Impacts of Public Law 92-500 Grants and Cost Recovery on Efficiency*

by

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I Introduction

Sections 201 and 202 of PL 92-500 specify that the federal government (EPA) will pay 75 percent of the capital cost of approved waste treatment works including connecting sewers and land application systems. Growing awareness that funds are limited is forcing ever narrower definitions of what will be funded and puts pressure on the states to figure out how to assign priorities. A high subsidy for some items and none for others can have a variety of negative effects on the allocation of resources. We advocate that Congress return to 55 per cent grants, that they provide the same federal share of operating and maintenance costs and that they explicitly include the same subsidies for non-plant pollution control measures.

Section 204(b) (1) (B) of the Federal Water Pollution Control Act Amendments of 1972 requires industrial users of the treatment works to make payments for that portion of the cost of construction and operation of such works which is allocable to the treatment of such industrial wastes. The congressional intent of this provision is that "it is inappropriate in a large Federal grant program providing a high percentage of construction funds to subsidize industrial users from funds provided by taxpayers at large" [EPA, 1976]. This provision is getting more and more attention as municipalities are required to have in operation an industrial cost recovery (ICR) and user charge system prior to receiving more than 80 percent of the federal grant.

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The financial provisions of the 1972 Amendments are especially important for certain industrial firms whose waste streams contribute a large proportion of the treated wastes. This includes many food processing firms which have high BOD and suspended solid wastes and can be connected to small towns' facilities.

There are many forms of adjustment to the federal subsidies and required taxes on industrial users. The service of waste treatment is a many dimensional good which has many margins of adjustment. Communities which seek federal grants have multiple objectives of minimizing local tax and user payments, attracting and maintaining industrial jobs, and perserving healthy and aesthetic living conditions. All of this leads to a complicated set of incentives which the subsidy and charging system has imposed on many communities and agricultural processing units.

II Inefficiencies of municipal grants.

It is widely recognized in the economics literature that subsidies to one factor input will induce excess use of the subsidized factor relative to the competitive norm. Capital subsidies will cause cities to construct municipal plants with excess capacity to the extent that operation and maintenance costs which are locally financed, are not increased. To prevent such excesses in the use of capital relative to land, labor or energy, EPA has had to institute many guidelines and "cost-effectiveness" checks. This has probably contributed to the slow rate of construction and the fact that about 50 percent of municipalities do not meet the PL 92-500 July 1st 1977 goal of secondary treatment.

Prior to 92-500 there was a strong incentive for small towns to jointly treat wastes with industry because the average total costs of abatement fall drastically with the volume of flow through a treatment facility. For example, Young and Carlson [1975] found that total costs

for 125 municipal systems only increased by 7 percent as size was increased 10 percent. Thus, a town could afford to offer inducements up to 30 percent of the facility's cost to attract a plant that would double the treatment plant size. When the local share of capital cost is only 15 percent, then there is proportionally smaller incentive for municipal officials to combine with industries and other towns (see Figure 1).

Likewise, a larger proportion of the risks of underutilization of capacity are borne by the federal government under 92-500. That is, if a municipality builds a treatment facility it must collect capacity utilization charges (industrial cost recovery) from industry only as long as the industrial plant is on the system. Should an industry leave, it stops paying these charges to the local government (50 percent) and the federal government (50 percent). Prior to the 1972 laws, the local government would have borne all the costs of underutilized capacity. Capacity utilization costs are not trivial, the Young, Carlson study showed that a reduction of capacity utilization by 10 percent can increase average total costs by 6 percent (see Figure 2). Under earlier incentives, local government could afford to use long-term contracts to insure future capacity utilization. Again, it is easy to see that these considerations are most critical to towns with a small number of large industrial users.

It is interesting to speculate on the joint efforts of small towns and industrial plants to minimize treatment costs in the presence of the federal grants program. Clearly, industry now has to pay for its use of capital and operation costs. Yet, no interest need be paid on these capital outlays by industry. Therefore, some industries are likely to use municipal facilities because they gain scale economies and pay no interest costs. Firms are occasionally taking active roles to help cities minimize average total locally borne costs. Yet, many firms choose not to hook on to city services.

One industry which appears to be heavily supported by other industries is the housing industry. Except for acreage or frontage fees, there is little evidence of charges to pay for the additions to connecting sewers associated with providing sewer treatment service to homes, apartments and commercial firms on the urban fringe. Such firms often cost more to serve because of longer distances to treatment sites, pumping costs and low population density. Prior to 92-500 connecting sewers were not available for federal matching grants. Now, such grants encourage development on the urban fringe (Figure 3). This social inefficiency is aggrevated by other external costs associated with urban sprawl--congestion externalities,

Another inefficiency which is associated with the design of treatment facilities is long-run in nature. Subsidizing conventional treatment facilities tends to induce technical change in these methods of treatment at the expense of other methods. Land treatment adoption has been delayed [Carlson and Young 1975]. There is less emphasis on municipal treatment plant operator skills. There is little research in the technology and management of such systems as low-flow augmentation, in-stream aeriation and lagoons. For example, a tabulation of fruit and vegetable processing construction shows an increasing share of facilities utilizing land and water disposal (Table 1). It may be that the reuse of residuals is more attractive for high BOD producing industries.

III Distribution of PL 92-500 grants.

Prior to the federal financing of public waste treatment, there were relatively larger per capita expenditures in smaller communities (perhaps because of scale economics), in wetter parts of the country (perhaps because there are fewer opportunities for land application), and in the higher income

states. Some hypothesis about these relationships are that the increasing federal grants would raise relative expenditures in areas with larger communities, in dry areas, and in low income states. An analysis of per capita waste treatment facility expenditures by city size, by income level and by climate for the 1968 to 1974 period supports the first two hypotheses. During this period EPA's share of waste treatment construction contracts rose from 14 percent to 62 percent.

Table 2 gives the percent of expenditures per capita by size of community the treatment facility serves. Prior to PL 92-500 communities with less than 50,000 people spent 65 percent of the waste treatment dollars while only having about 45 percent of the urban population. This is undoubtedly due to the higher treatment plant costs per capita in serving these small towns. However, the inclusion of storm sewers and collection facilities in the grant program in the 1972 amendments and the red tape involved in grant application favored larger cities. By 1973-74 expenditures per capita closely followed the city-size distribution. 1976 data from Ed Young [1977] shows this trend continuing to give a disproportionate share to cities greater than 50,000 in population.

Table 3 shows the results of two tests of the shift of waste treatment to dry states. Prior to the 1972 amendments, states with low rainfall and high evapotransporation were spending about 100 to 150 percent less than the wettest states for waste treatment facilities. It must be that previously people in the dry states were content to use land treatment, lagoons and other forms of treatment. Also, they have not had to contend with urban storm waters like the wet states have. The 1973-74 expenditure data (2 years averaged) shows a tendency for expenditures to increase relatively more in the dry states. Single-equation regression coefficients for the 3 cross-sectional (48 states) models are also given in Table 2. In each of the three time periods, the dry-

ness index (rainfall-evapotransporation) is significantly associated with lower waste treatment expenditures for all waste treatment facilities and for collection facilities alone (not shown). The implication is that there has been increased emphasis on waste treatment facilities construction in dry areas. This doesn't seem to be one of the intentions of the proponents of 92-500.

It was also hypothesized that 92-500 affected the relationship between per capita income and the expenditure on waste treatment by states. The single-equation model fit to state expenditure data showed a statistically significant positive income effect for all three periods. (See income coefficients in last row of Table 4.) Cleaner water is a normal good. There does not seem to be any significant shift in relative expenditure per capita toward low-income states as a result of PL 92-500. (The coefficient .0046 in 1973-74 is not significantly different from .0052 in 1970-71.) This can be interpreted as saying that raising local monies for local matching shares has not served as a barrier to low income states' participation in the waste treatment subsidies. Alternatively, one could not say that lowering the local share has not speeded waste treatment in low-income relative to high-income states.

IV What are efficient charging schemes?

Like most other services, there are many dimensions or qualities to waste water service which give it utility to purchasers and others. Municipal waste treatment costs are affected by volume of water flow, contents of the waste loads, distance to service, and many other characteristics. Consequently, when municipalities charge customers for waste treatment services they may be charging for several qualities of service. In the past it has not been efficient for towns to measure and charge for many service dimensions.

It is a question of comparing marginal cost of monitoring and administration of a new charge with the marginal benefits of the added metering and charging. Both the metering costs and the resource allocative effects of the pricing mechanisms are important. That is, assuming firms pay the same total amount in each case, more sophisticated pricing schemes must be justified in terms of improved resource allocation.

There is a tendency in the administration of EPA grants to require that charges be based on usage and especially that industrial firms pay according to pounds of BOD and suspended solids treated as well as the volume of waste water.

Before PL 92-500 a number of cities adopted waste strength charges on their own. These were, by-and-large cities which were located on small streams with high waste treatment requirements and which had some industries that were sending them treatable wastes. Elliott and Seagraves [1973] estimated the elasticities of industrial waste (water-carried BOD -0.8, and industrial water consumption -0.6) with respect to surcharges on BOD and suspended solids. McLamb and Seagraves are in the process of making a new survey of cities using strength charges and hope to improve upon earlier estimates.

Many people would agree that such incentive charges do affect usage. But, should charges on BOD and suspended solids be recommended to all cities? Our reaction is "no!" They are only worthwhile if the extra monitoring and administrative costs are less than marginal benefits.

One adverse incentive of charging food processing industries for their wastes is that some of the processing then will be driven to homes and restaurants which don't "feel" these costs or pay strength charges.

Strength charges may make sense for some potentially toxic materials and for some pollutants which cities are not now treating. Cities might encourage removal of these such materials at the industrial plants with a

system of permits plus penalties. This would be logical if states are holding cities responsible for water quality. Cities could assign penalties based on their expected future costs of tertiary treatment of such substances. If such a charge leads to complete in-plant recovery of such "by-products" so much the better.

V What are efficient waste management units?

PL 92-500 specifies in Section 201 (e) and Section 208 that EPA shall encourage the establishment of regional waste management agencies broadly defined to include solid as well as liquid wastes, waste heat and probably even air pollution and water supplies in their scope of activities. Once established, these agencies will be the sole recipients of EPA grants (Section 208 (d)) in each region and eventually they should be self sufficient units of government. These regional management agencies could be units of a state-owned waste management corporation. Another possibility is that the state could franchise major cities or counties to carry out a set of well-defined tasks within a region.

Regardless of the degree of centralization one factor that is not often recognized about PL 92-500 is that it does allow states to implement stream charges both for withdrawals of water and for discharge of wastes and each charge could depend on both water qualities and quantities. It is important that waste management agencies be allowed to dispassionately consider the advantages of liquid versus solid means of transporting, utilizing and disposing of various wastes. Also, such agencies should be encouraged to use non-plant techniques such as in-stream aeration, flow augmentation and controls on non-point pollutants and to implement the most cost-effective ways of improving the environment.

While PL 92-500 seems to permit many things it is also being interpreted by some to require uniform implementation of new regulations and agencies on strict timetables. This is not logical. Regional waste management agencies are needed in some places much more than in others and they represent expensive social experiments. Obviously, the states and EPA should try out these new ideas where they are most needed first.

VI Summary and recommendations.

1. It appears to be clear that Congress wants to continue funding publicly owned waste treatment works including sewage collection, community septic and land applications systems at the 75 percent level. Local communities are paying a small proportion of capital costs compared to their paying 100 percent of operation and maintenance costs and if states pick up an additional share of these capital costs the resulting misallocations of resources can be serious. There is a strong incentive to buy capital intensive systems and expensive designs. EPA has had to try to offset many such adverse incentives with regulations regarding the size, "cost effectiveness" and the operation and maintenance of systems.

2. Even though "waste treatment works" that may be funded by PL 92-500 are broadly defined, there is still a marked bias against non-plant techniques for improving the environment such as in-stream aeration and low-flow augmentation. Limited funds plus the 75 percent constraint will probably cause further reduction in the classes of projects funded. A more sensible position for EPA to take would be to ask Congress to switch back from 75 percent to 55 percent matching grants while adding non-plant alternatives for improving the environment. Land application techniques

of waste treatment should be given equal consideration in the analysis of alternative systems.

3. Add to these large subsidies and the capital intensive waste treatment plants that cities want to build a requirement that industrial users will have to pay their fair share of total costs and you have a strong incentive for larger firms to treat their own wastes. It will be profitable for some firms to treat their own wastes despite the interest-free loans they receive via the repayment policies of the municipal grants program.

4. Thus, we hypothesize that both the scale and the percentage utilization of waste treatment plants financed with matching grants will be less than optimal. The grants cause costs to be excessive and the industrial cost recovery program plus the high costs cause industries to go their own way. Depending on when they pull out it affects either scale or percentage utilization. We recommend EPA requirements for the use of long-term contracts between cities and firms to improve capacity utilization.

5. Another allocative effect of making industry pay the full cost of waste removal while subsidizing the same in households is to shift more food preparation and preservation to households. Further study of the resource allocation costs of this and similar effects are needed.

6. PL 92-500 also contributes to the geographic dispersion of households and urban sprawl by paying a high proportion of the cost of trunk lines and collection systems. We would recommend elimination of grants for collection systems and storm sewers. Guidelines for cost recovery from households or apartments should require cities to consider the marginal cost of additional service to serve fringe area subdivisions.

7. Allocation systems for grant monies have boosted investments in waste treatment systems in states in dry areas and other regions which previously had little need for expensive waste treatment plants. We encourage less equalization of grant allocations by insisting on more analysis of assimilative capacities of both the land and the ocean.

8. Prior to PL 92-500, charges based on the strength of industrial waste water were mainly used in regions which had high waste treatment requirements and only then by cities with some industries that were discharging large amounts of treatable wastes (usually BOD). PL 92-500 has caused many cities in other regions to build expensive waste treatment plants, has added requirements that industry pay its share of the costs and has caused a number of these cities to adopt industrial waste strength charges on BOD and suspended solids. In certain cases it is sensible for EPA to encourage the use of more sophisticated incentives including charges and penalties for pounds of various harmful waste materials discharged. Such charges should not exceed the future incremental cost of removing these substances plus the damaging effects of the remaining quantities on downstream populations.

9. Emphasis on conventional waste treatment and removal of BOD has been stressed in some regions where oxygen is not a problem. Perhaps regulations promulgated by PL 92-500 have been more costly in this regard than financing schemes. Still, it would seem that some cities are now being encouraged to charge industries for BOD when the emphasis would be better placed on toxic materials. We recommend consideration of penalties or subsidies for non-municipal treatment plant removal of these wastes.

10. One of the critical issues relating to 208 planning is that it is difficult to know how much to plan new programs and regulations if one doesn't know what units of government will be implementing them (local governments, new regional waste management agencies or states). We recommend reallocation of funds away from planning and toward highly selective trials of regional management agencies in some regions where the need for coordinated programs is greatest. These agencies would be encouraged to use a variety of charges and subsidies for water withdrawals and waste discharges and to experiment with non-plant treatment techniques.

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TABLE 1 METHODS OF ULTIMATE WASTE DISPOSAL CHOSEN BY NEW FOOD PROCESSING PLANTS BY PERIOD OF CONSTRUCTION[A]

METHOD OF DISPOSAL	BEFORE 1960	1960-69	AFTER 1969
	(PERCENTAGE DISTRIBUTIONS FOR EACH PERIOD)		
TO MUNICIPAL TREATMENT PLANTS	20	48	35
LAND APPLICATION	60	29	41
WATER (TO STREAM OR OCEAN)	20	23	24

[A]SOURCE COMPILED FROM MAR AND SWAYNE (1976)

TABLE 2 THE EFFECT OF FEDERAL GRANT SHARES ON THE DISTRIBUTION OF WASTE TREATMENT GRANTS BY CITY SIZE [19]

ITEM	1968-1969[A]	1970-1971[A]	1973-1974[A]	1976[B]	URBAN POPULATION PERCENT[C]
FEDERAL COST SHARES	14	40	62	75	
CITY SIZE:	(PERCENTAGE DISTRIBUTIONS FOR EACH PERIOD)				
500- 2,499	11	12	9	7	7
2,500- 5,999	8	9	6	3	5
5,000- 9,999	12	13	9	6	8
10,000-24,999	18	15	15	13	13
25,000-49,999	15	16	12	11	12
50,000	36	35	49	61	55

[A] EXPENDITURE SHARES, ENVIRONMENTAL PROTECTION AGENCY 1968-1974(1974).

[B] ENVIRONMENTAL PROTECTION AGENCY FIGURES FROM YOUNG (1977).

[C] U.S. DEPARTMENT OF COMMERCE, 1974.

Table 3 Changes in Waste Treatment Expenditures Per Capita in Wettest and Dryest States Over Time With Rising Federal Cost Shares

Item	1968-69	1970-71	1973-74
Federal Cost Shares, percents	14	40	62
	(Dollars per capita per year)		
20 Wettest States, $1 capita	$ 8.50	$10.05	$ 19.05
20 Mid-Dry States, $1 capita	6.20	6.24	16.96
8 Dryest States, $1 capita	4.06	3.84	12.38
Ratio Wettest/Dryest	2.09	2.62	1.65
Regression coefficients reflecting added dollars per capita per added unit of "dryness" (average evapotranspiration minus rainfall per state)[a]	-0.062	-0.153	-0.127
(t-ratios)	(2.72)	(5.32)	(2.81)

[a] From the following cross-sectional multiple regression equations for state average annual expenditures per capita for waste treatment works, E:

Years	Equations	R^2s
1968-69	E = -2.43 + 0.0006 N + 0.00245*Y + 0.9764 P - 0.06226**D	0.37
1970-71	E = -7.57 - 0.0062 N + 0.00518**Y - 1.8669 P - 0.15269**D	0.52
1973-74	E = 2.23 + 0.0038 N + 0.00459*Y - 1.8955 P - 0.1269**D	0.38

where:

N = population density of states (It would probably be better to use the percent of the population in cities over 50,000 here).

Y = per capita disposable income of states.

P = percent of industries with approved permits for independent discharges as of 1970 (same for each regression).

D = dryness of states as indicated by evapotranspiration - rainfall + 20 inches. * and ** indicate that coefficients are significantly different from zero at more than the five and the one percent levels, respectively.

Table 4 Total Expenditures for Waste Treatment Works per Capita in High and Low Income States With Rising Federal Cost Shares

Item	1968-69	1970-71	1973-74
Federal Cost Shares, percents	14	40	62
	(Dollars per capita per year)		
8 Highest Income, $1 capita	$ 7.43	$ 9.41	$18.75
32 Mid-Income, $1 capita	6.79	6.86	16.93
8 Lowest Income, $1 capita	5.08	4.69	11.36
Ratio, High/Low	1.46	2.01	1.54
Regression coefficients reflecting added expenditures per dollar of added disposable income per state[a]	.0025	.0052	.0046
(t-ratios)	(2.53)	(4.25)	(2.39)

[a] These partial regression coefficients are from the multiple regression equations given in Table 3.

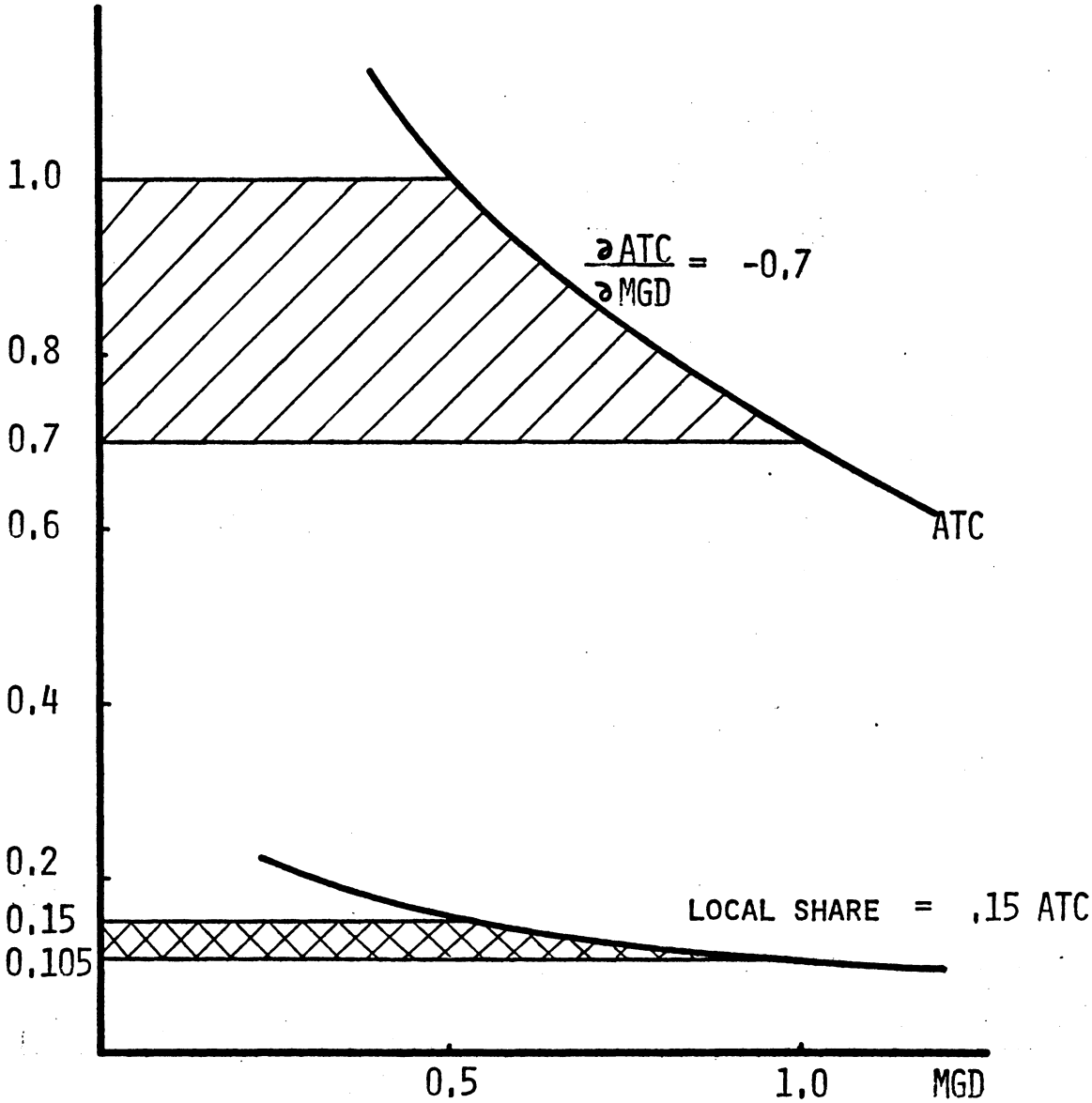

FIGURE 1. ILLUSTRATING SAVINGS (SHADED AREAS) FROM REDUCTIONS IN AVERAGE TOTAL COSTS ASSOCIATED WITH DOUBLING THE SIZE OF A WASTE TREATMENT WORKS FOR A SMALL TOWN AND THE RELATIVE INSIGNIFICANCE OF THE LOCAL COST SHARING (SOURCE: YOUNG AND CARLSON (1975))

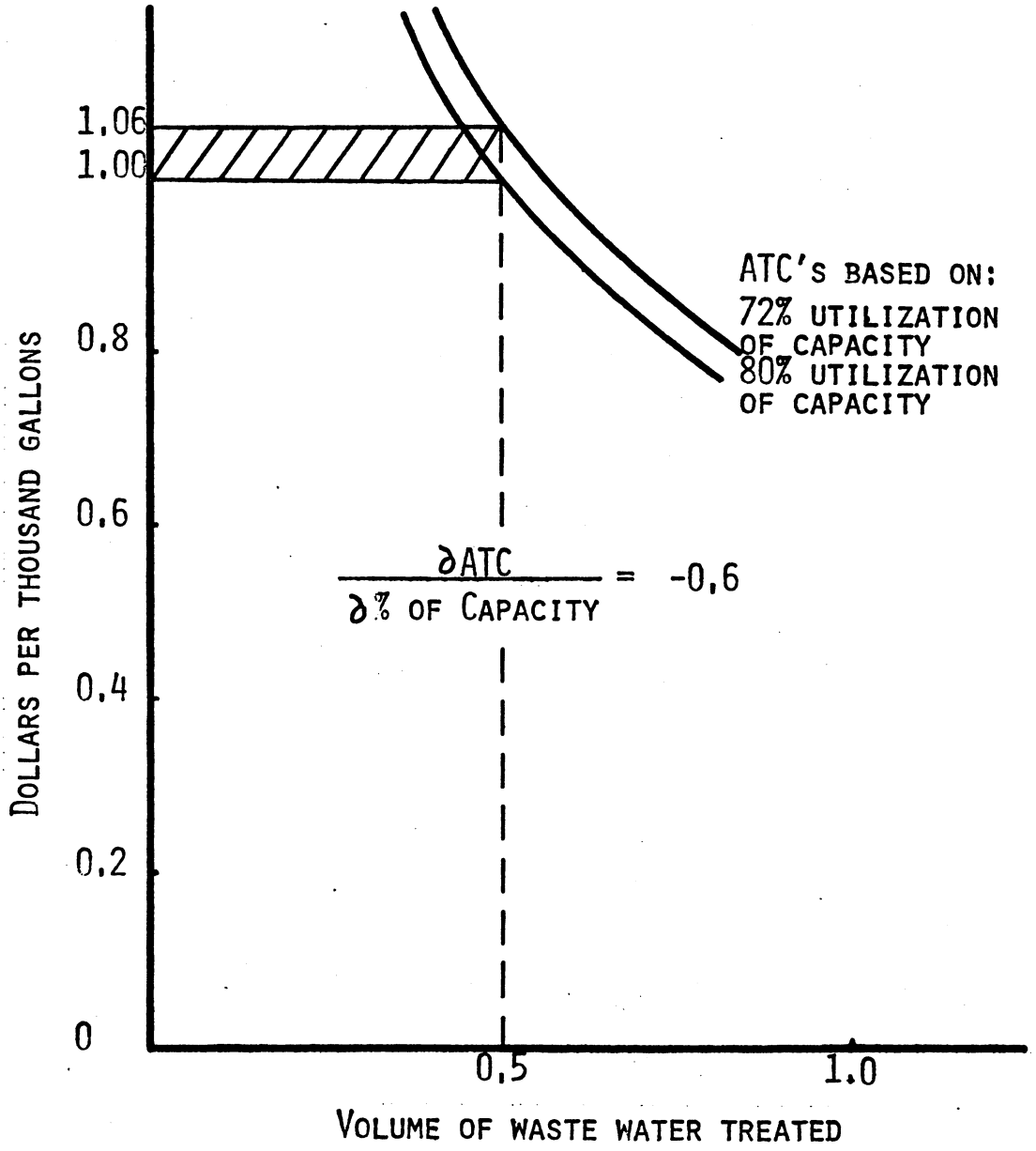

FIGURE 2. ILLUSTRATING LOSSES IN TERMS OF AVERAGE TOTAL COST ASSOCIATED WITH A TEN PERCENT REDUCTION IN UTILIZATION OF CAPACITY OF WASTE TREATMENT PLANTS
(SOURCE: YOUNG AND CARLSON (1975))

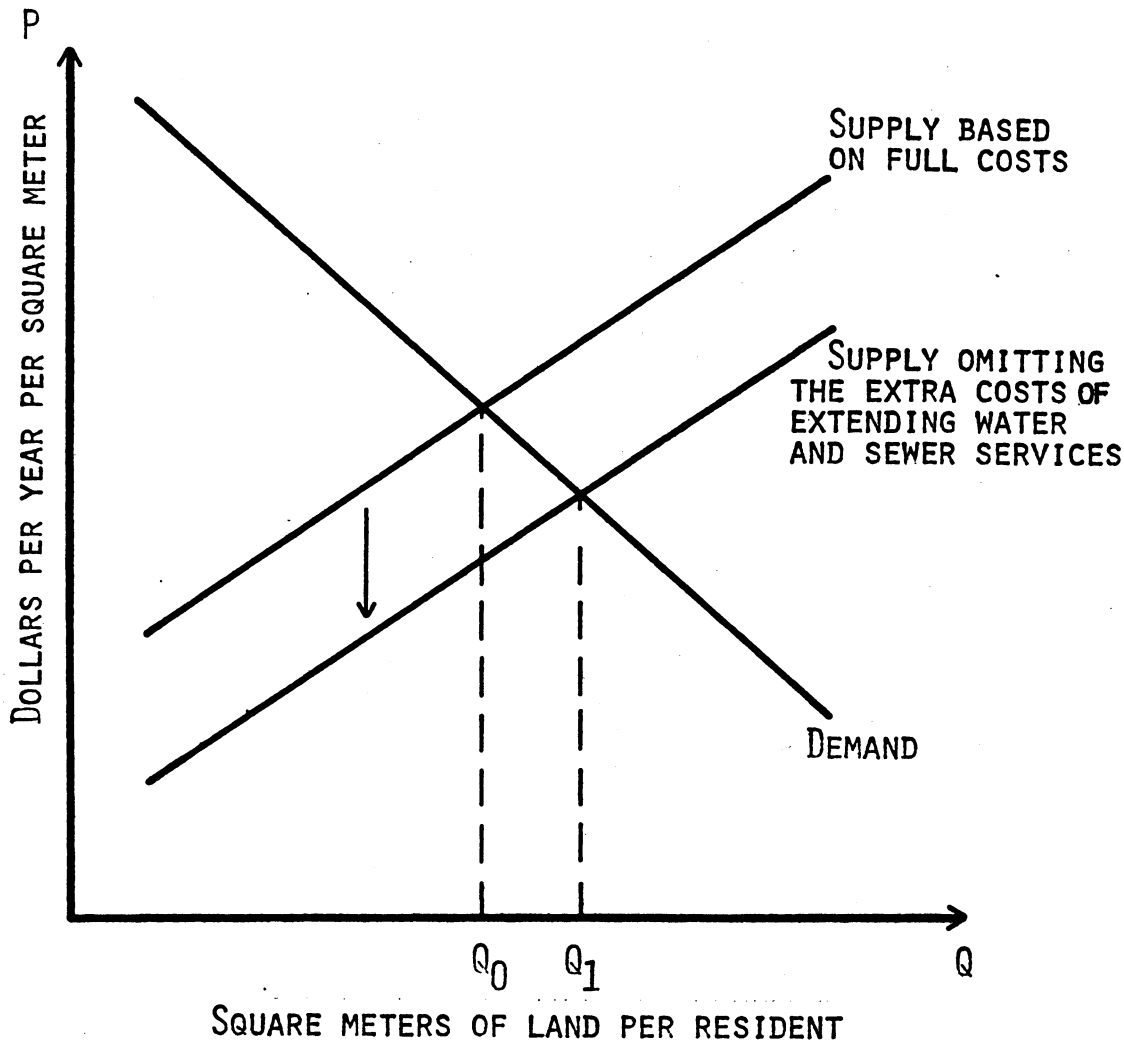

FIGURE 3. ILLUSTRATING EFFECTS OF NOT CHARGING THE ADDED COST OF WATER AND SEWER SERVICES ON LOT SIZE AND URBAN SPRAWL