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Rational Pricing of Electric Power in India

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RATIONAL PRICING OF ELECTRIC POWER IN INDIA

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INTRODUCTION

Electric prices typically vary by classification of customers (e.g., residential, commercial and industrial) and time of use (e.g., seasonal, time of day); they may also vary by voltage, location and other characteristics related to the generation, transmission and distribution network. Some of the pricing policies are based on private producer costs while others are motivated by social and political considerations. The questions we investigate are related to whether electric pricing policies in India meet the standard tests of a sound pricing policy. Our first task is to specify the standards and criteria we should adopt to evaluate electric pricing policies in India. We believe it is important to agree on the ends before discussing alternative means to achieving those ends.

STANDARDS TO GUIDE EVALUATION OF PRICING

Bonbright, Danielsen & Kamerschen (1988) have specified the functions performed by a competitive market and derived from them a set of standards used extensively in the United States to assess the performance of regulated private companies. Using these standards we will assess electric pricing policies in India. The functions and associated standards are referred to as (1) production-motivation or capital-attraction, (2) efficiency incentive, and (3) demand control or consumer rationing. An elaboration of these functions and standards is in order.

Production-Motivation or Capital-Attraction Function--Standard

Prices both motivate and enable people to participate in the production and

distribution of commodities or services that other people want and can buy. This is one of the most widely recognized social functions of prices. If denied the opportunity to levy compensatory charges, an enterprise owned by investors, or a public enterprise "owned" by its customers, would have neither the incentive nor the ability to continue operating in the long run without subsidies.

Adopting the capital attraction function as a standard, reasonable prices yield revenues that cover all legitimate operating expenses plus a return on investment sufficient to maintain sound credit standing and to attract required amounts of new capital. Prices below this level are deemed deficient because, at least in the long run, they will not enable the organization to live up to its obligations to serve its customers or will require perpetual injections of revenues from public sources.

Efficiency Incentive Function--Standard

In a competitive market prices tend toward the lowest possible average costs consistent with an acceptable return to all people who choose to devote their resources to rendering the services. Although there may be temporary opportunities for inordinate returns (or losses), the ease of entry (or exit) ensures that goods or services are produced only by those willing to accept prices as low as other suppliers. This means only the most efficient producers (i.e., those that produce at the lowest costs or offer higher-quality services) can survive.

For public or regulated enterprises, entry and exit and profitability and/or pricing flexibility are constrained by some form of social control. Thus, the circumstances essential

to the survival of only the more efficient organizations are lacking to some degree under public ownership and most forms of regulation. Incentives for efficiency must be provided by administering, regulating and monitoring the inputs, output and/or behavior of the organizations. Therefore, the efficiency incentive function of a competitive market is established as a standard against which we measure and assess performance under public ownership, regulation and competition.

Demand-Control or Consumer-Rationing Function--Standard

Prices signal customers the financial sacrifice required to acquire a product or service. In competitive markets prices are based on the private costs of those companies which survive in the marketplace. Welfare theorists and social planners have emphasized that prices should ideally be established to reflect incremental social costs and that public and regulated enterprises can theoretically improve the outcome of a competitive market when there are substantial social costs. We will not adopt the social welfare criterion because it requires interpersonal welfare comparisons and is largely a rationale for redistributing income from those with more wealth to those who are poor. The use of the social welfare criterion has been so prevalent in India that substantial gains can be anticipated from adopting demand control as a standard. The consumer rationing function as it operates in a competitive market is adopted as a standard against which we measure and assess performance under public ownership, regulation and competition.

The No-Loser Test

The standards outlined above are so general that a more practical and operational standard like the *no-loser test* is required. A strict interpretation of the *no-loser test* requires that a change from the *status quo* not harm anyone. We modify this strict interpretation, and emphasize there are circumstances in which welfare can be enhanced by changing the form of organization from public to private enterprise and by carefully crafting and implementing simple forms of price discrimination.

The Positive Role of Price Discrimination. When price/cost ratios differ for various classes of customers, or when the percentage "contributions" to fixed costs and overhead differ among customer classes, the system of prices is discriminatory. Economists generally regard price discrimination as a second- or third-best solution relative to a single price for all customers in a competitive market. However, when a single price equal to marginal cost is not feasible, or when a system of prices which are each set equal to their respective marginal costs do not cover the supplier's total costs, and external subsidies are not feasible, it has been argued, and generally accepted, that price discrimination can be made to serve the public interest.

The measure of the public interest in this context is the change in the sum of consumer's and producer's surplus as compared to prices set equal to marginal costs. When there are economies of scale in the provision of commodities and services like electric power, a strict limitation on the expected total revenue a company may collect from its customers, and, importantly, when policymakers weight the change in consumers' surplus for each customer, then price discrimination based on inverse elasticities of demand, as

epitomized by "Ramsey prices." can enhance the sum total of consumers' surplus. These requirements are stringent. They are also probably unacceptable to policymakers in India. Thus, a less rigorous and demanding test than maximizing consumers' surplus is required. We propose a *comparative institutional test*, which takes the current institutional structure and system of prices as a base, and requires only that consumers' surplus be enhanced relative to the current situation. This is the weakest but most universally accepted standard or test generally accepted by western economists, namely, the *Pareto improvement* criterion. It comports fully with the so-called *no-loser test* for the customers of an incumbent supplier.

Pareto Improvement Criterion. From an initial state, a *Pareto improvement* is possible if at least one person can be made better off without leaving anyone else worse off. If this condition is met, then the proposal is judged a *Pareto improvement*, and fair in the sense that none of the affected parties would object to the change. The *Pareto improvement* criterion is compatible with what economists generally advocate and does not require interpersonal comparisons of the value various classes of customers derive from consuming products or services. Policymakers may want to extend the analysis to consider who benefits, as well as how much benefit each person derives, and assign appropriate weights to determine if a project is in the public interest.

Practical Application of the No-Loser Test. As indicated above, a strict interpretation of the *no-loser test* requires that a change from the *status quo* not harm anyone. However, the test we employ is successively restricted to the consumers and prospective consumers of electric power, the employees of an incumbent company, and the owners or shareholders of an

incumbent company and potential entrants. We believe that inefficiency, questionable financial viability, and subsidies for special interests, especially agricultural interests, are so widespread in India that alternative institutions, organizations, and rate designs hold the promise of substantial improvements and that proposed policies for India can be usefully evaluated using a *no-loser test*. There is ample room for improvement without employing the stringent, dubious and highly controversial standard of maximizing social welfare.

SPECIFIC CRITERIA TO EVALUATE ELECTRIC PRICING

Overview

More specific tests or criteria follow directly from the standards, tests and criteria presented above, and are especially pertinent for India. They include the following:

- (1) more efficient organizations should replace less efficient ones;
- (2) uneconomic bypass should be discouraged;
- (3) cross subsidies should be eliminated or minimized; and
- (4) contributions required from existing customers for the current amount of electric power consumed should not increase.

While other criteria could be adopted, these are the primary ones required to meet the standards and tests outlined above to evaluate the desirability of privatization and rate design.

More Efficient Organizations Should Displace Less Efficient Ones

More efficient forms of organization pass the *no-loser* and *Pareto improvement* tests since efficiency gains can be used to benefit some parties without harming anyone else. Even this simple proposition needs to be qualified, since reorganization may harm some people who currently contribute little or actually have a negative effect on output. For example, bureaucratic administration of a public or private organization over long periods of time may result in rent-seeking empires within the organization that actually reduce output while transferring income to those who are benefitting from the rent-seeking activities. When these empires are eliminated or scaled back, some people will lose. Therefore, the *no-loser test* is restricted to the customers of the enterprise rather than to current employees. The assumption is that employees who contribute little or reduce output can be more

productively employed in another organization.

Uneconomic Bypass Should Be Discouraged

Uneconomic bypass occurs when a customer takes service from a higher-cost provider instead of from a lower-cost provider (i.e., the lower-cost provider is bypassed) because the price charged by the lower-cost provider is higher than the price offered by the higher-cost provider. *Uneconomic bypass* may be the result of (1) a manager's mistake in negotiating the sales price, (2) a public agency or regulatory authority's refusing to allow the lower-cost provider to charge a price based on its own costs, and/or (3) a public agency or regulatory authority's allowing the higher-cost provider to charge a price based on its own costs.

It is essential for *uneconomic bypass* to be discouraged or eliminated. When a public agency or regulatory authority enables or condones *uneconomic bypass*, it violates all of the standards and tests specified above. Resources are wasted through inefficiency, the bypassed public enterprise or private company has greater difficulty attracting capital, and some customers pay higher prices and/or make do with less of the service. Therefore, those charged with public administration and regulation of private enterprises in India should be particularly sensitive to ensuring that *uneconomic bypass* does not happen.

Cross Subsidies Should Be Eliminated or Minimized

A *cross subsidy* occurs when a seller provides a product or service to a buyer at a price less than the *seller's costs*. The costs referred to are usually taken to be the long-run incremental costs, but short-run marginal costs are also used to evaluate *cross subsidy* when

the supplier has excess capacity. The short run refers to a time period so short that capacity costs are not included while in the long run all costs are included. If a negotiated price is less than short-run marginal costs, then other customers will have to make a contribution to cover avoidable (also referred to as variable) costs, or the owners of the organization providing the services incur losses. When there are constraints on capacity, the proper test is long-run incremental costs because service curtailment or capacity expansion cannot be avoided. Thus, when there are capacity constraints all costs (fixed and variable) are considered *avoidable*. Short-run marginal costs are the appropriate when there are no capacity constraints. For a public enterprise the customers are in a sense also the owners, so when one class of customers is *cross subsidized*, the other customers must pay for the avoidable costs caused by the subsidized class. The consumer rationing and capital attraction standards are not met when there are cross subsidies, so public administrators and policy makers in India should eliminate or minimize *cross subsidization*.

Contributions from Existing Customers Should Not Increase

When there is no excess capacity available to generate, transmit or distribute electric power, a one-part price may be established to cover long-run incremental costs. However, when there is excess capacity, a multiple-part pricing system will enable a supplier to recover its capital costs while utilizing the available capacity more efficiently. The most common multiple-part pricing schedules for electric power include a *customer charge*, *demand charge* and *energy charges*. The *customer charge* is designed to recover the costs of adding or maintaining a customer on the system (e.g., meter reading, billing and collection). The

demand charge is designed to recover the costs of providing capacity. And *energy charges* are designed to cover fuel and related costs that are required to operate the electric system.

A rate design which satisfies the standards and meets the tests outlined above would result in the recovery of short-run marginal costs through *customer charges* and *energy charges*. Recovery of long-run incremental costs would be through the *demand charges*. In business terminology the *demand charges* would make a *contribution* to overhead and profit sufficient to recover the *return on capital* and the *return of capital* devoted to the enterprise. The specific criterion is that *contributions* required from existing customers for the current amount of electric power consumed should not increase.

We recognize that many so-called native-load customers are making very little, if any, *contribution* to their current supplier and are even being *cross subsidized*. Thus, there is a conflict between the *cross subsidy* and *no increase in contribution* criteria. We are impaled on the horns of a dilemma. Compromising on the *cross subsidy* criterion requires that we violate our basic standards, while abandoning the *no increase in contribution* criterion requires that we violate the *no-loser test*. When a dilemma like this arises, we defer to the standards as opposed to the weaker tests and criteria. In this case we specify that the *cross subsidy* criterion dominates the *no increase in contribution* rule.

REAL-TIME PRICING

Introduction

When one closely and critically examines the historical development of electricity pricing, it is clear that those pricing experiments which have survived usually serve the interests of the producers and their customers. However, many pricing experiments have been tried and many have failed, so there is justifiably a degree of skepticism when innovative pricing procedures are proposed. We need to assess whether and to what extent real-time pricing (RTP) in the electric industry may be appropriate for power companies in India.

Real-time pricing is an innovative rate design wherein prices vary over short time intervals as generation, transmission, distribution and related costs change. Some RTP programs track short-run marginal costs closely over short intervals, such as 6 minutes, 15 minutes, or an hour, with additional monthly charges unrelated to usage to cover customer and capacity costs. Other RTP programs recover capacity costs directly in the usage charge by applying an adder or multiplier to real-time prices based on marginal costs. Our task is to determine whether or not real-time pricing comports with sound pricing policy. If it does we anticipate pricing options that reflect real-time costs will be developed and adopted more extensively, and especially in markets that are relatively more competitive. Real-time pricing might also be implemented in markets where there are degrees of market power, but regulatory constraints may prevent it from being adopted more extensively. Conceptually, we know that properly conceived and administered real-time pricing options carry short-run marginal cost pricing to its logical conclusion and has the potential to confer benefits on

electric companies and their customers alike.

Standards and Criteria Applied to Real-Time Pricing

Efficient generation and distribution of electric power requires numerous large generating units that are interconnected in a complex network. While all of the generating and distribution facilities are used optimally during periods of peak demand, there is excess capacity during off-peak periods. Therefore, a rate design that shifts load from peak to off-peak periods has the potential to reduce the need to build more generation and transmission capacity and increase efficiency by reducing investment requirements. Naturally, there are capital costs as well as operational costs when implementing a new rate design, so the net benefits of each new pricing program turns on the present value of investment savings as opposed to increased operation and monitoring costs.

RTP Meets All of the Evaluation Standards and Criteria

RTP clearly has the potential for meeting the standards and criteria of sound rate design outlined above. It gives the consumer greater flexibility in making consumption decisions, provides incentives for customers to reduce consumption during peak hours and enable customers to purchase incremental low-cost energy during off-peak hours. It permits the company to operate with less peak-load capacity which tends to be its highest cost power and promotes a more efficient utilization of existing capacity. Therefore, as long as the costs associated with implementing a real-time pricing program are less than the savings from the more efficient utilization of capacity plus the avoided costs of new capacity, such a rate design has the potential to fulfill the specific criteria for a sound rate design which were specified above.

RTP performs well from the standpoint of the *consumer rationing standard* since it allows customers to manage their bills by adjusting consumption to variations in the supplier's costs and spot prices, which may vary during a single day from 2 cents to \$1 or more for one kilowatt hour (kwh) of usage. Typical RTP customers have been large industrial firms with monthly individual customer peak capacity demand of at least 1 megawatt and system peak capacity demand of at least 250 kilowatt. These customers are large and flexible enough to shift major amounts of usage from peak to off peak periods when provided with appropriate financial incentives.

A RTP program has the potential to discourage uneconomic bypass since the customer pays no more incremental costs when capacity is constrained and no more than short-run marginal costs when capacity is unconstrained. As long as these conditions are satisfied there are no cross subsidies since the prices equal or exceed incremental (or marginal) costs. Finally, no additional revenue needs to be collected from existing customers for the current amount of electric power consumed because costs are no higher and may even be less under a RTP program.

Conclusions About Real-Time Pricing

One can conclude from the growing number of RTP programs throughout the world that the RTP experience is being implemented successfully. Customer retention and the potential to recruit new customers to RTP at lower load requirements remains high. The New York Mercantile Exchange started a futures market for electricity in March 1996. This will allow customers to hedge against variations in prices during periods of peak

demand and facilitate the development of additional RTP programs. As companies fine tune their RTP programs and peek over the horizon for a glimpse at the future business structure(s) of the electric industry, several questions arise.

First, what is the strategic potential of indexing the price of electricity to the price of another commodity with similar characteristics such as extreme variations in spot prices? Second, with privatization, what are some of the new combinations of services that can be demanded and how can the market value of such services be determined. We hope to answer these questions and formulate others as we continue to research this topic.

Has the time for greater utilization of RTP programs arrived? With privatization and increasing competition there is less reliance on profit regulation. Electric producers can be expected to price their services closer to market-clearing levels based on marginal and/or incremental costs on a real-time basis in order to remain profitable or even survive.

Some policy makers believe RTP programs will inherently increase costs and impose greater burdens on residential customers. But this need not be the case and in fact the opposite is true. Well conceived RTP programs are a means of improving capacity utilization, deferring the need for new capacity, thus allowing companies to remain competitive, while permitting customers to reduce their electric bills. RTP programs have the potential to do all of these things and thereby can enhance the value or lower the costs of electric services for companies and their customers.

CHANGING ORGANIZATIONAL STRUCTURES IN INDIA

Twin Problems--Market Power and Confiscation of Property

Electric companies in general, and the Central Sector Power Corporations and State Electricity Boards (SEBs) in India in particular, control essential facilities used to provide services to customers who have highly inelastic demands once they are connected to the system. Incumbent companies (and the SEBs) have highly specific assets such as generation equipment, complex transmission and distribution systems, and managerial talent with intricate technical expertise. These characteristics provide the incumbents with market power when pricing electric services to their customers in competition with potential entrants. This market power may also be exercised against companies that provide alternative but imperfectly substitutable products or services (e.g., suppliers of natural gas and fuel oil).

On the other hand, electric consumers in democratic societies are numerous and politically influential. They may band together to form special-interest groups and appoint or be represented by self-styled advocates to gain political favors and beneficial treatment from incumbents who have sunk substantial costs to provide electric services. The highly specific physical and human assets that give incumbents market power when dealing with individual customers and competitors makes them vulnerable to having their sunk investments confiscated, or at least diluted and shared with individuals and groups who are favored politically.

All democratic societies have to cope with the twin problems of potential market power and confiscation of highly specific physical and human assets. In the United States during the last one hundred years these problems have been addressed with a combination of

federal and state regulatory bodies to mediate and ultimately arbitrate disputes among largely private producers and consumers (Bonbright, Danielsen & Kamerschen, 1988). In India during this time the problems have been handled by forming public enterprises. In all democratic countries during this period, the conditions required for viable competition have been considered so muted and skewed in favor of incumbents, and/or so vulnerable to confiscation by politically favored interest groups, that either government ownership, government regulation, or some combination of government ownership and control has been deemed necessary. However, due largely to cumulative political excesses in favor of special-interest groups, changing ideological orientations, technological advancements, and concomitant cost and price changes, the traditional methods of coping with the twin problems of market power and confiscation of property are being reconsidered.

Current Institutional and Organizational Structure in India

In the Indian Electricity Acts of 1910 & 1948, the Central Electricity Authority (CEA) was set up as the electricity planning arm of the Government of India (GOI) and the Ministry of Power (MOP) as the policy arm. Originally, CEA was intended to be politically independent but it has never been independent. The Power Finance Corporation (PFC) was formed in 1989 to be a lending arm to the State Electricity Boards (SEBs) as a carrot to restructure. In order to get loans, the SEBs must undergo certain structural and pricing reforms.

Currently, the rate of return for SEBs is at best 3%. This is due to the political influence of the states not to set compensatory rates for agricultural consumers, even though

the SEBs have the legal freedom to set their own rates. Agricultural customers are charged a flat monthly connect fee at some places. Other places charge a third or fourth of the cost of generation. SEBs are also inefficient in generation, transmission, and distribution. The national average for losses is 22% - 15% theft and 7% technical.

Delhi Electric Supply Undertaking (DESU), one of the many SEBs, has 40% losses (30% theft and 10% transmission) amounting to Rs. 700 crore. In order to privatize, losses will have to be cut down and identified in order to increase the value of the assets and make them look more appealing to the private sector. Employees are not linked to productivity (persons/MW ratio is 5 - 25 times the international standards). Hence employees are opposed to the idea of privatization as it may mean huge amounts of unemployment.

The Asian Development Bank (ADB) is one of the major players in the Power Restructuring Program in India. Together with the other co-financiers, including the World Bank and some commercial banks, they lend up to \$300m to private power projects that have the GOI loan repayment guarantee. Equity required is at most 10%. In cases where the GOI guarantee is not available, the amount of loanable funds are only \$50m per project with the equity requirement of 40%. ADB is currently negotiating with GOI for Balagarh Power Project, developed by the RPG group in Calcutta, West Bengal. Calcutta Electric Supply Corporation will buy the power generated. ADB would like SEBs rate of return to increase and wants increasing private participation in generation. ADB also provides loans for transmission and substation improvements. In order to be eligible for the loans, the SEB has to agree to:

1. Set reasonable tariff levels. This involves the introduction and implementation

of agricultural tariffs and complete elimination of cross subsidies from the industrial users and the state.

2. Increase the capital generated by reducing the commercial and technical distribution losses.
3. Restructure the SEB into three separate generation, transmission and distribution companies, that would be managed by outside firms.

The World Bank has given a \$270m loan to the Orissa SEB. \$20m are earmarked as technical assistance fund for the SEB to hire consultants to prepare bid documents. Another \$20m have been designated as a pre-investment fund for feasibility studies and bid specifications. \$230m are to be used for T&D upgrades. ADB is trying a similar deal with Gujarat for \$260m.

Institutional and Organizational Changes

After nearly fifty years of comprehensive development planning, reliance on public-sector enterprises, price fixing to achieve social objectives, and related policies, the Government of India, the World Bank, the IMF, and other international organizations are now promoting more rational economic policies, including privatization of public enterprises and altering incentive systems to promote efficiency and economic development.

The Central Electricity Authority (CEA) sees privatization as the only option since the private sector has the kind of funds required by the electricity system in India. The generation side needs to be opened to Independent Power Producers (IPPs) and the power sector needs to be freed from political influence. Profit regulation may be needed. The role

of CEA is going to change and diminish over time as additional segments of the electric industry are privatized. All projects over Rs. 400 crore, as opposed to an earlier limit of Rs. 100 crore, now come to the CEA for clearance. CEA is unlikely to play a regulatory role like the Federal Energy Regulatory Commission (FERC) in the United States since substantial regulatory authority rests with the state and they are unwilling to relinquish it.

The Ministry of Power (MOP) also sees privatization as the only solution to attract funds in the long run. In the short run, freedom from political influences and ability to set compensatory rates may do the trick. In the long run, privatization is highly probable. However, one model of privatization will not fit all states. Private distribution and public ownership or regulation of transmission will be common to all the privatization models. Generation may be public or private and subject to less regulatory oversight. Time of Use rates with two-part tariffs (capacity charge and energy charge) are needed and cross subsidies need to be phased out as they give no incentive to conserve.

In India the generation of electric power has been opened to private investment. The national average Plant Load Factor (PLF) for thermal plants in 1991 was 48%. The Government of India (GOI) wanted it to be higher and so it introduced a "two-part tariff" in October 1991. Private participants were told that they would get a rate of return (cost + tariff) of 16% if they could get a PLF of 68.5 and an additional 1% rate of return for each extra PLF. Enron promised a PLF of 90% which implied a 32% rate of return. GOI responded by renegotiating a 0.7% for each extra PLF.

There is substantial sentiment to privatize public enterprises involved in the provision of electric power in India. The Andhra Pradesh SEB is one of the first SEBs to start the

process of privatization by contracting the management of one zone to the Bombay State Electric Supply (BSES) for 18 months under a promise of 5% return and no obligation to invest capital. BSES has been given the rights for termination and valuation of employee contracts, which has been opposed by the labor unions. While this is a Quasi - Memorandum Of Understanding process and not really competitive bidding, it is definitely a move in the right direction.

An Urgent Need to Change Incentive Systems in India

India's state-owned and operated power companies are presently rife with subsidies. Prices of fossil fuels which are used as inputs into the generation of electric power as well as prices of electric power itself are often unrelated to their costs. The Central Sector Power Corporations and SEBs do not cover their full costs and are subsidized directly from general revenues. Fossil fuels are considered profitable as a whole, but some customers pay much less than replacement costs while other customers pay premium prices. In short, some groups of customers subsidize other customers. These subsidies and cross subsidies send signals that encourage usage for those who are subsidized and induce a variety of reactions by those who are charged premiums over costs. Investment decisions by the public enterprises are distorted and services are often inadequate.

Presently, the agricultural sector in India is a politically favored and protected sector with electric rates in some places being as low as \$2.00 per month regardless of the amount used. Such pricing policies neither reflect the true cost of producing electric power, nor do they provide any incentive on the part of the farmers to conserve electricity. In fact, these

ridiculously low electric rates are being grossly misused for non agricultural purposes (such as building palatial mansions) on tracts of land officially classified as agricultural. Although more rational pricing policies, such as Real Time Pricing will not solve all of the problems of providing electric power efficiently, improving the incentive systems may be a prerequisite. However, political constraints and realities limit the ability to restructure and rationalize the generation, transmission and distribution of electric power in India.

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