company and the average for 12 other AT&T operating companies in the North Central and North East United States, exclusive of metropolitan areas with over 500,000 subscribers.

It is clear that Bell Canada local exchange rates compare very favorably with the rates charged by the AT&T operating companies. Rates in New York range from 41% to 66% higher than Bell canada rates depending on the size of the community. Rates in the twelve other states average out well below the New York States rates, but they are still well above the Bell Canada rates. The twelve state averages range from 19% to 25% higher than Bell Canada rates.

Table II presents the rates in metropolitan areas with over 500,000, subscribers in the areas served by Bell Canada and the above affiliates of AT&T. Part of the variation in rates among these areas is due to difference in size. However, even after allowing for the differences in size, it is clear that Bell Canada rates for metropolitan areas are substantially lower than the rates charged by the AT&T affiliates.

There are two possible explanations for the lower Bell Canada residential exchange rates. One is that Bell Canada system costs are lower. The other is that higher rates for other types of services make possible the lower residential exchange rates. Cost comparisons are very complex and difficult, but there appears to be little basis for believing that Bell Canada's costs are materially if at all lower than the AT&T company costs. On the other hand, it is well known that long distance rates are higher in Canada than in the U.S.,

TABLE I

Comparison of Bell Canada and United States
Local Exchange Rates for Residential Service in
Communities with up to 500,000 Terminals, June 30, 1974

Area	Number of Terminals						
	4,000 10,000	10,000 20,000	20,000 35,000	35,000 70,000	70,000 150,000	150,000 300,000	300,000 500,000
Bell Canada	$4.61	$4.95	$5.20	$5.40	$5.80	$6.05	$6.25
New York Tel. Co.	$6.91	$7.29	$7.69	$8.07	$8.45	$9.21	$10.36
% above Bell Canada	41%	47%	48%	48%	46%	52%	66%
12 States Average[1/]	$5.71	$5.94	$6.17	$6.53	$6.95	$7.35	$7.81
% above Bell Canada	24%	20%	19%	21%	20%	21%	25%

1/ The states are Conneticut, Illinois, Indiana, Iowa, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, Ohio, Pennsylvania and Wisconsin.

TABLE II

Comparison of Bell Canada and United States Local Exchange Rates for Residential Service in Areas with over 500,000 Terminals, 1974

City	Number of Terminals[1]	Monthly Bill
Boston	1,644,917	$14.68[2][3]
Buffalo	696,265	11.52
Chicago	5,272,028	11.25
Cincinnati	924,600	8.15
Cleveland	1,366,916	9.25
Detroit	2,467,000	9.55[2][3]
Indiannapolis	820,974	10.15
Kansas City	947,932	7.35
Manhattan	5,551,159	15.20[2]
Milwaukee	971,000	9.80
Mineapolis-St. Paul	1,513,386	6.70
Montreal	1,882,000	6.50
Newark	2,712,298	7.03
Possaic	678,193	6.83
Philadelphia	2,672,400	9.60[2][3]
Pittsburg	1,148,600	9.07[2][3]
St. Louis	1,160,915	7.85
Toronto	1,988,000	7.10

[1] Number of terminals for the local service area.

[2] The monthly bill includes a flat rate and a use charge with the latter based on 150 message units.

[3] The use charge is for calls outside the primary calling area, and 1/3 of the calls were assumed subject to the charge.

and it is quite likely that the rates for business services are also higher. One may therefore conclude that Bell Canada's residential exchange rates are lower than in comparable U.S. areas due in large measure to higher charges for other services.

However, comparison of Bell Canada residential exchange rates with those in the prairie provinces of Manitoba, Saskatchewan and Alberta presents a different picture. Table III reveals that the rates in all three provinces are lower by varying amounts than the Bell Canada rates. There are many possible reasons for these differences. Among them are: (1) lower costs due to greater efficiency; (2) lower costs due to the less industrialized nature of the areas served and a smaller fraction of business use; (3) higher rates for toll calls; (4) more favorable terms for sharing in the Trans Canada Telephone System (TCTS) revenues, and (5) lower costs due to a lower quality system.

Another possible explanation, one that is more easily evaluated is the financial advantage a crown corporation enjoys. All of the prairie provinces are served by crown corporations which are free of corporate income taxes, have much higher debt ratios and do not require the same return on capital to attract capital as a private corporation.

To test whether crown corporation status could explain the differences in residential rates, the following analysis of the three corporations was carried out. First, the long term capital was allocated between debt and equity in the same

TABLE III

Comparison of Local Exchange Residential Rates, Bell Canada and the Prairie Provinces, 1974

Bell Canada

Terminals (000)	1.0-2.0	2.0-5.0	5.0-10.0	10.0-20.0	50-100	100-250
Rates	$4.10	$4.40	$4.65	$4.95	$5.55	$5.95

Alberta

Terminals (000)	.5-1.5	1.5-5.0	5.0-10.0	10.0-30.0	over 30	100-250[1/]
Rates	$3.50	$3.65	$3.80	$4.00	$4.25	$4.75
% Bell Canada above		21%	22%	24%	31%	25%

Manitoba

Terminals (000)	.5-1.0	1.0-2.0	2.0-5.0	5.0-10.0	10.0-40.0	over 100
Rates	$2.75	$2.90	$3.05	$3.25	$3.45	$3.90
% Bell Canada above		41%	44%	43%	43%	53%

Saskatchewan

Terminals (000)	.5-1.0	1.0-5.0	5.0-10.0	10.0-40.0	over 40	
Rates	$3.05	$3.20	$3.45	$3.70	$4.15	
% Bell Canada above		38%	35%	34%	34%	

[1/] Edmonton rate.

proportion as Bell Canada's capital structure. Next, earnings before interest and taxes was calculated on the assumption that the company had the same return on common, the same corporate income tax rate, and the same imbedded interest rate as Bell Canada. The excess of this figure over the actual earnings before interest and taxes in the test year, 1973, is the additional revenue the company would have had to earn as a private corporation. The additional revenue requirement expressed as a percentage of revenue from services within the province was then applied to the residential exchange rates to arrive at what they would be in the absence of a crown corporation.

To illustrate, Tabel IV presents the March 31, 1974 Manitoba Telephone System capital structure and what it would have been if the Bell Canada allocation between debt and equity had been employed. Notice that the equity is increased from 17% to 52% of long term capital. Table IV also presents the companys actual and computed income statement for 1973-4. For the latter start with the net income figure which is the imputed equity times the Bell Canada return on equity of 9.25%. The income before taxes of $23,965,000 times the Bell Canada corporate income tax rate of 45.3% results in the tax figure shown and the net income figure derived previously. Inputed debt of $226,830,000 times the Bell Canada imbedded interest rate of 6.39% results in interest charge shown. Adding the interest

charge to the income before taxes results in $32,323,000 earnings before interest and taxes. Sales revenue $13,051,000 higher than the revenue actually shown is needed to generate the computed earnings before interest and taxes and offset Manitoba Telephone's financial advantage in being a crown corporation.

Manitoba Telephone could not raise all its rates to generate the required increase in operating income. A reasonable hypothesis is that it could raise its local service, intra-provincial toll, and other intra-provincial rates. A 26.7% increase in these revenues would generate the required increase in revenue. Looking back at Table III we see that Bell Canada rates range from 41% to 53% higher than Manitoba Telephone's residential exchange rates. Therefore, eliminating Manitoba's crown corporation status advantages would go a long way towards closing the gap. However, Manitoba Telephone's rates would still be about 15% below Bell Canada's rates.

Carrying out the same analysis for Saskatchewan's Telephone company reveals that it would have to raise residential rates by less than one percent, if it were denied the financial advantages of being a crown corporation. For one reason or another Saskatchewan Telecommunication is able to earn about the same before tax return on capital as Bell Canada and still charge substantially lower rates, about 35% lower than Bell Canada. The Alberta Telephone Company with the Edmonton Telephone Company consolidated

into it would require a 20% increase in residential exchange rates to offset the advantages of crown corporation status. With this upward adjustment its rates would be only slightly lower than Bell Canada's. It seems therefore, that all three crown corporations have lower residential exchange rates than Bell Canada in varying degrees even after allowing for the differences due to their advantages as crown corporations.

It should not be inferred from this analysis that telephone users in Ontario and Quebec would be better off being served by a crown corporation. The tax advantage enjoyed by crown corporation customers are better obtained by making all telephone companies free of the corporate income tax. In fact this advantage the prairie province users enjoy would be wiped out if Bell Canada and B.C. Telephone became crown corporations. The higher debt ratios and lower returns on equity that are typical of crown corporations represents a subsidy that provincial residents as taxpayers confer on themselves as telephone users.

The choice between crown corporation and private ownership should be made on the basis of ability to provide service and operating efficiency. Without going into a detailed analysis it is clear that Bell Canada compares favorably not only with the crown corporations but with the AT&T system as well. The differences in residential exchange rates between Bell Canada and the prairie systems not accounted for by crown corporation

TABLE IV

Manitoba Telephone Company, Actual and Imputed
Financial Statement Data, 1973-74
(000)

Balance Sheet March 31, 1974

	Actual		Imputed	
Capital Structure	Amount	Percent	Amount	Percent
Net long term debt	$226,830	83.0	$130,813	48.0
Equity	45,698	17.0	141,715	52.0
Total	$272,528	100.0	$272,528	100.0

Income Statement 1973-74

Revenues	Actual	Imputed
Local Service	$26,740	$33,870 4/
Intra-Company Toll	16,066	20,350 4/
Other Intra-Company	6,148	7,785 4/
TCTS and Other Intra Company Toll	31,532	31,532
Miscellaneous	572	572
Total	$81,058	$94,109
Operating Expenses	$61,786	$61,786
Operating Income	$19,272	$32,323
Debt Charges	14,796	8,358 3/
Income before taxes	$ 4,576	$23,965 2/
Income Taxes		10,856 2/
Net Income	4,576	13,109 1/

1/ Imputed equity of $141,715 times Bell Canada return on equity of 9.25%.

2/ Based on Bell Canada's tax rate of 45.3%.

3/ Based on computed debt and Bell Canada imbedded interest rate of 6.39%

4/ Increased by 26.7% over actual revenues to generate net income figure shown.

status may be due to any number of reasons unrelated to the comparative operating performance of the companies. In addition Bell Canada plays a leadership role in the development of the telecommunications industry in Canada that might not be matched if it were changed to a crown corporation. Nonetheless, it might well be useful to explore the relative importance of the factors mentioned earlier in the residual differences between the residential exchange rates charged by Bell Canada and the prairie companies.

We have seen that the prices charged for residential exchange service by Bell Canada and the prairie provincial companies compare very favorably with the prices charged in the United States. For the future a reasonable goal in the current inflationary environment is to hold the line. If the price is not raised and the burden of cost increases due to inflation falls on other services, the pricing of residential exchange service may be considered satisfactory. Accordingly, the rates for the service should be increased only if it is clearly demonstrated that the alternative price increases in other services are counterproductive. That is, the fall in demand for the other services would be too large to meet the company's overall revenue requirements, or the performance of the economy as a whole would be seriously impaired by the higher rates for other services.

Our public policy goals in the pricing of residential exchange service may not be realizable under the present method of pricing. At the present time residential exchange service is paid for through a flat monthly charge that is independent of how much the subscriber uses the system. The alternative is a lower monthly charge plus a charge per call, with perhaps some number of free calls included in the monthly charge. This alternative is compatable with universal access to the system and equality in the distribution of income. Universal access does not require free use, and charging for use causes less inequality in the distribution of income than raising the monthly rate.

Metering local exchange calls is undesirable if metering costs are large and if system costs are independent of local exchange use. On the other hand, metering may be the only feasible alternative to raising the monthly charge for access to the system. This is the case under the following conditions: new developments in switching technology make metering costs substantially lower than they have been; local exchange use varies over a wide range among subscribers; system costs vary with system use; and perhaps most important there is an upward secular trend in the average local exchange use by subscribers with system use free.

There may also be a place for peak load pricing in the pricing of local exchange service. The gains in utilization of the system and user benefits from differential evening and weekend rates on long distance calls are well known. The use of local exchange facilities also seems to vary over the course of the day and week more or less depending on the relative mix of business and residential phones on the exchange. As the investment in local exchange facilities grows, it becomes increasingly important to consider the use of time of day and week pricing both to limit investment in the facilities and to ameliorate the burden of usage sensitivity pricing.

Answers to the questions just raised must be found to establish the consequences of flat rate pricing of local calls for growth in the demand for service and the rise in the flat rate charge needed to cover the cost of service. We may be entering an era in which usage sensitive and peak load pricing is to be preferred. It would seem more desirable to find the answers to this question and act on the policy implications than to establish the cost of each type of service without any reference to policy questions.

3. Entry in Other Lines of Business

One of the unsolved problems of regulation has been what to do with a subsidiary such as Northern Electric which is engaged in a line of business that would not be considered subject to regulation if it were not owned by a regulated firm. Since such entry poses problems for the pricing of regulated service it is appropriately considered here.

A simple solution to the problem is to prohibit a regulated utility from engaging in the production or sale of products and services other than the utility services that it has been chartered to provide. In the case of Northern Electric, it could be argued, following this rule would increase the cost of telephone equipment to Bell Canada and its customers. This is true insofar as owning its own equipment producer contributes to technological progress and reduced production and distribution costs for the equipment.

A stronger case can be made for prohibiting a utility from engaging in business activities unrelated to the utility services it provides. A public utility enjoys a lower cost of capital than unregulated companies in manufacturing and mining. Also, the utility prices are set to cover all costs including a fair return on capital. Therefore, when a utility goes into another line of business, its debt capacity and lower cost of capital are used for a different purpose. If the other business proves to be unprofitable the utility customers are burdened with the

losses incurred. The other side of the coin it may be argued is that if the non-utility business is exceptionally profitable, the gains accrue to the utility customers in the form of lower prices for the utility services.

This conclusion assumes that the corporate entity and not just the utility operation is subject to regulation. Although such a policy is conceptually feasible, it raises a number of problems. If the non-utility business is to earn no more or less than the regulated rate of return, through subsidies to or from the utility operation, what profit incentive is there for the utility to engage in the business? Notwithstanding the lack of any inducement for the stockholders in having the utility engage in other business ventures, the management may enjoy the challenge. However, allowing a utility management to do so may well subject other firms to unfair competition and place excessive burdens on the utility's consumers. Other manufacturing firms do not have a utility operation to provide low cost capital and absorb unexpected losses. Also, with this captive source of funds a utility management may not show the prudence and may not demonstrate the competence required of other firms before embarking on a business venture.

The alternative course of action is to limit regulation to the corporation's utility operations. Losses on the utility operations are not compensated for by allowing higher prices on

utility operations so that the corporate entity enjoys a return equal to its cost of capital. Conversely, gains on non-utility operations are not passed on to utility customers. In that event, what benefit is there to utility customers, for whom regulation is employed, in having the utility engage in other business activities. Perhaps more important this policy places an extraordinary burden on the regulatory process. If the regulator does not have far more resources and far more competence than one may reasonably expect, the utility consumers are likely to suffer the worst of both worlds. That is, they will subsidize the unregulated business if it is unprofitable and fail to enjoy the profits if it is profitable. It seems quite clear that a utility should not be allowed to engage in other types of business unless there is good evidence that economies of vertical integration exist.

What then should be public policy with regard to Northern Electric where economies of vertical integration may be presumed to exist? The Western Electric AT&T relation presents an analagous problem. There, Western Electric is prohibited from selling its products outside of the AT&T system apart from defense contracts, and prices charged to AT&T companies are required to be no higher than the prices charged by outside suppliers.

The prohibition on sales outside of AT&T is designed to protect other manufacturers of telecommunication and of electronic

equipment in general from unfair competition. The fear is that high prices to AT&T customers would subsidize open market sales. The requirement that Western Electric prices to AT&T customers be competitive would seem to allow regulation of the AT&T telephone companies without regard for Western Electric profits. That is AT&T long lines and operating companies can be regulated to earn their cost of capital, and with Western Electric charging them competitive prices its profits are unregulated.

However, it is extremely difficult to check on the reasonableness of the prices Western Electric charges. Consequently, there is a tendency to look at the rate of return Western Electric earns. If it is higher than the rate of return earned by the operating companies, the difference is attributed to excess prices charged by Western Electric, and it is argued that the revenue requirement of the operating companies should be reduced correspondingly. It is clear that both formally and informally the prices Western Electric charges are influenced by the requirement that it not earn a rate of return that is materially different than the return earned by the AT&T operating companies.

The policy governing the AT&T Western Electric relation has limited applicability in Canada. Prohibiting Western Electric from selling outside of AT&T makes sense. Otherwise, the many

other electronic firms in the United States would be subjected to unfair competition. However, in Canada we have few if any other independent electronic firms. Prohibiting Northern Electric from selling to other firms than Bell Canada would only protect the market for foreign firms or their branch plants in Canada. To seriously curtail the only significant Canadian presence in the electronic industry does not make sense.

Furthermore, to regulate Bell Canada so that the corporate entity makes a fair rate of return would also curtail Northern operations. The profit inducement to expand into other products and markets would be eliminated. Notwithstanding the regulatory problems and risks presented, only Bell Canada's telecommunication operations should be regulated to earn the cost of capital, and Northern Electric should be allowed to earn whatever profit it can, subject to only one condition. The condition is that prices charged to Bell Canada should be reasonable.(1) This is a difficult policy to enforce, but the alternatives seem even more costly in terms of the national interest.

(1) How determined ?
interrelated relative comparison!

4. International Toll Calls and Computer Services

In the previous section our examination of Northern Electric went beyond the welfare of telephone service consumers narrowly defined. Our policy recommendations were influenced by concern for the realization of national economic goals, in particular the strengthening of Canadian participation in a high technology industry that offers attractive employment opportunities. Similar considerations arise in the pricing of international toll calls and in deciding on the participation of telecommunication companies in the data processing industry.

As mentioned earlier the rates on long distance toll calls are considerably higher in Canada than in the United States. Rates on calls between the two countries, transborder rates, fall between the rates in each country. This may have been looked on as a reasonable compromise by those who made the decision, perhaps because they believed rates in each country reflected cost and transborder rates should also reflect cost. However, a very convincing case can be made for setting transborder rates as high or higher than Canadian rates.

The main objection to lower transborder rates is that they make transborder communication cheaper than communication within Canada. Insofar as price influences communication, it would seem more desirable to encourage communication among people and business firms in Canada than to encourage it between Canadian

and United States individuals and business establishments. It seems particularly undesirable to have a firm in New York able to communicate with a customer or subisdiary in Toronto at a lower cost than a firm in Montreal incurs. This rate structure appears to be in clear violation of national communication policy.

One of the objectives in setting long distance toll rates is to generate a profit that contributes to the reduction in local exchange rates. There is little room for doubt that this is true of Canadian long distance rates. A possible argument for not changing transborder rates is that the present rates maximize the profit contribution from the service. However, it would be most difficult to make a case for this position. The demand and cost characteristics of transborder traffic are little if at all different from the demand and cost characteristics of Canadian traffic. It follows that if a rise in transborder rates would reduce the traffic's profit contribution, a reduction in Canadian rates would raise its profit contribution. A more reasonable hypothesis is that a rise in transborder rates would raise revenue by practically the same percentage, reduce costs somewhat and materially increase the service's profit contribution towards the reduction of other rates, in particular Canadian long distance rates.

The short run influence on demand of a rise in transborder rates is not likely to be perceptible. In the long run the rise

in rates may restrict the rate of growth in the demand for the service somewhat. However, insofar as that is true the reduction in Canadian toll rates made possible by the increase in transborder rates will encourage the long run rate of growth in the demand for long distance service within Canada.

The present level of transborder toll rates are also anachronistic by comparison with other international toll rates. Such rates are typically very high by comparison with toll rates for national calls over the same distance, and these high rates make international calls very profitable. For instance, COTC (Canadian Overseas Telecommunications Corporation) handles all international traffic but the United States traffic and enjoys an exceptionally high rate of return on its investment. COTC enjoys this high return, notwithstanding its substantial investment, some would say overinvestment in cable facilities, the very unfavorable terms under which its participates in the commonwealth system, and the siphoning off of some part of the Canadian overseas calls by customer routing of them through New York.

The only group that does not seem to participate in the profits from the high prices on overseas calls are the national telecommunication users. In fact, it is possible that the rates at which TCTS is compensated for the domestic legs of overseas calls makes the national telecommunication system subsidize COTC.

Finally, there would seem to be no legal problem in raising transborder toll rates. The ultimate authority in setting international rates is each country. A country may set whatever price it wishes for incoming and outgoing calls. If each country sets its own price, the parties to the call pay the sum of the two prices, and the country that charges the higher price gets the best of the deal. To avoid such confusion two countries typically agree to a uniform set of rates for international calls with the telephone systems of the two countries sharing in the revenues from the calls regardless of where the calls originated and regardless of who pays for the call. The two countries' systems share equally in the revenues after deducting some amount for the cost of the facilities provided if the two countries do not share equally in the cost of providing the facilities. Consequently, if one country prefers a high rate between it and another country the two will agree on the higher rate.

In the absence of evidence to the contrary it would seem desirable to set transborder toll rates at least 25% higher than present Canadian rates and use the increased profit on the traffic to reduce Canadian toll rates.

Turning to the computer information industry, we have a problem analyagous to the Northern Electric problem. Should Bell Canada, CN-CP and other telecommunication companies be

allowed to go into the business of selling computer time, programming services, and other services related to computer information?

The economics of scale provided by very large scale computers, the growth in the use of very large data banks, and other developments in the information processing industry have increased the use of centralized data processing with remote terminals providing users with access to the facilities. In other words data transmission over telecommunication facilities has become an increasingly important part of the industry. A telecommunication company that also sold computer time, programming, data bank management, etc. would therefore have a strategic advantage over companies that were limited to the other services.

In the United States AT&T and other telecommunication companies are prohibited from selling anything else than the transmission of data and the equipment that take the data on and off the telecommuncation system. That policy is perfectly sound for the United States. It has a large data processing industry that is stimulated by competition to continuously improve the technology and reduce the prices of its services. Allowing AT&T into the industry could easily create a monopoly that would stifle further progress.

If the same conditions hold here in Canada, Bell Canada and CP-CN should also be prohibited from expanding into other

sectors of the data processing industry. On the other hand if a large fraction of the industry that serves Canada is located in the United States, the policy does not protect a high technology successful Canadian industry from unfair competition. It protects the United States data processing industry against competition from a few firms that might be able to provide a material increase in the Canadian presence in the industry.

There certainly are alternative policies to prohibiting Canadian telecommunication firms from engaging in data processing that can be employed to protect Canada's few small independent firms. Instead of these alternative policies, there is now a prohibition on participation in the industry by telecommunication companies. In addition there is a rate structure which makes it cheaper to move data between Toronto and New York than between Toronto and Montreal. Cost and demand studies designed to answer policy questions such as those raised here would seem to be more useful than studies designed to determine the cost price relations that exist for different types of services without regard for what one would do with the knowledge that cost price relations vary from one service to the next.