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Privatization of Natural Monopoly Public Enterprises

The Regulation Issue

Ralph Bradburd

On balance, it is not obvious that developing countries will obtain any significant improvements in allocative efficiency from regulating natural monopolies after privatization. This suggests that greater consideration must be given to other objectives of regulation including distributional concerns and the creation of confidence in the stability of the environment for business.

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This paper — a product of the Public Sector Management and Private Sector Development Division, Country Economics Department — is part of a larger effort in the department to analyze the relations between privatization and regulation. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Ernestina Madrona, room N9-057, extension 38526 (April 1992, 44 pages).

Many developing countries are considering the privatization of public enterprise natural monopolies — monopolies in charge of electricity, natural gas, water and sewer, and telephone services

If there is not already an apparatus for regulating private monopolies, these countries face a difficult choice: whether to continue letting inefficient public enterprises operate, to create a regulatory apparatus, or to replace public monopolies with unregulated private monopolies.

Improving allocative efficiency, though not the only objective of regulation, is certainly an important one, and one that has received a great deal of attention from economists. In theory, regulating private natural monopolies can improve allocative efficiency. In practice, sometimes it does, and sometimes it does not. So Bradburd tried to answer two questions:

- How great would the efficiency losses be, if any, if a public natural monopoly were privatized and allowed to function as an unregulated entity?

- How much could performance be expected to improve if the privatized natural monopoly operated as a regulated firm?

Bradburd argues that the deadweight losses from monopoly pricing by unregulated privatized natural monopolies are likely to be modest and may well be outweighed by improvements in technical efficiency. He also argues that regulation is not costless and may well foster static and dynamic efficiency losses greater than the deadweight monopoly losses it is intended to prevent.

But Bradburd also notes that reduction of allocative inefficiency is only one of several objectives of regulation. If the case for regulation on efficiency grounds is weak, then much greater attention must be paid to how these other objectives can best be achieved.

Historically, achieving distributional equity has been an important objective of regulation. We have very little systematic knowledge about the actual distributional consequences of privatization and deregulation, so more research is needed.

Another objective of regulation can be to help create confidence in the stability of the environment in which business activities take place. If enterprises are privatized and unregulated in an environment in which property rights are not secure, management is likely to take an extremely short-run view of profit maximization. The implicit "take the money and run" policies will yield all the undesirable deadweight losses of monopoly and none of the benefit of efficiency and improved service

Produced by the Policy Research Dissemination Center

Evaluating the Asset Based Minimum Tax on Corporations: An Option Pricing Approach

by
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Introduction

Many LDCs are currently considering efforts to privatize public enterprise natural monopolies that produce services corresponding to those of regulated "utilities" in the United States: electricity generation, transmission and distribution; water and sewer services; telephony services; and natural gas distribution. If there is not at present any apparatus for regulation of private monopolies, these countries face a difficult choice: whether to permit inefficient public enterprises to continue to operate, to create a regulatory apparatus, or to replace public enterprise monopolies with unregulated private monopolies.

There are several objectives that may be served by regulating monopolies, and the socially optimal regulatory choice will clearly be a function of the rates at which society is willing and able to make tradeoffs between them. Let us consider some possible regulatory objectives.

One important goal of regulation is to reduce the extent of allocative inefficiency--the deadweight losses of monopoly. This is the aspect of monopoly regulation that has traditionally attracted the attention of neoclassical economists.

Greater distributional equity, or income redistribution more generally, is a second objective of regulation; this normally takes the form of constraining the monopolist's ability to extract surplus from consumers. Economists have not devoted

great attention to this objective of regulation, nevertheless, historically, it has played an important role in the establishment of regulatory institutions.

A third objective of monopoly regulation is to encourage consumption of the regulated good through constraints on the producing firm's pricing. The goal here is more than simple redistribution designed to increase the welfare of some target group, which could in principle be effected by a cash grant that would enable the consumers to purchase the (socially) desired amount of the good in question if they wished to do so; rather, the social objective is actually increased consumption of the good in question, either because it is a merit good such as health care or because it is a good such as local telephony services that is characterized by significant network (or other) externalities. Historically, this regulatory objective has also been quite important.

A fourth reason for establishing regulatory institutions is to create confidence in the stability of the environment in which business activities must take place. The constraints imposed by public regulation of monopoly may not be the first-best choice of a firm that might be regulated, but they may be preferable to the kind of institutional uncertainty that accompanies the complete absence of articulated public policy, particularly in an environment that is politically dynamic. Although this function of regulation has not received much attention in the past, the enormous institutional changes occurring in Eastern Europe and

LDCs may increase the attention it receives in the future.

In some circumstances, pursuing the first of these objectives will also further the others; in other circumstances, there may be tradeoffs between them. For example, if a monopolist practices uniform pricing and maximizes short run profits, setting the appropriate price ceiling may well reduce static allocative inefficiency[1], transfer surplus from the monopolist to consumers, and increase consumption of the regulated good. In contrast, if the monopolist's normal practices involve very effective price discrimination, efforts to achieve the second through fourth regulatory objectives listed above are likely to increase allocative inefficiency, which would have been near zero in the unregulated environment.

In this paper we will focus our attention on just the first of these regulatory objectives: reducing the allocative inefficiency associated with monopoly pricing. We do so because improvement in allocative efficiency is the aspect of monopoly regulation that has received the most attention from economists and also because, whatever regulatory objectives actually motivate the establishment of monopoly regulation, allocative efficiency is frequently the motivation that is claimed. If public enterprise natural monopolies are to be privatized, and if resources must be expended in regulating them, then sound public policies must reflect an appreciation of regulation's costs and

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[1] This assumes that the deadweight losses avoided are greater than the cost of the regulatory apparatus.

benefits in terms of the allocative efficiency objective as well as an understanding of the possible conflicts between allocative efficiency and the other objectives, particularly distributional equity. If regulation's effect on allocative efficiency turn out to be uncertain, the policy debate and research need to be refocused on the other regulatory objectives.

In theory, regulation of private natural monopolies can improve the efficiency of the economy. In practice, sometimes it does, other times it does not. Therefore, we ask two questions: 1. How great would the allocative efficiency losses be, if any, if a public enterprise natural monopoly were privatized and allowed to function as an unregulated entity? and 2. How much of an improvement in performance could be expected if the privatized natural monopoly operated as a "regulated" firm?

Public enterprises presumably have less incentive to maximize profits. To the extent that this causes public enterprises to abstain from exploiting their ability to elevate price above marginal cost, society benefits from the reduction in monopoly deadweight losses. However, if a lack of concern with profit maximization takes the form of inattention to minimizing costs, society bears the burden. If we assume that a private monopoly will be more likely to maximize profits than a public enterprise, then from a policy perspective, it is clearly important to have some idea whether the production efficiencies that might be gained from privatization of a public enterprise natural monopoly will be sufficient to compensate for any

allocative efficiency losses that occur.

This study will first consider the extent of the social losses or gains that may occur when a public enterprise natural monopoly is replaced by an unregulated private monopoly. We do this by simulating welfare[2] losses from unregulated monopoly assuming reasonable bounds for demand elasticities, monopoly price increases, and relative production efficiencies of public and private monopolies. Next we will consider the potential allocative efficiency gains or losses arising from public regulation of the privatized natural monopoly. We conclude with some general comments regarding optimal regulatory policies.

II. Deregulated Private Monopoly vs. Public Enterprise

In analyzing the effects of natural monopoly privatization and deregulation, it will be useful to distinguish between static and dynamic consequences. We will begin our analysis by considering static efficiency, and then will go on to weigh the importance of some dynamic efficiency considerations.

A. Static Efficiency Considerations:

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[2] When we speak of "social welfare" gains or losses in the discussion below, we refer to changes in the sum of consumer and producer surplus.

Under the heading of static effects, we must consider three factors: 1. welfare losses due to allocative inefficiency of monopoly pricing; 2. welfare gains or losses due to changes in firms' efficiency; and 3. distributional effects of monopoly pricing. We will consider these in turn.

The extent of the welfare losses that might arise due to utility sector monopoly pricing following privatization is obviously of critical importance. If these are very small even in the absence of post-privatization efficiency improvements, it is difficult to make a strong case either for continued public ownership or for post-privatization regulation.

We will begin our analysis of the losses that might occur when an unregulated private firm replaces a public enterprise natural monopoly by assuming that the private monopolist cannot practice any form of price discrimination. That is, the firm must charge a uniform price for all units of output sold to all customers. Then we will consider the impact of assuming that the privatized monopoly will engage in systematic price discrimination.

1. Uniform Monopoly Pricing

In estimating the range of welfare losses consequent to privatization, we have employed a variant of the Harberger (1954) technique, which involves some formulaic computation combined with sensitivity analysis. Because the results vary with the parameter values assumed, it is important to review the

underlying assumptions of the approach.

For simplicity, the model we employ assumes constant marginal costs in the relevant range of production and a linear demand curve. It also assumes that prior to privatization, the public enterprise produced the "competitive" or "socially optimal" output, i.e. that at which price equaled marginal cost. We assume that the private unregulated firm that replaces the public enterprise produces the output that maximizes short run profit in the absence of price discrimination.

Taken together, these assumptions imply that the private monopolist's output (in physical units) will always be exactly one half the output of the public enterprise for any level of marginal cost. Further, they imply that every possible public enterprise equilibrium output is associated with a unique price elasticity of demand (depending upon where on the linear demand curve it is located) and that for each pre-privatization demand elasticity we can determine the percentage increase in price that will occur after the public enterprise is replaced with the private unregulated monopolist.

Thus, our assumptions allow us to create a schedule that associates pre-privatization price elasticities with (maximum) post-privatization percentage price increases. We provide this in Table 1.

As is evident in Table 1, if the public enterprise were producing at a point where the short run demand elasticity was

very low[3], the private monopoly's shift to short run profit maximizing pricing will lead to a very large percentage increase in price. Conversely, the higher the pre-privatization elasticity, the smaller the percentage price increase. Some of the percentage price increases seem extremely large, but depending upon initial conditions, they are not infeasible.

The relation between demand elasticity and percentage price increase is quite important. The schedule in Table 1 allows us to employ a variant of the well-known Harberger formula to calculate the deadweight loss resulting from the shift to monopoly pricing.

The Harberger (1954) formula for the deadweight losses due to the allocative inefficiency of monopoly pricing is

$$W = \tfrac{1}{2} * P * Q * e * d^2 \qquad (1)$$

where: P = the competitive price;

Q = the competitive output;

e = the price elasticity of demand for the monopolized product; and

d = the percentage increase in the price of the product consequent to monopoly.

In the analysis below, we modify the Harberger formula

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[3] Recall our assumption that public enterprises produce where price equals marginal cost. Thus, in terms of a demand curve, a low pre-privatization demand elasticity implies that price equals marginal cost well below the mid-point of the demand curve. With a linear demand curve, the elasticity at any given price will equal the distance along the ordinate axis from the origin to the that price, divided by the distance from that price to price intercept of the demand curve.

TABLE 1

PERCENTAGE PRICE CHANGES AFTER PRIVATIZATION CORRESPONDING TO PRE-PRIVATIZATION PRICE ELASTICITIES

PRICE ELASTICITY	CHANGE IN PRICE FOLLOWING MONOPOLY (%)
0.111111	450
0.176471	283.3
0.25	200
0.333333	150
0.428571	116.7
0.538462	92.86
0.666667	75
0.818182	61.11
1	50
1.222222	40.91
1.5	33.33
1.857143	26.92
2.333333	21.43
3	16.67
4	12.5
5.666667	8.824
9	5.556

(Note: a 450% price increase should be interpreted to mean that the new price is 5.5 times the old price.)

slightly in order to measure welfare losses as a percentage of of industry sales measured at the competitive price and output.[4]

Table 2 below provides estimates of the welfare loss (as percentage of industry sales) that would occur if a competitive pricing public enterprise were replaced by a short run profit maximizing uniform pricing monopolist. Column 1 is the pre-privatization demand elasticity; column 2 is the post-privatization percentage price increase; and column 3 is the welfare loss due to monopoly pricing expressed as a percentage of industry sales. We will return to columns 4 to 6 momentarily.

The first thing to note in Table 2 is that the simulated losses due to monopoly pricing vary greatly. With a price increase as large as 93%, the deadweight loss is about 23% of industry sales. A 41% price increase would cause a deadweight loss of about 10% of industry sales, and a 21% price increase produces a deadweight loss of about 5% of industry sales. Although we will return to this subject later, we should note here that this table provides information on the range of the benefits that could be obtained from regulating the privatized

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[4] In some circumstances it may be useful to consider welfare changes as a percentage of GDP. This is readily accomplished by multiplying the welfare loss (or gain) as a percentage of industry output by the share of GDP accounted for by the industry in question. As is evident in Appendix 1, the utilities sector accounts for a relatively modest share of GDP in developing countries --around 1 to 2 percent-- and therefore welfare changes as a percent of GDP are likely to be quite small.

TABLE 2

SOCIAL WELFARE GAINS OR LOSSES FROM
PRIVATE MONOPOLY OPERATION OF
NATURAL MONOPOLIES

(1)	(2)	(3)	(4)	(5)	(6)
	PERCENT	SOCIAL WELFARE	SOCIAL WELFARE CHANGE		
	CHANGE	CHANGE AS %	AS % OF INDUSTRY OUTPUT		
PRICE	IN	OF INDUSTRY	IF COSTS DECLINE BY:		
ELASTICITY	PRICE	OUTPUT			
			0.1	0.2	0.3
0.111111	450.00	-112.50	-104.96	-97.33	-89.62
0.176471	283.33	-70.83	-63.27	-55.57	-47.74
0.25	200.00	-50.00	-42.41	-34.62	-26.66
0.333333	150.00	-37.50	-29.87	-22.00	-13.88
0.428571	116.67	-29.17	-21.51	-13.52	-5.22
0.538462	92.86	-23.21	-15.51	-7.41	1.10
0.666667	75.00	-18.75	-11.00	-2.75	6.00
0.818182	61.11	-15.28	-7.47	0.95	9.98
1	50.00	-12.50	-4.63	4.00	13.38
1.222222	40.91	-10.23	-2.27	6.61	16.40
1.5	33.33	-8.33	-0.27	8.92	19.23
1.857143	26.92	-6.73	1.47	11.05	22.04
2.333333	21.43	-5.36	3.02	13.14	25.02
3	16.67	-4.17	4.46	15.33	28.46
4	12.50	-3.13	5.88	17.88	32.88
5.666667	8.82	-2.21	7.42	21.29	39.42
9	5.56	-1.39	9.49	27.11	51.49

Note: This table embodies the following assumptions: constant marginal cost the relevant range of production; a linear demand curve; price equal t marginal cost prior to natural monopoly privatization; short run profi maximizing behavior by the privatized natural monopoly; no price discrimination; no pyramiding welfare effects of cost distortions involving downstream purchasers of the natural monopoly's products.

natural monopoly.[5] Column 3 gives the deadweight loss of monopoly pricing relative to a public enterprise that produces the socially optimal output, that at which price equals marginal cost. Absent efficiency improvements, the most that one could hope for from regulation is that the regulated firm would produce the socially optimal output, so the figures in column 3 tell us the benefits perfect regulation can provide.

To this point, we have assumed that a private monopoly is no more efficient than a public enterprise. However, there is a significant body of literature arguing that public enterprises are less efficient than privately owned firms, and we need to take this into account in framing our analysis.

a. Efficiency Gains from Privatization

i. Theory

In evaluating the effects of changing from public enterprise provision of natural monopoly services to provision by private unregulated firms, we have to this point focused on allocative efficiency issues, implicitly assuming that there are no differences in the efficiency with which private and public enterprises produce their output. If the production techniques of private profit-oriented firms are more efficient than those of public enterprises, the cost-savings resulting from private ownership might offset or even outweigh any deadweight welfare

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[5] This assumes no efficiency changes after privatization, an issue to which we will turn immediately below.

losses due to monopoly pricing. We must therefore examine some theory and evidence relating to the relative efficiency of public enterprises and private firms.

"Efficiency" is a broad term. A firm could be "inefficient" because it fails to choose the appropriate capital/labor ratio given technological opportunities and given relative factor prices; it could be "inefficient" because it uses more inputs than necessary to produce a given level of output (even if it uses them in the "right" proportions), or equivalently, because it produces less output than it could for a given level of input use; and it could be "inefficient" because it overpays for the inputs it uses. Economists have attempted to distinguish between these kinds of efficiency. However, in practice they tend to meld together, and so we will simply equate differences in inefficiency with differences in cost for any given level of output.

There are several reasons to believe that public enterprises will be less efficient that private enterprises producing the same product. First and foremost, there is no residual claimant in a public enterprise who receives the profits.[6] Consequently, there is nobody who has a strong interest in ensuring that the difference between revenues and costs is as large as possible. To the contrary, if the outside auditing of the public enterprise

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[6] Borcherding et al. (1982) discuss both "property rights failure" and "public choice" explanations for the greater inefficiency of public enterprises. They do not find either approach entirely convincing.

is relatively ineffective, its employees (at all levels) have an incentive to capture as many rents within the firm as is possible. To be sure, this problem exists in private firms as well as public enterprises, as the large "managerial firms" literature attests. However, the extent of internal rent capture is likely to be much smaller in private firms.[7]

A second reason that public enterprises are likely to be less efficient than private firms is that their managers are largely shielded from the effects of the market for corporate control. For better or worse, managers of private firms are forced to keep profits up by the fear that low earnings will encourage a corporate takeover. This threat is absent for public enterprises.

A third reason for greater relative public enterprise inefficiency is that managers must often try to satisfy multiple objectives determined by politicians. When there are multiple objectives and no clear rules as to the optimal trade-offs between them, it is difficult to measure performance. If performance cannot be measured, then employees are freer to engage in internal rent capture.

"Soft budget constraints" of public enterprises also play a role in promoting inefficiency. Managers and employees of public enterprises are aware that shortfalls in revenues relative to

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[7] A recent study (Bradburd et al., 1991) of internal rent capture in American firms found that employees are able to capture about 14% of the potential profits in the form of higher wages and benefits.

costs can be remedied by recourse to government subsidies. This affects employees' behavior in seeking greater compensation and lighter workloads, and managers' behavior in resisting them. Further, managers are not unaware that efforts to cut costs and earn a surplus in the current period may be rewarded with nothing more than a corresponding cutback in government support in the future.

Finally, the risk-reward structure in public enterprises is less encouraging to risk-taking and innovation than is true in private enterprises. Without the potential for large gains, there is very little incentive to take risks that might result in failure. This latter problem affects dynamic efficiency rather than static efficiency, but is sufficiently important to require mention.

ii. Evidence

There have been many studies of the relative efficiency of public and private enterprises. These span many industries and many countries. A very thorough review of the literature was performed by Borcherding et al. in 1982,[8] in which they survey the results of over fifty intra-industry studies of the relative efficiency of private and public firms. As they report, of the more than fifty studies, only three studies found public firms

[8] A book on the subject of public enterprise economics (Bos, 1986) published in 1986 makes numerous references to Borcherding et al., suggesting that no major changes in thinking occurred in the intervening period.

produce at lower cost than private firms, and two of these three studies were considered invalid because the public firms were not producing the same product as the private firms.

In the electric utilities sector, three of four studies found public firm production to be more costly than private production. One study found public production costs to be 40 to 75% higher, with investment levels 40% higher per kWh for public firms.[9] For water utilities, three studies found private firms to be more efficient than public firms by amounts ranging from 15% to 40%. In non-utility industries, several studies found efficiency differences greater than 50%.

Taken together, the studies reviewed by Borcherding et al. offer quite convincing evidence that private firms are more efficient than public firms, and that this holds true in a number of different country settings and industries. Further, the efficiency differences are in many cases very large.

iii. Impact on Simulated Welfare Losses

The theory and evidence concerning the production inefficiency of public enterprises relative to privately owned firms suggest that we should consider how total surplus is affected when a competitive pricing public enterprise is replaced by a monopolistic private firm that sets its price to maximize

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[9] The one anomalous study among those reviewed in the survey article occurs in the electric utility industry. This study found weak evidence that private firms had higher costs of production.

short run profit but that is also more efficient in producing its output.

This analysis is more complicated than the last. As noted by Oliver Williamson (1968a, 1968b, 1969) and others, if a monopolist is a more efficient producer than the (more competitive) firm(s) it replaces, the net change in total surplus depends upon the relative values of both the deadweight loss of monopoly pricing and the resource savings made possible by more efficient production. Further, because the monopolist's marginal cost is lower, for any given initial price elasticity, the percentage increase in price due to monopoly pricing will be lower than that shown in column 2.

The formula employed to calculate the net welfare loss (or gain) is given in Appendix 2. It is similar in concept to that of Williamson (1968b), though altered to present the welfare changes as a percentage of the value of industry output evaluated at the competitive price and output.

Column 4 of Table 2 provides estimates of the change in social welfare (measured as a percentage of industry output) for each initial elasticity if a competitive pricing (P = MC) public enterprise is replaced by a profit maximizing monopolist that has 10% lower marginal costs of production. Several items are noteworthy. For initial elasticities of 1.5 or less, the welfare losses of private monopoly are reduced somewhat. For initial elasticities of 1.5 or greater, the privatization actually results in increased total surplus, though the improvements are

relatively modest.

Columns 5 and 6 repeat the exercise of column 4, except that they assume efficiency improvements relative to the public enterprise of, respectively, 20% and 30%. Here, it is only in the cases of the lowest elasticities --those that would have produced monopoly price increases of 75% and more in the absence of efficiency improvements-- that privatization without regulation leads to a reduction in total surplus The evidence reviewed above concerning efficiency differences between public and private enterprises suggests that 20% to 30% improvements in efficiency following privatization are not unlikely.

As is clear from Table 2, whether or not privatization is likely to cause a significant drop in social welfare depends upon the initial price elasticity of demand. It is therefore useful to consider some empirical estimates of the demand elasticity for services produced by natural monopolies.

Lester Taylor (1975), in a survey article drawing on the Houthakker-Taylor (1966) demand elasticity study as well as many others, reported that the estimated short run price elasticity of demand for electricity seemed to range from .14 to .90 (in absolute value) and that the long run elasticity ranged from 1.0 to 2.0. Further, as Alfred Kahn reports in his treatise on regulation (1971, pp. 102-3), the Houthakker-Taylor and other studies suggest that the price elasticity is significantly higher in poorer areas of the United States and abroad.

These elasticity estimates suggest two things. First, for

the ranges of demand elasticities found in most developing countries, the losses due to privatization without regulation are likely to be quite small; if there are efficiency improvements, countries may even enjoy net gains.[10] Second, if private monopolies practice price discrimination, as we will argue below is likely, poorer groups in society, with their higher demand elasticities, are least likely to suffer significant losses.

Simulation results are worth no more than their underlying assumptions. We must now ask if our approach embodies any assumptions that might bias our estimates of the costs of unregulated monopoly.

One aspect of our analysis in Table 2 may lead us to underestimate the social losses due to unregulated monopoly. The figures in columns 3 to 6 of Table 2 assume that all electricity is sold to final demand. However, we know that electricity is sold as an intermediate input to businesses as well as to final consumer demand.

Holding the demand elasticity constant, the welfare loss from a given monopoly price distortion for an intermediate input is likely to be greater than for a final good because the price distortion becomes a cost distortion that affects downstream output decisions. Depending upon the model employed, the welfare

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[10] We note again here that our use of "social welfare losses" (or "gains") refers to changes in combined consumer and producer surplus.

losses can be as much as 40% higher[11], which would suggest that the welfare losses in Table 2 are underestimated.

Table 3 below assumes that all monopoly price distortions cause deadweight losses 40% larger than those in Table 2. It is important to note that because the effect is proportional, for most elasticity values and/or elasticity-efficiency improvement combinations, unregulated monopoly's effect on social welfare remains very small.

There is another factor that might seem to increase the social cost of monopoly pricing of utilities services. The elasticity of demand for electricity and other utility-like natural monopoly services is higher for industrial use than for consumer final demand. Therefore, because, as equation (1) above shows, welfare losses are proportional to the elasticity of demand, the total welfare losses might seem more appropriately located in the vicinity of the larger rather than smaller values in columns 3 to 6. This effect could appear to be significant in LDCs, where the proportion of electricity, gas or telephony services sold as an intermediate input is almost certainly higher than it is in industrialized countries.[12]

We do not think this is a serious problem. Industrial use

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[11] Scherer and Ross (1990, pp. 665-667) discuss this issue in some detail.

[12] In 1972, in the United States, intermediate input use of electricity accounted for about 54% of total electricity demand. (See U.S. Department of Commerce, The Detailed Input-Output Structure of the U.S. Economy: 1972. (Washington, U.S.G.P.O, 1979): 173-178.

TABLE 3

SOCIAL WELFARE GAINS OR LOSSES FROM PRIVATE MONOPOLY OPERATION OF NATURAL MONOPOLIES WITH EFFECTS OF PYRAMIDING VERTICAL DISTORTIONS

(1)	(2)	(3)	(4)	(5)	(6)
PRICE ELASTICITY	PERCENT CHANGE IN PRICE	SOCIAL WELFARE CHANGE AS % OF INDUSTRY OUTPUT	SOCIAL WELFARE CHANGE AS % OF INDUSTRY OUTPUT IF COSTS DECLINE BY:		
			0.1	0.2	0.3
0.111111	450	-157.50	-148.96	-140.36	-131.67
0.176471	283.333	-99.17	-90.61	-81.94	-73.15
0.25	200	-70.00	-61.42	-52.67	-43.77
0.333333	150	-52.50	-43.89	-35.07	-26.03
0.428571	116.667	-40.83	-32.19	-23.28	-14.08
0.538462	92.8571	-32.50	-23.82	-14.80	-5.42
0.666667	75	-26.25	-17.53	-8.38	1.20
0.818182	61.1111	-21.39	-12.62	-3.33	6.50
1	50	-17.50	-8.68	0.80	10.93
1.222222	40.9091	-14.32	-5.42	4.27	14.76
1.5	33.3333	-11.67	-2.68	7.28	18.22
1.857143	26.9231	-9.42	-0.32	9.99	21.51
2.333333	21.4286	-7.50	1.76	12.53	24.83
3	16.6667	-5.83	3.64	15.07	28.44
4	12.5	-4.38	5.43	17.83	32.83
5.666667	8.82353	-3.09	7.25	21.28	38.99
9	5.55556	-1.94	9.48	26.76	49.88

Note: This table embodies the same assumptions as the previous table except that it assumes that the pyramiding vertical distortion effects of intermediate good price distortions increase the welfare losses of monopoly pricing by 40 percent.

of natural monopoly services as intermediate inputs plays a role in determining which elasticity price-increase combinations are likely. The elasticity of demand for intermediate input demand is higher because industrial users have greater substitution possibilities than private residential users, including generating their own power. This clearly constrains monopolies' ability to raise prices significantly, and therefore probably rules out in practice the larger percentage price increases in the upper part of Tables 2 and 3.

For at least some reasonable elasticity values in Tables 2 and 3, monopoly pricing appears to produce non-negligible costs, even if the private monopoly produces more efficiently than the public enterprise it replaces. However, just as our simulation assumptions might cause us to underestimate the social costs of private unregulated monopoly, they can also cause us to overestimate them. Two of our assumptions have this effect.

We have assumed in the above analysis that the public enterprises price their products at marginal cost. To the extent that this is not the case, the welfare loss estimates are lower. If the privatized public enterprise was pricing its product below marginal cost, the price was actually being set inefficiently low, and the allocative efficiency losses are not as large as a straightforward application of the Harberger formula would suggest. However, it is much more likely that the public enterprise was setting its price above marginal cost. In this case, it was already acting to some degree like a monopolist, and

therefore, for any initial price elasticity, the private monopolist's percentage price increase would be smaller. The welfare losses would be correspondingly smaller.

We have also assumed that the private unregulated monopolist considers only the maximization of short run profit in setting price. Clearly, in an industry where the long run price elasticity is significantly greater than the short run elasticity, this is not a rational strategy. Consumers can adjust their patterns of electricity, water, or telephony consumption just as they adjusted to high oil prices by purchasing more efficient automobiles and heating systems. Further, as we have seen in the case of telephony, entry is not impossible even in sectors long considered naturally monopolistic. These longer run considerations will significantly affect the monopolist's optimal pricing strategy. Thus,the estimates in Tables 2 and 3 almost certainly exaggerate the losses due to monopoly and underestimate the gains from efficiency improvements.

On balance then, we would argue that even with single-price monopoly pricing and <u>without</u> any significant efficiency improvements, static welfare losses are likely to be no more than 10 to 15 percent of the value of pre-privatization output. These are not wholly insignificant figures, but neither do they suggest a crippling of the economy. Further, it is important to note that if even relatively modest efficiency improvements accompany privatization, welfare losses are replaced by gains.

2. Price Discrimination

To this point in our analysis of the deadweight losses of unregulated monopoly pricing, we have assumed that the monopolist would be unable or unwilling to price discriminate among customers or groups of customers. Given the possibilities for profitable price discrimination in the natural monopoly situations we are considering, this seems an unlikely eventuality. Even in the early part of the twentieth century, (unregulated) utilities in the United States were able to implement price discrimination practices (Shepherd and Wilcox, passim); today, with firms' ability to determine customer groups' reservation prices or demand elasticities so much greater, and with the costs of monitoring customer usage so much lower, it is hard to imagine that a profit-maximizing unregulated monopoly would make the sacrifice in profits necessitated by charging a uniform price to all customers for all units of output.

Price discrimination will have an impact on income distribution and on static allocative efficiency. Let us examine these effects in turn.

Systematic monopoly price discrimination always has the effect of shifting surplus from consumers to the monopolist, else the monopolist would practice uniform pricing. Given the likely patterns of asset ownership in LDCs and the patterns of residential and industrial use of utility services, this effectively means that price discrimination will increase real income inequality, and this would almost certainly be viewed as

undesirable. It should be noted, however, that in many countries the poorest citizens have very limited access to utilities services, or none at all. The effect of monopoly price discrimination on their real income is therefore likely to be small. Nevertheless, if there were no compensating allocative efficiency advantages of price discrimination, requiring unregulated monopolies to practice uniform pricing might seem an attractive policy.

Price discrimination can either increase or decrease static allocative efficiency. As is well-known, simple first and second degree price discrimination always increase output relative to the uniform price monopoly profit maximizing equilibrium and therefore reduce the static deadweight welfare losses due to monopoly. In the case of first degree price discrimination, where each unit of output is sold at its reservation price, output is expanded to the point where marginal cost is exactly equal to price, and there is no monopoly deadweight loss at all. The effects of third degree price discrimination depend[13] upon demand and cost conditions, and cannot be generalized.

The non-linear pricing systems such as two-part or multi-part tariffs that are employed by regulated utilities in the United States are forms of second degree price discrimination; as such, they have the effect of improving economic efficiency

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[13] Third degree price discrimination involves dividing consumers into groups according to type and pricing according to group demand elasticities.

precisely because they move output closer to the point where marginal cost equals price. If utility-type natural monopolies were deregulated in LDCs, they would almost certainly want to implement non-linear pricing schemes, and consequently, the welfare losses due to monopoly pricing would be significantly lower than those shown in Table 1.[14]

This is very graphically demonstrated in Table 4 below, which juxtaposes in two columns the proportion of monopoly deadweight losses (DWLs) avoided as output increases from the short run monopoly profit maximizing level in the direction of the competitive output. As is apparent in the Harberger formula for deadweight loss of monopoly, in which the DWL increases in proportion to the square of the monopoly price distortion, a disproportionately large fraction of the DWL costs can be avoided by increasing output part of the way to the competitive equilibrium. For example, the DWL is cut in half by increasing output a third of the way from the monopoly equilibrium to the competitive equilibrium output; it is cut by three-quarters if output is increased to a level halfway from the monopoly equilibrium to the competitive equilibrium. Deadweight losses are reduced less than 10% by the last 30% of the total potential movement.

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[14] Regulated utilities in the United States have frequently been stymied in their efforts to implement non-linear pricing schemes by state utility commissions. This has not only led to inefficient pricing, but has also blocked the introduction of new services the profitability of which depends upon use-based prices.

Thus, a very large part of the deadweight losses of monopoly are avoided if the possibility of profitable price discrimination induces the monopolist to increase output above the monopoly uniform pricing profit maximizing equilibrium by even a relatively modest amount.

B. Dynamic Efficiency Considerations:

To this point, we have discussed only whether static efficiency will increase or decrease if a public enterprise natural monopoly is replaced by a private unregulated monopoly. We turn now to dynamic efficiency issues.

The most important dynamic efficiency consideration is whether an unregulated private natural monopoly will make the investments necessary to offer the quality of service appropriate to the country's changing needs over time. Natural monopolies' services are an important part of a nation's infrastructure, and if they are suboptimally provided, this can be an impediment to growth.[15]

Economists by now generally agree that, barring extreme values of either, gains from improvements in dynamic efficiency will usually begin to outweigh static inefficiency losses over a relatively short time horizon (Scherer and Ross, pp. 682). If an unregulated private firm would be significantly more likely to

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[15]The "public interest" associated with the services of many natural monopolies was one of the bases for introducing regulation of pricing and output. See Shepherd and Wilcox (1979, pp.287-288).

TABLE 4

REDUCTIONS IN DEADWEIGHT LOSS AS OUTPUT MOVES PROGRESSIVELY CLOSER TO SOCIALLY OPTIMAL LEVEL

	(1) PROPORTION OF DISTANCE FROM TRAVERSED FROM MONOPOLY OUTPUT TO COMPETITIVE OUTPUT	(2) % DWL REMAINING
Competitive Output (P=MC)	1.00	0
	.90	0.01
	.80	0.04
	.70	0.09
	.60	0.16
	.50	0.25
	.40	0.36
	.30	0.49
	.20	0.64
	.10	0.81
Monopoly profit max. output	0	1.00

Note: These figures assume linear demand and marginal cost curves.

introduce product/service improvements or cost-saving innovations than would a public enterprise, there is a strong presumption that absent strong distributional consideration, private firm provision of natural monopoly services is preferable to public enterprise provision. Similarly, if an unregulated private monopoly will be more dynamically efficient than a regulated one, then the private monopoly is probably better left unregulated.

There may be dynamic efficiency effects of price discrimination as well. In many LDCs, the quantity and quality[16] of service of publicly-owned utilities is sub-optimal. Upgrading service will be very costly, and private owners' upgrading efforts may be financially constrained. The increased profits from price discrimination may provide both the means of financing capital improvements and the incentive to do so.[17]

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[16]"Quality" here subsumes both the range of services provided and the reliability of service provision.

[17] It might be asked why we assume that a privately owned natural monopoly would engage in price discrimination and/or provide service improvements to a greater extent than a publicly owned firm would. Although publicly owned natural monopolies do practice price discrimination, they probably do not pursue it as aggressively as would a private firm for the same reason that many public enterprise utility services were priced artificially low: political expediency. In the case of service improvements, the matter is more complicated, but three factors probably play a role. First, the financial resources necessary to expand and upgrade service must come either from other government budgets or from raising the price of the natural monopoly's services, neither of which is politically appealing. Second, governments may reason that additional resources provided to natural monopoly public enterprises would be diverted to the benefit of those enterprises' employees rather than used as intended. Third, managerial initiative may be blunted because the rewards to individual managerial effort and initiative in a public enterprise tend to be lower than in private profit-oriented companies.

Although there will be some negative redistributive effects of permitting unregulated natural monopolies to engage in price discrimination, in practice these may not be large. In this case, the potential redistributive effects of price discrimination might be outweighed by the potential benefits in the form of improved static allocative efficiency and dynamic efficiency effects of service improvement.

We should note here the importance of government assurances that privatized natural monopolies will not be expropriated in the future. Without some confidence that this is true, risk averse operators of unregulated natural monopolies will attempt to make as much profit as possible from current physical capacity, increasing short run static efficiency losses in the process, but will be very reluctant to invest in new physical plant. The effect of this will be continued sub-optimal provision of services. Given that the "public interest" served by utilities' products provided much of the rationale for public operation or regulation of natural monopolies in the first place, this would clearly be undesirable.[18] As the evidence from the Eastern European economies clearly demonstrates, a low-priced good or service that is unavailable is not preferable to a higher

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[18] Note that multilateral lending organizations may be able to play an important role in this situation. If a private utility is funded to some significant degree by an international lending organization, then the government may view expropriation or confiscatory regulation as potentially very costly. This might provide the assurance necessary for private investors to take a long run view of asset management.

priced one that is.

III. Benefits of Regulating Privatized Natural Monopolies

To this point we have focused our attention on whether society's losses due to monopoly pricing in a privatized natural monopoly sector are likely to be large or small. We have argued that the static welfare losses of monopoly pricing appear to be quite modest given reasonable assumptions regarding the price elasticity of demand for natural monopoly services, the gains from greater efficiency of private firms, and the likelihood that unregulated private monopolists will engage in price discrimination. If efficiency gains are in the 20% to 30% range, improvement in static allocative efficiency is a distinct possibility. We have further argued that dynamic efficiency arguments suggest that even if LDCs had to accept some static efficiency losses in the short run, within a short period of time these would be outweighed by the dynamic efficiency benefits.

We must now address the question: Could LDCs do even better by privatizing the public enterprise natural monopolies and then regulating them to try to ensure that they set price and output close to the competitive equilibrium?

One way to answer this question is to consider the maximum benefits that LDCs could obtain from natural monopoly regulation. Again, Tables 2 and 3 provide some guidance. Even perfect regulation can do no more than eliminate the welfare losses of monopoly. If we take the middle range of column 3 in either

Table 2 or 3 to bracket the likely range of welfare losses due to uniform pricing monopoly, this implies that costless and perfect regulation would probably reduce welfare losses by no more than an amount equal to 5% to about 20% of the value of industry output. If we admit the possibility that a private unregulated monopolist would implement a non-linear pricing scheme as a means of price discrimination, the effect of which is to substantially reduce welfare losses due to monopoly, then even if we continue to assume no efficiency gains after privatization, the likely static allocative inefficiency losses avoided by perfect and costless regulation are not likely to be more than 2% to 10% of industry output.

Unfortunately, even in the best of all worlds, regulation is not costless. In the world in which we live, it does not remotely approach perfection. Bradburd and Ross (1991) provide a survey of the regulatory experience in the United States; for the most part, it is a history of regulatory misdirection and regulatory failure.

There are many reasons for regulation to be imperfect. Perhaps some may be minimized by excellent design of regulatory mechanisms. Others are almost impossible to avoid.

Regulators do not have access to good information, much less perfect information, regarding demand and best-practice cost conditions. As a consequence it is only by chance that they will set the optimal price. Further, in an economy that is undergoing change, as one would hope would be the case in LDCs, the optimal

price is a moving target, making it difficult even to employ decision rules based on incrementalism.

Shepherd and Wilcox (1979, Chapter 11) provide a concise summary of what factors regulators must try to take into account when setting rates and rate structures and when determining the regulated firm's allowed rate of return. They also discuss many of the things that can and do go wrong with the process. They conclude (pp. 315-16) that serious problems with efficiency and investment arise under regulation that seem to have no easy solution, and that in some cases the social costs of regulation-induced inefficiency are possibly large enough to outweigh regulation's benefits.

Shepherd and Wilcox discuss a number of problems caused by regulation. One is a tendency for regulators to come to defend the regulated utilities against competition and to therefore reinforce their monopoly status. Bradburd and Ross (1991) discuss some institutional factors that make this likely.

A second problem arises from the fact that regulators have imperfect information. Consequently, in setting rates, they soon come to rely upon a cost-plus system under which the firm charges cost plus a profit margin. Such a system encourages inefficiency, and as Shepherd and Wilcox argue, because the managers are quite free of constraints, the degree of inefficiency is likely to affect all inputs and be quite significant.

This by no means exhausts Shepherd and Wilcox' list of

problems, but it suffices to make clear that regulation is not a simple and foolproof process, nor one guaranteed to yield net benefits.

It is helpful to once again think about likely costs and benefits of regulation. We argued above that the static efficiency costs of unregulated monopoly are unlikely to be greater than 10% of the value of industry output. If regulation operates in a manner that increases the regulated firm's costs by 10% or more relative to what they would be in the absence of regulation, then regulation will yield a net reduction in static efficiency for society rather than a net improvement.

There is another potential problem with regulation that Shepherd and Wilcox do not mention, perhaps because it is more likely to surface in a developing country context. There will be great political pressures in a developing country context to keep regulated products' prices low, reflecting the second and possibly the third of the regulatory objectives discussed in the introductory paragraphs. The danger is that if they are set too low, firms will lack the resources to maintain the integrity of the services they now provide, much less have adequate resources to expand and improve those services. The dynamic efficiency losses associated with this problem are likely to be both very costly, and very difficult to avoid.

A. Alternatives to Direct Regulation

Competition is a very inexpensive and efficient form of

regulation. If all traditional natural monopolies were in fact protected by insurmountable barriers to entry, then this very appealing method of preventing monopoly pricing would be unavailable. However, many traditional natural monopolies have recently been shown to be less naturally monopolistic than was once thought to be the case. This is certainly now the case in long distance telephony, and may soon be in local telephony as well (Bradburd and Ross, 1991). Changes in energy generation and co-generation technology have made the power sector more competitive as well. Now, many industrial customers of electricity utilities are capable of satisfying their own needs without incurring excessive costs; some even produce surplus power that they sell to utilities.

In effect, in the absence of government protection, at least some degree of competition is a real possibility for many "natural" monopolies. The figures presented in Table 4 above suggest that the bulk of the static deadweight losses associated with monopoly will be avoided if privatized natural monopolies must price their products with an eye to the threat of potential competitive entry, or to the possibility that industrial customers will find alternative methods of meeting their needs. Non-linear pricing schemes are likely to reduce welfare losses still further. It is difficult to justify a complex regulatory apparatus, at least on efficiency grounds, when market forces might operate to achieve the bulk of the potential benefits of regulation without any of the costs.

Another policy alternative is to choose not to regulate at present, but to craft legislation that would allow for regulation at some point in the future if prices at that time are found to be unreasonably high by international standards. For reasons that have already been discussed, this would probably have the effect of significantly diminishing static inefficiency. However, unless the legislation were written in a way that provides great assurances against expropriative regulation in the future, it might result in underinvestment and dynamic inefficiency more costly than the static inefficiency avoided.

IV. Summary

We have argued in this report that the deadweight losses due to monopoly pricing by unregulated privatized natural monopolies are likely to be modest, and that they may well be outweighed by the benefits of improvements in efficiency. We have also argued that regulation is not costless, and that it might well foster static and dynamic efficiency losses greater than the deadweight monopoly losses it is intended to avoid. On balance, it is not obvious that LDCs will experience an increase in combined consumer and producer surplus in either the short run or the long run if their natural monopoly public enterprises are regulated after privatization.

Our results do not suggest much support for regulation on the basis of its effect on allocative efficiency, and they certainly indicate the importance of avoiding costly regulatory

systems. However, this does not necessarily imply that regulation is socially undesirable: as we stated in our introduction, there are several possible objectives of regulation. What our results do suggest is the need to devote greater attention to the other objectives of monopoly regulation, especially those involving income distribution and investor confidence in institutional stability.

Distributional consequences of monopoly pricing are politically potent. Government policies are undoubtedly influenced by the fear that, unless privatized public enterprises are regulated, they will significantly raise their prices and the poor will suffer as a consequence. It is hard to implement good policies with inadequate information, and unfortunately, we have very little systematic knowledge about the actual distributional consequences of privatization and deregulation. Research is needed to determine how price changes after privatization have affected various income groups, and how those price changes differ with the extent and nature of regulation.

The role of regulation in shaping the institutional environment may also be important. If natural monopoly public enterprises are privatized and unregulated in an environment in which property rights are not secure, management is very likely to take an extremely short run view of profit maximization. The "take the money and run" policies implied by this will yield all the undesirable deadweight loss and distributional consequences of private monopoly and none of the efficiency and service

improvement benefits. Attention must be devoted to ensuring an institutional environment in which firms will have an incentive to invest substantial resources to improve the quantity and quality of the services they provide.

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APPENDIX 1

ELECTRICITY, GAS AND WATER AS A PERCENT OF GDP

ARGENTINA	4.68
BANGLADESH	1.17
BOLIVIA	0.08
BOTSWANA	2.50
CHILE	2.58
COLOMBIA	1.10
ECUADOR	1.65
EGYPT	0.01
ETHIOPIA	0.01
GHANA	0.01
INDIA	1.80
INDONESIA	0.01
IRAQ	1.62
KOREA	2.90
AVERAGE	1.44

SOURCE: National Accounts Statistics: Main Aggregates and Detailed Tables, 1988, Parts I and II. New York: United Nations, 1990. (All data are 1988 except Egypt, for which the figure is 1985 level.)

APPENDIX 2

FORMULA FOR CALCULATING WELFARE GAINS AND LOSSES WHEN A MONOPOLY IS MORE EFFICIENT

Let the demand curve be of linear form

$$Q = a - b*P \quad ;$$

and let marginal costs of the public enterprise be constant, so that

$$MC = m.$$

Further assume that the private firm replacing the public enterprise is more efficient so that its marginal costs of production are lower than those of the public enterprise by a constant proportion equal to the decimal fraction μ. Thus the monopolist's marginal costs are given by

$$MC(M) = (1-\mu)\cdot m.$$

If the public enterprise was producing where marginal cost equals price, then it can be shown that the net change in total surplus, W, resulting from the transition from the public enterprise to the monopolist is:

$$W = \mu\cdot(m\cdot Q(c)/2)(1+\mu\cdot e) \; - \; e\cdot(P(c)\cdot(Q(c)/2)\cdot[(P(m)/P(c))\cdot(1/(1+2\cdot e))\cdot(1+2\cdot e-\mu\cdot e)-1]^2$$

where

μ = the decimal fraction improvement in efficiency ;

e = the price elasticity of demand at the public enterprise price;

P(c) = the public enterprise price, which is = m;

P(m) = the monopolist's short run profit maximizing price;

Q(c) = the public enterprise output; and

P(m) = the monopolist's short run profit maximizing output.

cont'd

The net change in total surplus, expressed as a percentage of pre-privatization output, is

$$W' = 100*((\mu\cdot/2)(1+\mu\cdot e) -$$

$$(e\cdot/2)\cdot[(P(m)/P(c))\cdot(1/(1+2\cdot e))\cdot(1+2\cdot e-\mu\cdot e)-1]^2)$$

To take into account the fact that monopoly price distortion of factor inputs affects resource allocation in downstream production processes, we multiply the deadweight loss estimates by 1.4. The total welfare change that occurs when a (more efficient) private monopoly replaces a competitively pricing public enterprise may be expressed as

$$W'' = 100*((\mu\cdot/2)(1+\mu\cdot e) -$$

$$(1.4)(e\cdot/2)\cdot[(P(m)/P(c))\cdot(1/(1+2\cdot e))\cdot(1+2\cdot e-\mu\cdot e)-1]^2)$$

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