PRIORITY RIGHTS, CAPITAL FACILITIES CHARGES, AND EFFICIENT PRICING FOR UTILITIES

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The rise in the price of inputs for electricity production and public resistance to rate increases have caused regulated industries to reexamine their pricing policies in an effort to alleviate the situation. Debate over fuel adjustment mechanisms reflects current disagreements about the effects of regulatory lag and the sharing of risk between producers and consumers. Here we address the problem of pricing to meet costs incurred in the provision of new capital facilities. This issue has caused much political debate, especially in states with population and industrial growth.

The issues considered here are by no means purely academic in nature. The National Association of Regulatory Utility Commissioners (NARUC) requested that the Electric Power Research Institute (EPRI) and the Edison Electric Institute (EEI) conduct studies of rate design, including available technologies for metering (and controlling) time-of-day consumption. Production costs and rate design have been given special emphasis in the studies commissioned by EPRI. The background studies indicate strong disagreements between those favoring more traditional average cost pricing and those promoting price structures based on incremental cost.[/] Here we do not address peak load pricing issues, but focus on incremental costs, fully allocated historical costs, and differential pricing to various customer groups. Although the framework presented here is highly simplified, it draws out the major implications of alternative rate designs (price structures).

[/] For example National Economic Research Associates, Inc., has prepared several studies on conceptual issues and quantification of marginal costs [4]. The average cost approach has been recommended by Ebasco Services, Inc. [3]. A Task Force is still examining the alternatives and will make some recommendations in the near future. The EPRI studies represent a unique effort to apply economic insights to complex social and technological problems, with business, government, consulting and academic communities involved in the effort.

We consider five alternative pricing schemes for covering the costs of new capital facilities: (1) marginal cost pricing to all, (2) compensation of old customers for the imposition of a higher marginal price, (3) the same weighted average price for all, (4) vintage pricing (price discrimination between old and new customers), and (5) a capital facilities charge to new customers to cover differences between the return to capital needed for the new, higher priced facilities and the old generating units. Here we focus on the efficiency and equity consequences of the five pricing schemes, and conclude that if the first scheme is not politically feasible, the second approach is much to be preferred to the others, since it provides efficient price signals over time.

1. <u>The Analytical Framework</u>

We make some simplifying assumptions for this analysis: there have been constant, long-run average costs (LRAC) for the industry, the demand by new customers is identical to that of the existing customers (the arrival of the new group occurring at a single point in time), and the costs attributable to each group are wholly separable. Although these are unrealistic assumptions, they will facilitate the analysis of the five pricing schemes. Later we will examine the implications of other assumptions. Finally, holding technology constant, we add to our model unanticipated inflation for capital equipment; the price of equipment rises <u>and</u> the interest rates for financing the acquisition of equipment also rise. We assume that initially the old customers required the full capacity, and any new customers could only be supplied at higher LRAC'.

It is important to note that we are assuming not only inflation but unanticipated inflation.[/] If inflation has been anticipated, the interest rates which the old cusomers would be implicitly paying for the financing of their capital facilities (in their electricity prices) would reflect the expected rate of inflation, and thus, both old and new customers would, in this case, face LRAC'. Since inflation was unanticipated, however, owners of the equipment (stockholders) would realize an unanticipated capital gain if the regulators allowed the price of electricity to reflect its opportunity costs in the presence of a doubling of demand. The unanticipated inflation has a different effect on those with claims on future revenue streams (bond-holders). They suffer capital losses as real interest payments to them fall. If new facilities are to be built for new customers, not only will investors desire their real required rate of return, but an additional risk premium might be required in the event that utilities have shifted into a higher risk class. Thus, the pricing policies approved by regulators have implications for the distribution of benefits and costs among customers and investors, and we shall see that the efficiency consequences are also significant.

In Figures 1 through 4, we have D_O, the demand for electricity of the old customers, equal to D_N, the demand of the new customers. A horizontal summation of D_O and D_N yields D_T, the total demand for electricity. The price to the old customers, P_O, is equal to their long-run average cost, LRAC, prior to the arrival of the new customers. The price P_N is equal to the long-run average cost for new facilities, LRAC'.

[/] In the graph the amount demanded is taken to be a function of the real price of electricity which has risen relative to the general price level.

2. Marginal Cost Pricing

The first pricing scheme to be discussed is marginal cost pricing. "Madison Gas" (Wis 1974, 5 PUR 4th 28, Docket 2-U-7423) represented a major victory for economists who advocate such pricing. The decision can be viewed as highly innovative - signaling a new openess on the part of regulatory commissions (and firms) to economic concepts of efficiency.[1] The decision accepted a basic principle of economic efficiency: the requirement that the price of a good or service should be equated with incremental (or marginal) cost. Since in our simple example we are dealing with constant LRAC (assuming no inflation and historical cost), this will equal the long-run marginal cost, LRMC. Thus, as is seen in Figure 1, the optimal quantity for consumption by all the customers would be at Q* the point where LRAC' (reflecting replacement cost) intersects total demand, D_T. Prior to the arrival of the new residents, the optimal quantity was at the point where LRAC intersects the demand of the old customers, D_O, quantity Q_O.

Note that whether or not there are new customers, the old ones should be informed that the price in the future will be P_N when current capacity is replaced. Throughout the paper we assume that capacity depreciates with time and not with use. If the latter obtains, the efficient price for the old customers should rise to P_N, whether or not new customers arrive. For simplicity we are valuing future consumption at a zero discount rate. Given our assumptions, the price to old residents should rise to P_N with the inflow of the new residents; for efficiency the old residents should pay a higher price, P_N, and consume only Q', which is less than Q_O.

[1] See Cudahy [2] for a review of the Madison Gas Case. For sample incremental cost calculations, see Bower and Rohr [1].

In a sense, the new residents are imposing costs on the old residents, but both old and new customers should face the higher price, P_N, since the old cusomers are responsible for the use of new facilities as well as the new customers. If the old customers are unwilling to pay for service at the margin because the cost outweighs the old customers' benefits, then new customers, willing to pay that price, could replace the old customers, reducing the amount of new facilities to be built. Clearly, such marginal cost pricing has attendent political problems. This policy causes the sharpest and largest increase in prices initially to old customers, who are already upset with rising fuel prices (not considered here). It is these "old customers" who are present voters, and any regulatory commission that is elected (or appointed by elected officials) is likely to be concerned more with the desires of old customers than new customers.

3. Compensating Fee and Marginal Cost Pricing

The second pricing alternative is designed to meet the objections of current customers. Let us establish a priority property right, in which the initial level of real income for old customers is given priority and must not be reduced. This "right of prior residency" is being used by some rapidly growing communities to justify impact fees to be borne by new residents.[/] Such a concept could also conceivably be used to justify an "entry fee" form of price discrimination between old and new customers. If this concept were

[/] The legal literature on this topic is growing rapidly. For an example of the issues see Scott, Brower, and Miner [5]. For example, in Florida, local government has been delegated broad police powers but has only limited taxing powers. Revenues obtained through impact fees must be spent to regulate strain placed upon facilities by the arrival of newcomers to the community. Courts have been called upon to determine appropriate uses of excess funds collected through such fees. Application to electricity would not be inconceivable, especially for a municipally-owned system.

upheld in the courts, then an entry fee would not constitute, by legal definition, price discrimination because one group by right is entitled to compensation by those imposing costs.

If such a property right is established, then old customers are entitled to compensation for their lost annual consumer surplus, area $P_O P_N XZ$ in Figure 1, caused by a price rise to the marginal cost price P_N (due to new customer demand). Since the entrance of new customers causes the price to rise to P_N, their entrance would be rightfully blocked under this theory, unless they are willing to compensate the old customers for their loss (either as an annual payment or as a present value of losses). In Figure 1, this means that the area $P_N WX$, representing new customers' annual consumer surplus, must be greater than or equal to the area $P_O P_N XZ$, representing old customers' lost consumer surplus. If $P_N WX$ is smaller (as in Figure 1) then the new customer would be unwilling to pay the compensation, since the total cost of the service price plus the compensation charge would be greater than the utility the new customer would derive.

The implementation of such an impact-compensation process could be done through local property tax rebates. Thus, the old customers experience a capital gain. The full incidence of such compensation needs to be carefully studied, since, for example, renters do not benefit from the transfer to property owners - assuming that rental prices are determined by the costs of new apartments.

4. Weighted Average Price

Consider now a third pricing alternative: historical average-cost pricing described in Figure 2. Such an average (embedded) cost procedure has characterized pricing to cover the addition of new electricity capacity in the past. A weighted average price, P_A, to both old and new customers would cause a smaller jump from P_O for old customers (vis-a-vis the jump in price under marginal cost pricing) and would allow recovery of investment in the new facilities. At this price below marginal cost, both old and new customers will tend to overconsume, demanding Q_A* output instead of the optimum Q*, since consumers are not receiving the proper price signals. The net loss to society due to misallocation of resources is represented by the triangle XYZ, the marginal cost of the additional capacity minus the additional utility (XWZ) derived from it. Area P_AP_NTS represents income redistribution arising from unanticipated inflation and this particular regulatory policy. Quantity RX represents the only capacity that should be built for efficiency. Not only is average price not as economically sound as marginal cost pricing, but it still causes political problems as old customers' rates rise because of the acquisition of new capital facilities. (Note that P_AMNP_O = RNLY).

5. <u>Vintage Pricing: Price Discrimination Without Marginal Cost Pricing</u>

The next system of dual rates has been considered by the Tennessee Valley Authority as one way to handle inflationary pressures. Current rates would apply to existing loads placed upon existing facilities, with a higher price to new users of electricity and to increased use by existing customers. This "vintage" approach to capacity and consumption has substantial administrative complications, and represents price discrimination in that different customers are charged different prices for electricity which has the same opportunity cost.

Vintage Pricing, just like use of a weighted average price, leads to faulty price signals, but overconsumption is confined to old customers who pay a price P_O, below marginal cost (LRMC = LRAC') and consume a quantity Q_O. Figure 3 indicates that net social loss, due to overinvestment in new capacity, will be equal to the area XYZ. New customers are charged price P_N and hold their quantity demanded to Q_N. The result is total quantity demanded of Q_O + Q_N, versus the smaller, optimal Q*. It is as though the new customers used Q_N of the "old" capacity, and the old customers consumed a total of Q_O, requiring the additional investment of Q_N; while the efficient investment would have been only $Q^* - Q_O$ (equal to ZS of capacity). Thus, area XYZ represents the cost of resources drawn into the industry above the net benefits obtained by old customers (XWZ). The entire area $P_O P_N ZX$ represents transfers stemming from unanticipated inflation.

A factor to be considered under each of these pricing schemes is that demand growth is dependent on the expected price of electricity in the future. For example, a customer buying a consumer durable will match his expected utility from the item against the item's total expected cost, including operating costs. If the item is an automobile, part of the cost is the expected price of gasoline over the lifetime of use. If the actual cost of this total gasoline use is higher than the expected outlay for gasoline at the time the automobile is purchased, there is a consumer loss. Had the consumer been aware of the future higher price of gasoline, and if he had been one of the marginal buyers, then he would have bought either an automobile with higher gasoline milage or possibly have chosen an alternative mode of transportation. The reason is that, at the margin, total expected costs would be higher than the value of the utility he would derive from that car. Clearly, an unexpected rise in the price of gasoline will cause less use of the car than anticipated, due to the negative price elasticity of demand for gasoline.

The important point is that there is an overinvestment in this durable good, and the consumer's demand for gasoline, even at the higher price, is greater than it would have been had he known the future price of gasoline. This is obvious if his alternative action had been to buy no car; however, if he had bought a more economical car, due to correct gasoline price expectations, he would still be using less gas for his day-to-day driving than he would with the larger car bought under incorrect expectations of gasoline prices.

This example would apply equally well to any durable good that is a complement of utility service, such as a swimming pool and water rates, or an air conditioner and electric rates. Thus, an incorrect, lower price expectation will tend to cause utility service demand to grow faster than a correct, higher price expectation. If prices are held steady instead of allowed to rise with marginal cost, then lower price expectations will result. When old facilities are replaced at the new higher costs, and a rate hike becomes necessary, a consumer loss due to incorrect expectations takes place, in addition to a societal loss from overinvestment. This factor should be built into any dynamic comparison of the efficiency consequences of alternative pricing schemes.

6. Capital Facilities Charge

A special form of price discrimination which has recently gained interest, and which is surrounded by controversy is the capital facilities charge (CFC), whereby new customers are assigned a fixed charge equal to the difference between the costs of the old and new facilities. The concept of the capital facilities charge is sometimes mis-labeled as an "impact fee." The latter concept has tended to be subjective in nature and is designed to retard growth (or, at least, cover an array of costs related to growth). However, CFC is not growth related but is tied directly to the recovery of any cost differences between old and new facilities. Under a CFC pricing scheme, both old and new customers would pay the old per unit price for their consumption, the differential between new customer revenues and costs being recovered through the CFC. As in the case of price discrimination *per se*, underlying the use of a CFC is the assumption that old customers have a "property right" with regard to existing facilities. In the absence of such a right, there would be no basis for differentiating between the two customer groups (assuming no differential in opportunity costs of supplying the two groups).

Since the CFC is a fixed charge, new customers will consider the charge in their decisions as to whether or not to accept the service at all. The new customers will not, however, consider the charge in their decisions to purchase the marginal unit of output. Thus, a marginal price of P_0 (with the appropriate CFC) would be a faulty allocation mechanism for the new residents, since the marginal price they face is below marginal cost.

In Figure 4, under a CFC pricing scheme, both old and new customers would face a price equal to P_0 and would together consume a total quantity equal to Q" (which is equal to $2Q_0$).[1] The amount of the annual capital facilities charge to be paid by new customers would be equal to the area P_0P_NAB = AEFB (alternatively, the present value could be collected at once). Recall that under a scheme of price discrimination per se, the old customers consume too much output due to inefficient pricing. In the case of a CFC pricing scheme, both old and new customers overconsume, resulting in a net societal loss equal to the area DEF in Figure 4. Even if a weekly fee were made, since the charge is independent of consumption, there will be overconsumption, and overinvestment in new facilities. The optimal level of consumption (where all customers face a price P_N equal to LRAC') would be Q*, yet due to inefficient prices, Q" is consumed.

Not only do capital facilities charges cause overconsumption in the short-run, but, like price discrimination, they cause lower price expectations through the concealment of rising facilities costs in a one-time charge, thereby causing consumption decisions thereafter to be based on a lower-than-marginal service

[1] We assume that all new customers have chosen to accept the service, and that the income effect is zero.

rate. Price expectations will remain faulty until such time as capital facilities need replacement or supplementation. At that time, rate revisions or a new capital facilities charge (based on the realization of higher costs) will cause losses to consumers. Note that this argument hinges on the constant cost assumption. Under declining average costs, such fixed fees may be necessary for marginal cost pricing.

For consistency, capital facilities charges would apply to some old customers since increases in demand may come from old residents themselves. In addition, a new customer may not be adding to capacity requirements, as in the case of off-peak demands. Also, we have only been considering differences in capital costs; our constant cost curves have ignored fuel (or operating) costs. If new facilities have lower running costs and thus become part of the base load for the utility, old customers may benefit. Assigning causal responsibility for each generating unit for each customer is a truly Herculean task, especially if production interdependencies exist.

The efficiency consequences of the CFC are clear from the standpoint of overconsumption. There may also be effects on the input mix stemming from Averch-Johnson considerations. When the allowed rate of return is greater than the actual cost of capital, the profit maximizing firm subject to a rate of return constraint will not favor the CFC. That device will only take capital out of the rate base. But if the cost of capital is higher than the permitted rate of return, the CFC is a more attractive alternative. A more complete analysis of such considerations is sorely needed.

With these complications in mind, let us turn to a more manageable and defensible charge: connection fees. Such fees are not as ambitious as capital facilities charges, since they would cover the costs of the hookup --

such things as the meter, the service wire, and the costs of labor. Unlike the CFC, there is no inefficiency in that these costs are independent of quantity consumed, and, thus, should not be a part of marginal consumption decisions. Indeed, with the developer paying for the costs, the buyer would never see them directly. In addition, the scale is considerably less than that of the CFC, and it can be argued that such costs are separate from the production of electricity and, therefore, should not be included in the marginal price of electricity.

7. Conclusion

The purpose of this paper has been to contrast the efficiency and equity implications of five alternative pricing schemes. The simple example illustrates nicely the allocative impacts of deviations from incremental cost pricing. We also elaborated upon some of the implications stemming from the imposition of capital facilities charges. When long-run average costs are falling, charging separately for capital costs and pricing at marginal cost has an economic justification. However, if there are constant or rising costs, such a split provides inefficient price signals if a single marginal price appropriate for pre-inflation times is charged to old and new customers. There will be overconsumption in present and future periods. Politically, it might be possible to compensate old customers and charge everyone the new opportunity costs of serving them. Although such marginal cost pricing is efficient, it introduces some priority rights which must first be recognized within our legal system.

FIGURE 1

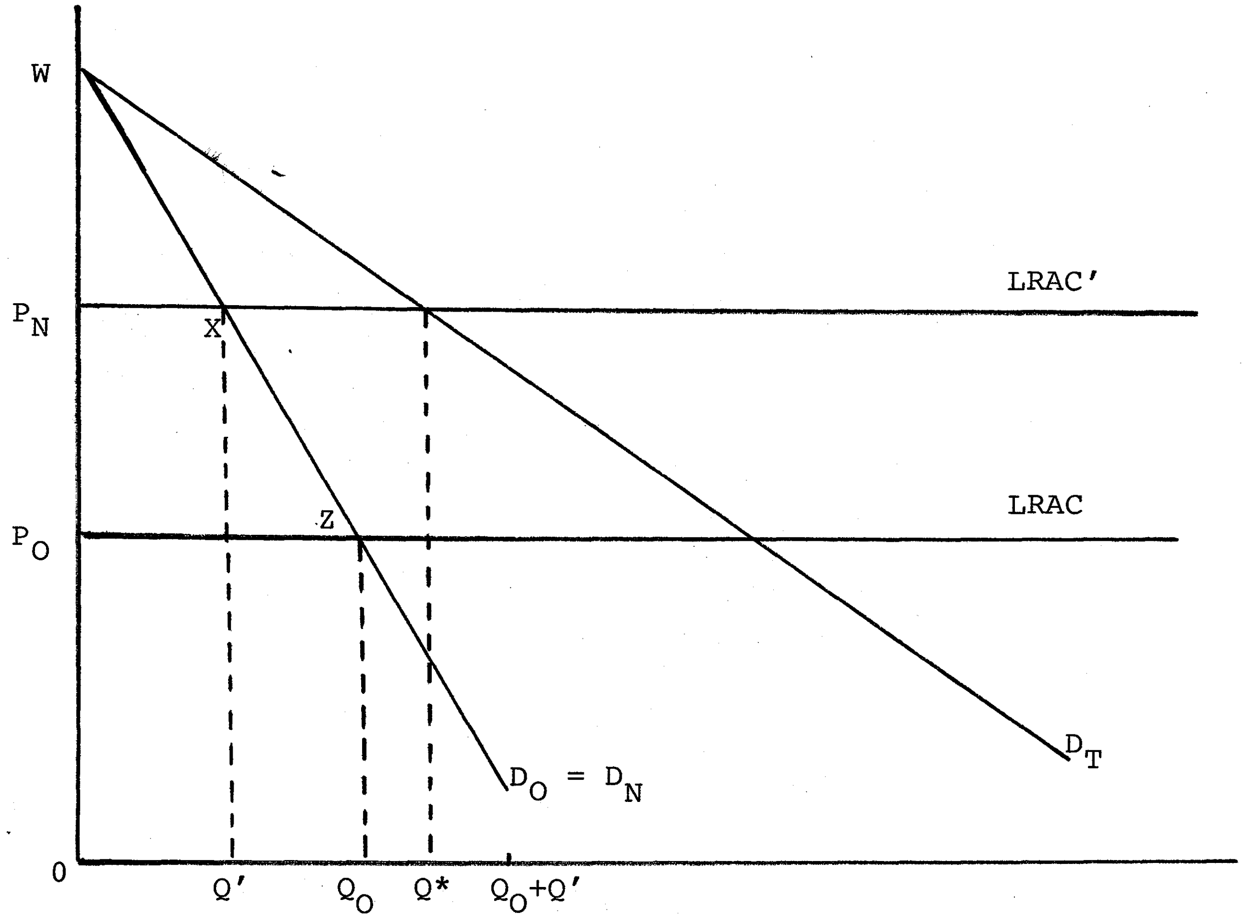


FIGURE 2

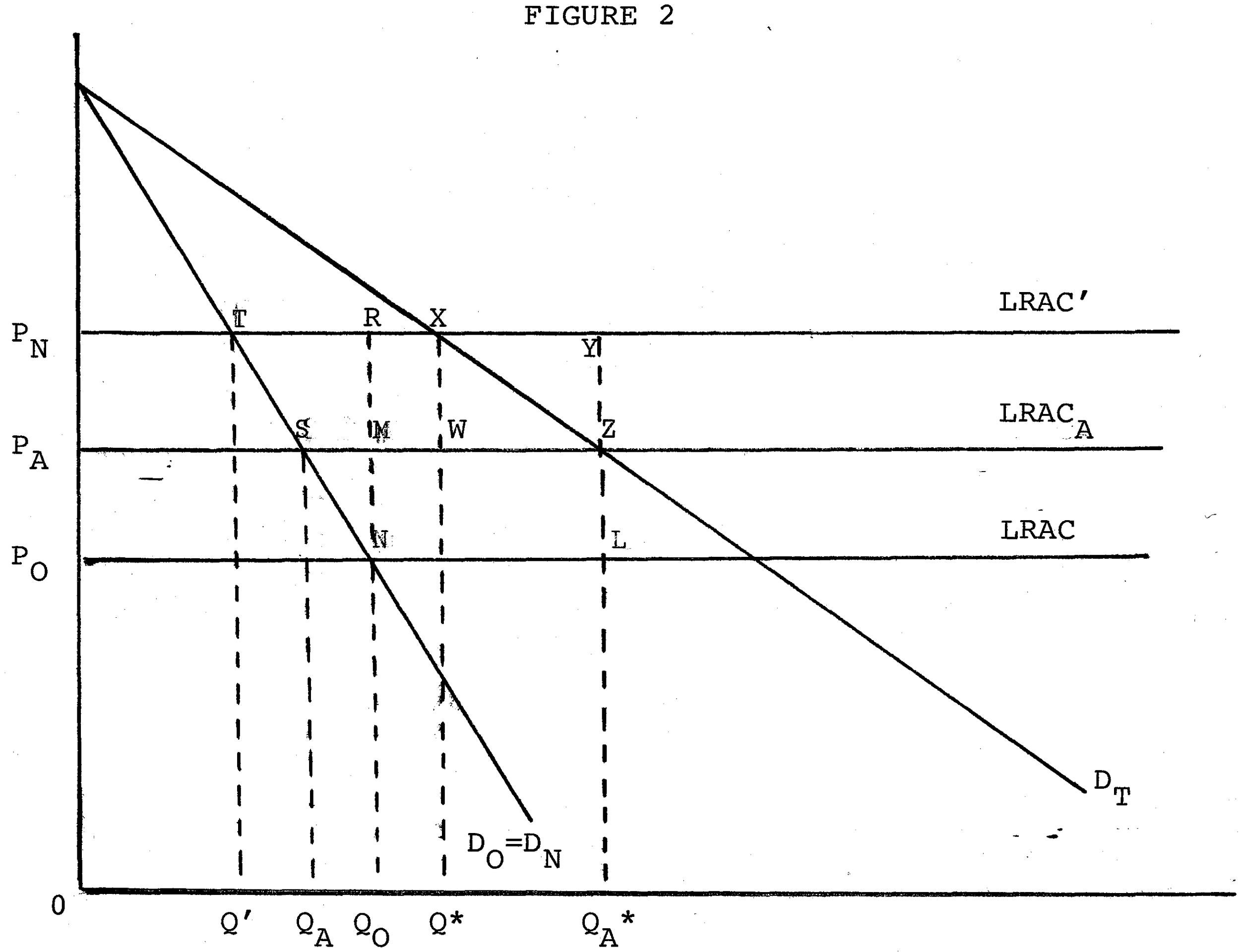


FIGURE 3

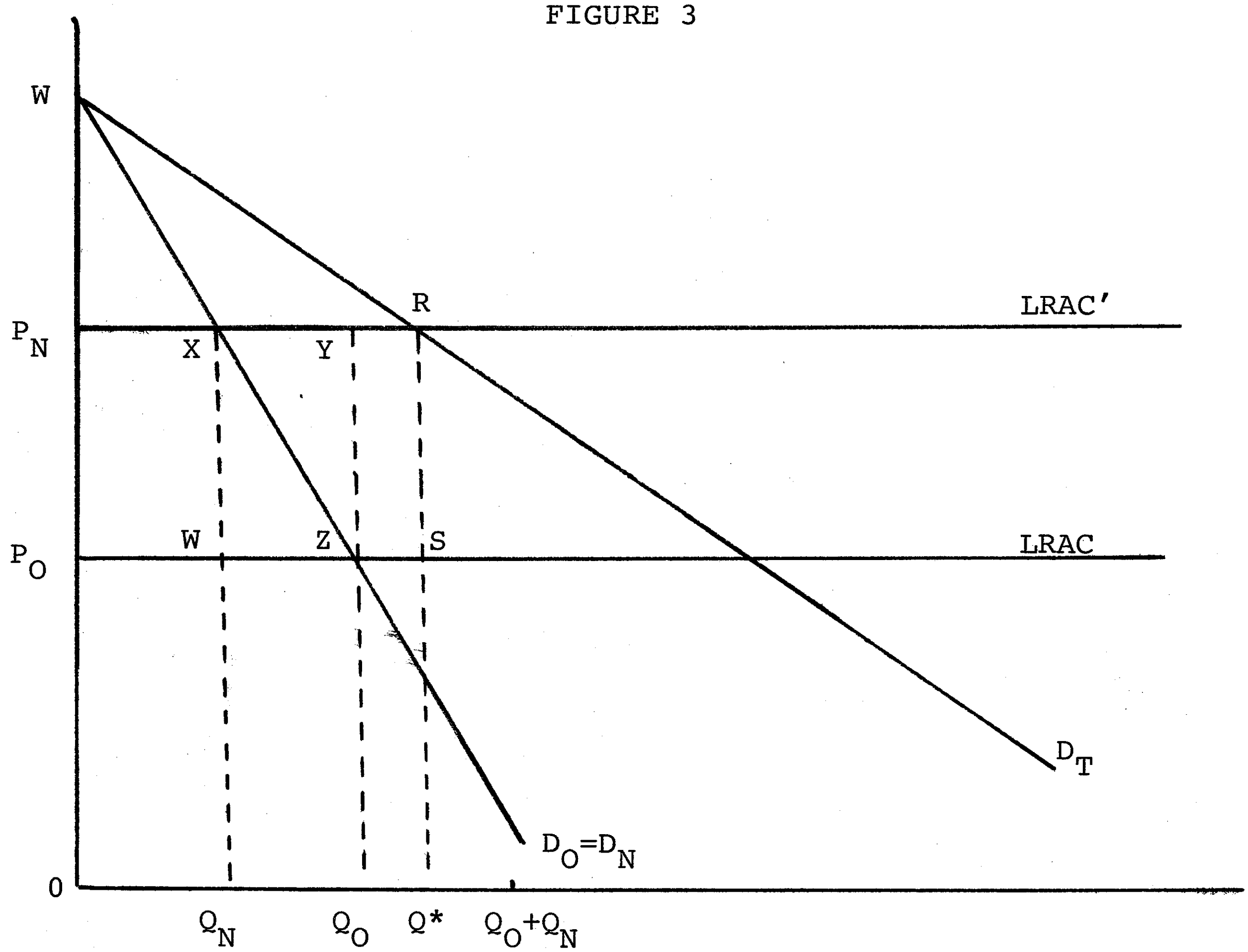
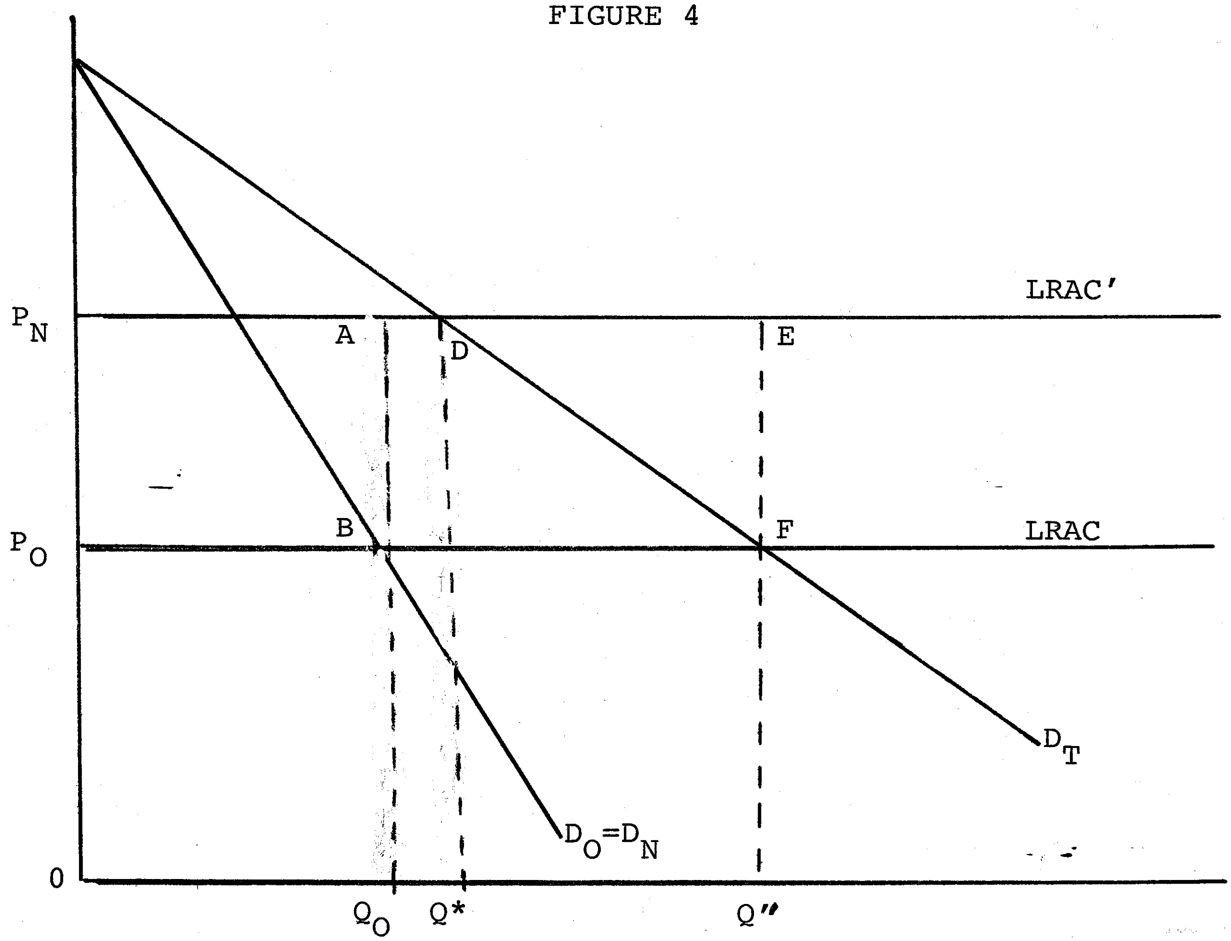


FIGURE 4



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