

Cross Subsidies in Public Services:

Some Issues

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Foreword

The past decade has seen the reform of industries that historically operated under heavy government control, giving rise to a new model of infrastructure provision. Three features characterize this new model. First, ownership, management and financing of infrastructure assets are increasingly in the hands of private sector firms. Second, the public sector exercises a regulatory function that complements the functioning of the market. Third, consumer prices cover total costs and return on investment compensates capital.

Multilateral lending institutions have issued recommendations for providing infrastructure services that take this new model into account. One of the topics covered in these recommendations is pricing policy. Pricing recommendations advocate that prices should be set to cover the total cost of the service and cross-subsidy schemes avoided. Although straightforward, the application of these recommendations to real world infrastructure services may be complex because uniform pricing may not be fully compatible with total cost coverage and welfare goals when technologies have increasing returns that may result in price discrimination and cross subsidies.

This paper explores the economic literature for rules on applying these principles to concrete world infrastructure services. It constitutes an important tool for the staff of multilateral institutions as well as for national policymakers and other interested parties in ensuring that private participation in infrastructure improve access and service options for the poor.

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INTRODUCTION

During the past decade, many industries that historically operated under heavy governmental control have undergone a substantial reform process. A new model of infrastructure provision has emerged and extended worldwide. Three features characterize the new model. First, the property, financing and management of infrastructure assets rests, at least to some extent, on private sector firms. Second, the public sector has a regulatory role that should not substitute for the market but complement it. Third, consumer prices should cover total costs. Multilateral institutions have prepared recommendations for providing infrastructure services through the new models which deal with several topics, ranging from the selection of the private sector firm to the organization of the regulatory institutions, from pricing policy to entry and exit control and from financing policies to the role of markets.

Pricing policy recommendations are based on two principles. One is that prices should cover the total cost of the service. The other is that cross subsidy schemes¹ should be avoided. Although both principles may appear simple, their application to real world infrastructure services may be complex. The reason is that among the several notions of free cross subsidy prices only one is fully compatible with both covering total cost and welfare

goals when technologies have increasing returns.² This paper explores the economic literature for rules on applying these principles to real world infrastructure services. The discussion is based on a partial equilibrium approach that uses market surplus as a proxy for social welfare and efficiency.³ Although equity issues are important and are related to cross subsidy pricing, they are not addressed in this paper because these two issues require different analytical frameworks. For efficiency issues market surplus is enough, while for equity issues social welfare functions and income distribution goals are needed. Therefore, a partial equilibrium analysis is appropriate for the former and a general equilibrium framework is best suited for the latter.

This article reaches three main conclusions. First, if a uniform price schedule is established and prices diverge from marginal cost, then social welfare can be increased by establishing appropriate price discrimination schemes that have cross subsidies. This does not mean that all schemes with cross subsidies increase welfare, but some do. For instance, cross subsidy schemes where prices are lower than marginal cost are not appropriate from the welfare standpoint, whereas cross subsidy schemes with prices below average cost may be welfare optimal. Second, from a voluntary

¹ There are several definitions of cross subsidy schemes, in the economic literature, which are discussed in section 2 of this paper. For the purpose of this introduction, a price scheme has cross subsidies if prices for some consumers are below average costs and prices for other consumers are above average costs.

² Although increasing returns are not always equivalent to decreasing average cost functions, for simplicity this paper considers both terms equivalent. The paper assumes that the conditions for such equivalence holds. See Panzar, 1989.

³ The terms "social welfare" and "efficiency" are used as synonyms.

sustainability⁴ standpoint, some cross subsidy schemes are not suitable, whereas others are appropriate. Third, sometimes, optimal and voluntary sustainable price schedules are not compatible. In these cases, a trade-off between optimality and sustainability is often necessary. The regulator's choice should be based on a comparison between efficiency losses and the cost of maintaining a price schedule that drives some consumers away from the regulated firm or forces the exclusion of other consumers.

Section 1 provides an example that sets forth the main issues discussed in the paper. Section 2

reviews several definitions of cross subsidy price schedules. Section 3 discusses the conditions under which price schemes with cross subsidies increase efficiency. Section 4 defines conditions for efficient price allocations. Section 5 explores the notion of voluntary sustainability. Section 6 discusses the case where a price schedule that is both optimal and sustainable does not exist. General conclusions are further elucidated in section 7. An annex to the paper provides an example of a case where optimal prices are not sustainable.

⁴ A precise definition of voluntary sustainability is given in section 4. The idea is that a public service is voluntarily sustainable when consumers are not willing to change to a different supplier. That is, all consumer groups are better off if the regulated firm continues providing the service.

1.

CROSS SUBSIDIES AND CONSUMER SEPARATION: AN EXAMPLE

To illustrate the issues discussed in this paper, assume that a profit-regulated firm provides water to two neighborhoods, a and b . Water supply requires two types of investments. The first type of investment, distribution pipelines, is specific for each neighborhood. Investments of the second type, storage tanks and pumps, can be used by both neighborhoods. The regulated firm's total costs are the capital cost of investments and the cost of electricity for pumping water from the river to neighborhoods. The regulator sets the same price for both neighborhoods, which equals total average cost.⁵

The manager of the regulated firm notices that the company may increase its profit by providing water to a new neighborhood, c , at a lower price than that charged neighborhoods a and b . The manager sets prices in neighborhood c so that revenues are slightly above that neighborhood's costs, as well as, the pipeline distribution cost and the electricity cost. Nevertheless, he does not charge for the cost of the storage tank and pumps. After starting the new policy, the firm profits and total consumption increase.

The regulator imposes a penalty on the manager because by setting lower prices in the new neighbor-

hood, he is in noncompliance with existing regulations. The manager claims that the new price policy increases social welfare, arguing that if consumers pay voluntarily, then consumer welfare should be larger than consumer payments. He also says that if revenues from new consumers are larger than incremental cost, the welfare gains are larger than the increase in social costs, that is, a net increase of social welfare occurs.

In spite of the manager's claims, the regulator forces the manager to distribute the cost of the tank and pumps uniformly among the three neighborhoods. The new price policy means an insignificant reduction in the prices paid by the consumers in neighborhoods a and b , and a large increase in the prices paid in neighborhood c . The results of this regulatory policy are a dramatic fall in consumption in neighborhood c , while consumption in neighborhoods a and b remains at approximately the previous levels.

The manager's arguments did not convince the regulator, but real life facts make him reconsider the manager's proposal. Thus, the regulator contracts a consultant to evaluate the manager's price policy. The consultant agrees that the manager's proposal increases social welfare, and points out that further increases of welfare can be brought to the community if a full price discrimination scheme is set across the three neighborhoods. He recommends increasing prices in neighborhood a , decreasing them in neighborhood b , and maintaining the manager's price proposal in neighborhood c . He supports his recommendations with the following argument: Prices should be increased in neighborhood a because the area only has tourist hotels and the

⁵The average cost for the case of a multiproduct firm may be ambiguous due to the assignment of the common cost among products. For this example, the regulator defines the average cost of servicing water as follows: pump cost plus storage tank cost plus distribution cost to neighborhoods a and b plus electricity cost for neighborhoods a and b , divided by the amount of service water in both neighborhoods.

volume of water consumed by tourists is not sensitive to price increases⁶ Thus, prices can be increased in neighborhood *a* to include the entire cost of the storage tank and pumps in addition to distribution costs, without resulting in a decline in water consumption. Prices can then be brought down in neighborhood *b* where consumers are sensitive to prices and the regulated firm would not incur any losses. The increase in consumption in neighborhood *b* is higher than the decrease in the neighborhood *a* and total consumption and social welfare increase.

The regulator carries out the consultant's recommendations. During the first months, the new measures are very popular. After six months, however, company revenues drop due to a decrease in consumption in neighborhood *a*, despite the fact that the number of tourists has increased sharply. Further investigations point to the fact that each hotel has its own well water system. Tourists may have low price elasticity but hotels do not. The results are higher social costs for the communities and large losses for the regulated firm. The regulator tries to forbid the use of well water, but is unsuccessful.

⁶ The consultant is not able to estimate demand functions for each neighborhood due to a lack of price variations changes during the last period. However, the consultant calculates the demand of neighborhood *a* based on the demand for tourists. By doing so, the consultant does not mention in the analysis that the hotels can use well water as a source of supply.

2.

PRICE SCHEMES WITH CROSS SUBSIDIES

Are the proposals made by the regulator, the manager and the consultant free of cross subsidies? The answer depends on how a price scheme that is free of cross subsidies is defined. The notion of cross subsidies has been developed for dealing with the relation between service payments from a group of consumers and the costs associated with providing a service or related services to them. However, several definitions have been used for price schemes free of cross subsidies. The following definitions are used in this article.

DEFINITION 1: MARGINAL COST CRITERION

Under this criterion, a price scheme is said to have cross subsidies, if some consumer prices are lower than the marginal cost. Otherwise, if all consumer prices are equal or above marginal costs, then the price scheme is subsidy free. Notice that according to this criterion, a price scheme in which all consumer prices just equal marginal cost is cross subsidy free. However, such a scheme may not raise enough revenues to cover the total cost of the service. In the previous example, the proposals made by the regulator, the manager and the consultant are free of cross subsidies according to this criterion because the prices proposed by each cover neighborhood electricity costs in all three neighborhoods.

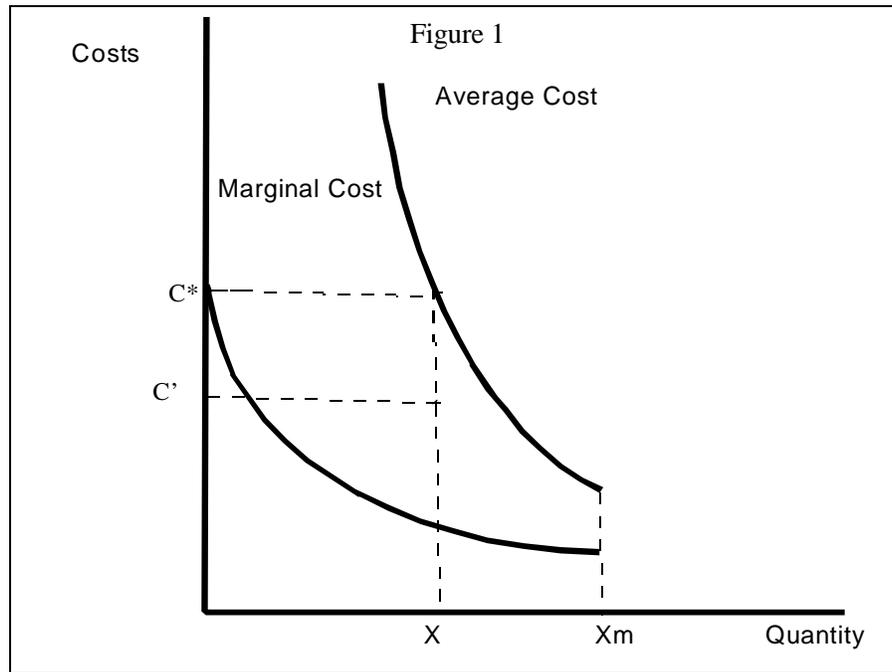
DEFINITION 2: AVERAGE COST CRITERION

Under this criterion, a price scheme is said to have cross subsidies if some consumer prices are below average costs and others are above. This criterion

may be difficult to apply to multiproduct firms because their average cost schedules may not be well defined. In particular, when some costs are shared among different products, the average cost schedule cannot be precisely defined. For example, the regulated firm in the previous example may be considered a multiproduct firm if providing water to neighborhoods a and b is viewed as two different products. Therefore, an average cost schedule for each neighborhood cannot be precisely defined due to the different ways of distributing common costs. Nevertheless, for purposes of illustrating the average cost criterion, the average cost is defined as the sum of all costs (pumps, storage, distribution and electricity) in both neighborhoods divided by the amount of delivered water to both neighborhoods. That is, water provision is considered a unique product regardless of where it is delivered. According to this definition of average cost, the manager's proposal has cross subsidies since the price for neighborhood c is below average cost while prices in neighborhoods a and b are above average costs.

DEFINITION 3: INCREMENTAL COST CRITERION

Under this criterion, a price scheme is said to have cross subsidies if revenues from a consumer or a group of consumers are less than the incremental cost of providing services to that consumer or group of consumers. In the example, the incremental cost for neighborhood c is the cost of electricity for pumping (marginal cost) plus the cost of pipelines in neighborhood c . The incremental costs for the other neighborhoods are similarly defined. Therefore, according to the incremental cost cri-



terion, the manager's price schedule is subsidy free since all neighborhood revenues cover variable and distribution costs for each neighborhood.

**DEFINITION 4:
STAND-ALONE CRITERION**

Under this criterion, a price scheme is said to have subsidies if the revenues from a consumer or group of consumers are larger than the cost of providing service alone to this consumer or group of consumers. In the example, the price scheme proposed by the consultant is not subsidy free because revenues from neighborhood a are higher than the cost of producing the service for this neighborhood using wells.

This leads to the following observations: First, definitions 1 and 2 compare prices with the actual costs of providing services, whereas definitions 3 and 4 compare prices to the costs of other alternatives for providing the service. This means that, for assessing price schedules according to criteria 1 and 2, only the knowledge of the regulated firm cost schedule service is required, while for assessing price schedules according to 3 and 4, criteria information about other technologies is needed. Second, it is necessary to examine all groups of consumers in order to establish that a price scheme is subsidy free under definitions 3 and 4. In other words, it is not enough to test some individuals or some groups. Thus, definition 3 requires that all consumers and consumer groups

pay the incremental costs that correspond with the actual technology used by the regulated firm and any other available technologies. Definition 4 requires that all consumers and all consumer groups prefer the service of the regulated firm to all other alternatives. Third, with increasing returns, a price scheme that is free of cross subsidies according to the average cost criterion will be also

subsidy free according to the marginal cost criterion since marginal costs will be below average costs when average costs are decreasing. Increasing return technologies have decreasing average costs (see figure 1). Fourth, if the profit of the firm is zero, then a price scheme is subsidy free according to definition 3 if, and only if, the price scheme is subsidy free according to definition 4.⁷

⁷ For a proof, see Breutigam, 1989.

3.

CROSS SUBSIDIES AND MARKET EFFICIENCY

In the previous example, the proposal of the manager of the regulated company is supported by well-known theoretical results which state that any uniform price schedule different from marginal cost can be welfare dominated by a nonuniform price schedule if consumers have different price elasticities. These findings are relevant for setting discriminatory prices in infrastructure services because marginal cost pricing does not cover total cost in the presence of increasing returns, a common feature of infrastructure. Therefore, if revenues from infrastructure services cover total costs, then prices must diverge from marginal cost. In other words, from a welfare standpoint, price discrimination schedules may be better than a uniform price when the uniform prices do not equal marginal cost and price elasticities differ among consumers.

However, price discrimination may or may not imply cross subsidies. If regulators set prices so that they just cover costs without yielding extraordinary profits, then any price discrimination scheme has implicit cross subsidies according to the average cost criterion. The reason is that consumers who pay higher prices are paying more than average costs, while consumers who pay lower prices are paying less than average costs. In these cases, the allocations resulting from pricing with cross subsidies according to the average cost criterion may dominate, from an efficiency standpoint, allocations resulting from uniform prices. It may occur that a price scheme that increases welfare with respect to uniform prices has cross subsidies according to the average cost criterion and does not have them according to the stand-alone or the incremental criterion. However, it may also be the case that a price scheme appropriate for

welfare purposes has cross subsidies according to the average cost, the stand alone, and incremental cost definitions. Nevertheless, as discussed in the next section, prices must be free of cross subsidy according to the marginal cost criterion for welfare goals.

Although a formal proof of the above is not intended, the following arguments may be useful in understanding them. Notice that if the price is above marginal cost and if consumers have different price elasticities then welfare may be increased by reducing prices to consumers with a high price elasticity of demand and increasing prices to consumers with a low price elasticity of demand. This is so because the increase in consumption and consumer surplus of the former group would compensate for the decrease in consumption and consumer surplus of the latter group.

In figure 2, m is the marginal cost schedule of providing an infrastructure service. Each neighborhood demand function is represented by D_a and D_b , respectively. The price elasticity of demand for neighborhood b is larger than the price elasticity of demand for neighborhood a . Prices are equal in both neighborhoods and they are higher than marginal costs in order to cover fixed costs. The gray area represents revenues over variable costs that can be used to cover fixed costs. The black area represents the welfare loss with respect to the maximum welfare that could be achieved (the maximum welfare is attained when prices equal marginal costs). The welfare loss is larger in neighborhood b than in neighborhood a . The reason is that given the difference in the price elasticity of demand between the two neighborhoods, consumption in neighborhood

b diminishes less than in neighborhood a as prices increase from marginal cost to \mathbf{P}^*_a .

Figure 3 shows what happens when a discriminatory price schedule is established. In neighborhood a , prices are now higher than in figure 2 (i.e., \mathbf{P}^{**}_a is higher than \mathbf{P}^*_a), while in neighborhood b , prices are lower (i.e., \mathbf{P}^{**}_b is lower than \mathbf{P}^*_b). The new

prices are above marginal costs. The difference between revenues and variable cost is larger (the gray area) in figure 3 than in figure 2. Welfare losses with respect to maximum welfare are smaller in figure 3 than in figure 2 (i.e., black area). The price scheme in figure 3 with price discrimination is better from a welfare point of view than the price scheme in figure 2.

Figure 2

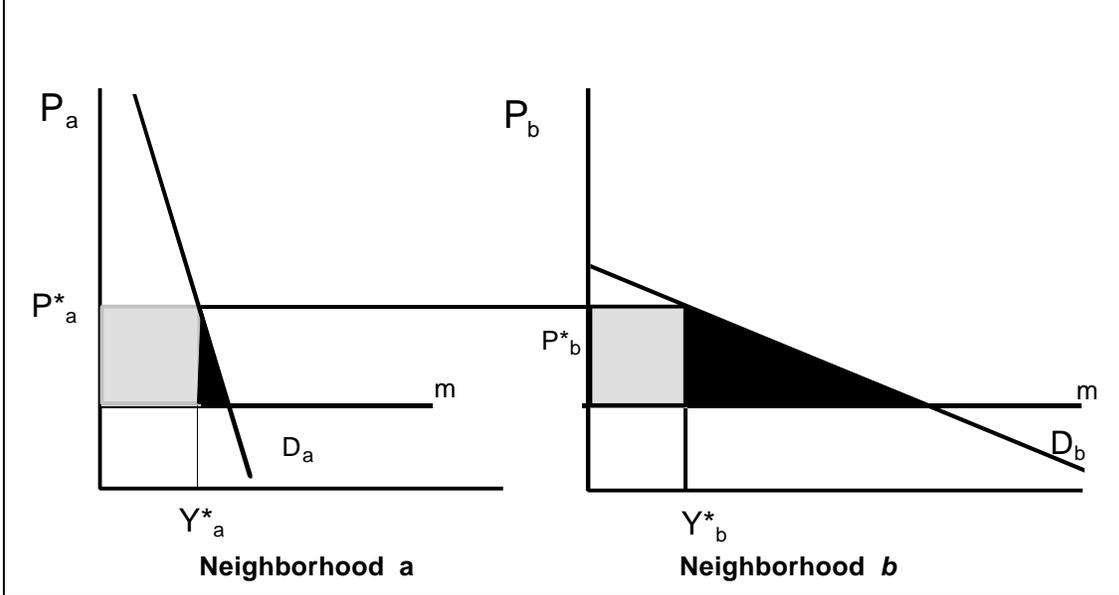
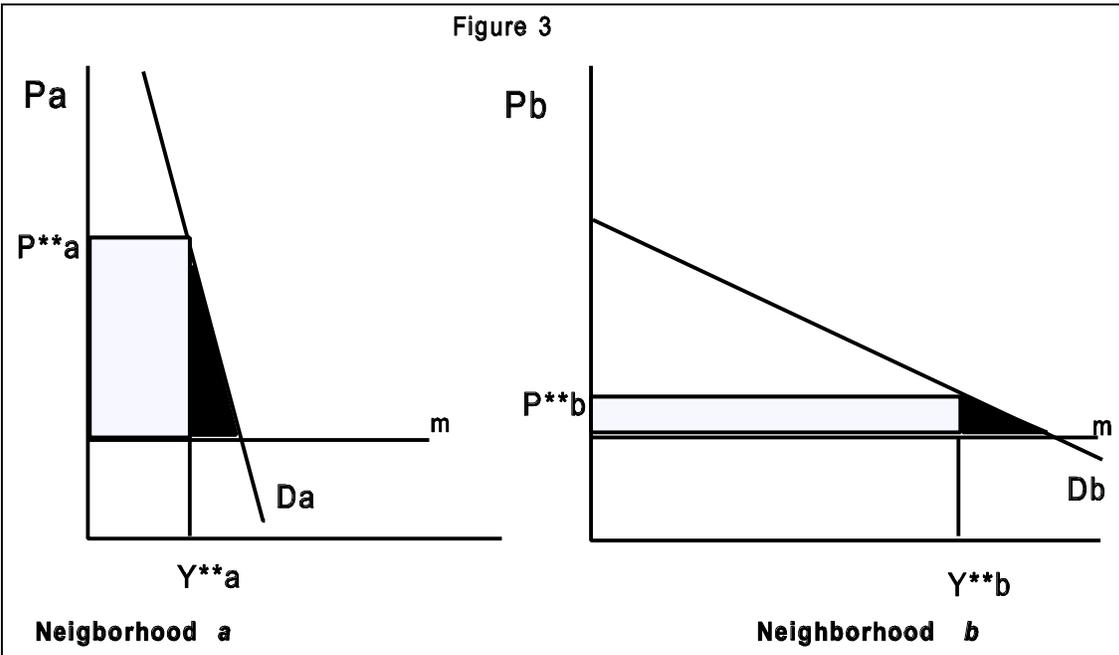


Figure 3



4. PRICES SHOULD COVER MARGINAL COSTS

The previous sections have shown that price discrimination and cross subsidies, in the increasing returns and a no-losses restriction, may increase social welfare. Yet, they are far from showing that all discriminatory schemes are appropriate for improving welfare. This section discusses three important considerations in analyzing the welfare implication of schemes with price discrimination and cross subsidies.

First, cross subsidy schemes with prices lower than marginal costs are not appropriate from the efficiency standpoint. The reason is simple, if the price paid by a consumer is lower than marginal costs, the social cost of this consumer service is larger than the benefit to the consumer, as measured by the price. If there are no externalities,⁸ welfare is increased by just reducing production in the amount corresponding to the underpriced consumer. Therefore, a first rule is that consumer prices should be greater than marginal cost. This rule sets a lower bound for price schedules.

Figures 4 and 5 illustrate this rule. Comparison of both figures shows that welfare increases just by increasing prices in neighborhood *b* and keeping prices level in neighborhood *a*. The price increases bring down consumption and losses, while im-

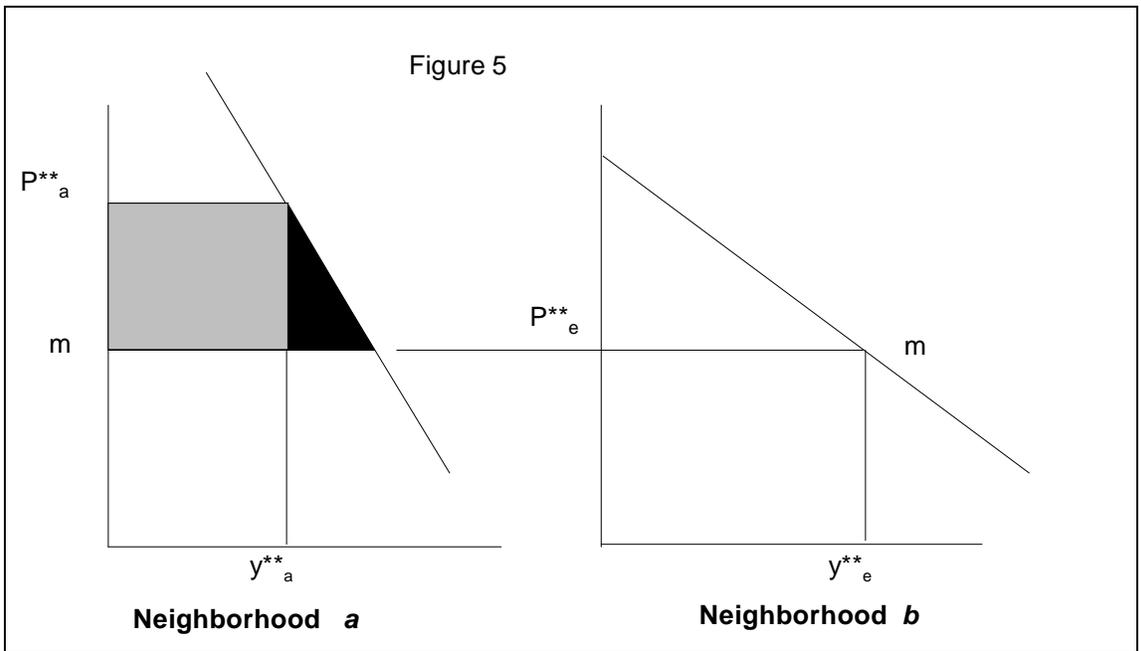
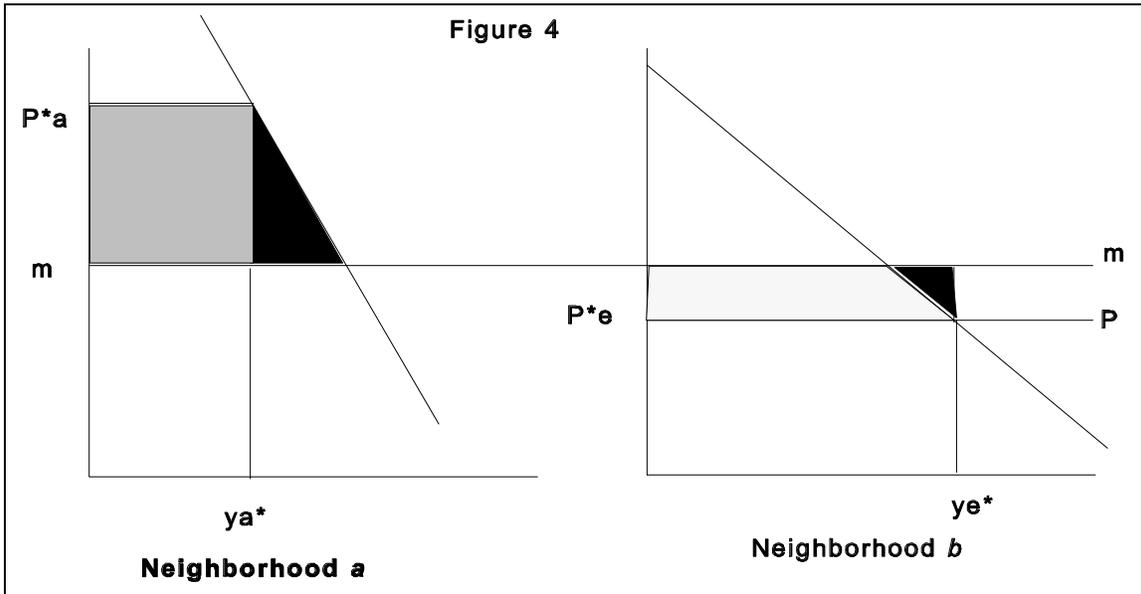
proving welfare. That is, the black areas are smaller in figure 4 than in figure 5. (As in figures 2 and 3, black areas are a measure of welfare loss with respect to maximum welfare.)

Second, schemes with cross subsidies and price discrimination increase welfare only if they increase the level of consumption, since price discrimination and cross subsidies causes marginal rates of substitution to be different among consumers. Therefore, for a given amount of consumption, they are socially inferior to uniform prices. However, if a cross subsidy scheme is successful in increasing the consumption level, the welfare improvement from greater consumption may be larger than the welfare loss from the difference in marginal rates of substitution. It should be clear that if some prices are below marginal costs, then welfare may increase when these prices increase up to marginal costs

Third, under increasing returns and the restriction of no losses in the regulated firm, a necessary condition for welfare maximization is that the deviation of prices from marginal cost in each market should be inversely related to the price elasticity of demand in each market.⁹ Prices should be higher in markets with lower price

⁸ If there are externalities, subsidy schemes may need to be implemented to increase consumption. Direct subsidies, as in Chile, are preferred from an efficiency point of view. Nevertheless, the administrative cost of direct subsidies is usually large.

⁹ A formal proof of this can be found in Boiteux, 1971. If nonlinear prices are allowed, then price discrimination is not a necessary condition for maximizing welfare (Willig, 1978).



lower price elasticity than in markets with higher price elasticity. This result shows that if welfare maximization is the goal, then price discrimination is appropriate. It also means that prices for some consumers will be higher than average costs and for others they will be lower. In other words, there are cross subsidies among consumers, which redistributes income away from low-elasticity groups toward consumers in the high-elasticity groups.¹⁰ Thus, if consumers do have different elasticities, optimal prices are not subsidy free according to the average cost criterion. This result does not say whether optimal prices hold for the stand-alone and the incremental cost criteria for price schemes

to be subsidy free (for a discussion of this issue, see section 5).

Although, the third point relies on increasing return technologies and the no losses restriction for the regulated firm, it is, nevertheless, relevant as a guide for pricing policy of public services because increasing return technologies are the main reason for regulating the prices of infrastructure services. The case for public sector intervention in infrastructure services is the presence of market failures due to increasing returns (decreasing average cost structures). In fact, if infrastructure services do not have these features, regulators should not control prices, but only promote competition.

¹⁰ Optimal prices would improve income distribution if low elasticity groups are the wealthier consumers. This is an empirical matter, nevertheless it seems plausible that wealthier consumers could have a lower price elasticity.

5. CAN CROSS SUBSIDIES DESTROY MARKETS?

The above results suggest that one cannot make a case against all price schemes with cross subsidies on a welfare basis. Some schemes may have bad properties, but not all. Even more, cross subsidies schemes, according to the average cost criterion, are a necessary condition for welfare maximization when increasing returns are present and losses are forbidden. Therefore, reasons other than welfare should be the cause for rejecting price schedules with cross subsidies.

One reason for rejecting cross subsidies is that they may lead overpriced consumers to abandon the regulated firm or force the exclusion of underpriced consumers. Overpriced consumers may realize that their payments to the regulated firm are larger than what they would pay under other arrangements. Also, overpriced consumers may notice that by excluding some underpriced consumers, they may reduce their payments to the regulated firm. Thus, overpriced consumers may force the splitting of the service and the whole community would lose the benefits of technologies with economies of scale.

The notion of voluntary sustainability characterizes price schemes under which every group of consumers in a community is better off when the public service is jointly provided. Therefore, no consumer is willing to change to another provider. A price discrimination scheme for a community is voluntarily sustainable, if the following two conditions hold:

- *Stand-Alone Criterion.* Each group of consumers pays less for the provision of the service than they would pay alone. Thus, separation of a group will not improve the welfare of members. This condition sets an upper bound for revenues from a group of consumers.

- *Incremental Cost Criterion.* Revenues from each group cover the incremental to total cost that occurs when the service is provided to that group as opposed to not being provided at all. This condition sets a lower bound for revenues from a group of consumers.

When the first condition holds, no group will be willing to separate because doing so will increase their payments. However, if the second condition holds, no group is willing to exclude other groups, since the exclusion of one group will make the remaining consumers worse off.

Some observations on these conditions should be made. First, a price scheme is sustainable if, and only if, it is cross subsidy free according to both the stand-alone and the incremental criteria. Second, the incremental cost condition requires that prices should be above marginal costs. Therefore, price over marginal cost should hold for both welfare and sustainability reasons. Third, price schedules meeting the conditions for voluntary sustainability may have implicit cross subsidies according to the average cost criterion. Therefore, prices with cross subsidies according to the average cost criterion may be compatible with both welfare and sustainability requirements. Fourth, the sustainability of a price scheme closely depends upon the alternatives for service provision of each consumer or group of consumers. That is, checking sustainability requires information about alternative technologies available to every group of consumers. Fifth, the notion of voluntary sustainability is strong because all groups should be checked. However, in the real world, it is often difficult for consumers to join in

order to reach other alternatives of service provision even if they can technically reach them.

The example may be used to illustrate these notions. The manager's proposal is voluntarily sustainable because neighborhood c pays its incremental cost. Also, because neighborhoods a and b share the common costs, hotel payments are smaller than the costs of self provision by using wells. Thus, the stand-alone criterion holds. However, the manager's proposal has cross subsidies according to average costs because the price of water for neighborhood c is less than total average costs. By contrast, the consultant's proposal is better in terms of welfare than the manager's proposal. However, hotels have cheaper alternatives than receiving water from the regulated firm at prices that cover the total cost of tanks and pumps. Therefore, the consultant's proposal is not voluntarily sustainable and most hotels separate.

To illustrate that the notion of voluntary sustainability may be too strong, the example is modified slightly. Assume that the cost of water provision for each group of hotels is larger than payments to the regulated firm. However, a coalition of one hotel and a thousand consumers may obtain water at a cost lower than its actual payments. Assume that the new water supply alternative for this coalition requires a large initial investment. Assume also that the consumers do not have financial capacity to pay their share of the initial investment. This coalition of a hotel and a thousand consumers is technically possible, but the coalition would likely not undertake the required investments. By modifying the example, the price schedule of the consultant is still not voluntarily sustainable according to the definition of sustainability because it does not hold to the stand-alone criterion. However, the separation does not actually occur.

6. REGULATORY APPROACHES

The economics of regulation deals mainly with three topics. The first is market failure to reach efficiency and the corrective actions that regulators should undertake to ameliorate them. The second refers to equity issues and the measures for improving income distribution. The third, and the more innovative, refers to the compatibility between regulatory frameworks and the behaviors of the economic agents for achieving welfare and equity goals. For the issues addressed in this paper, the research for optimal prices with no-losses condition falls within the first topic, while the sustainability of a price scheme falls within the third. Modern theory drives regulators jointly dealing with welfare and incentive issues. In the context of this paper, this means that regulators should look for prices that are optimal and sustainable. They may follow different approaches to reach this goal.

In one approach, the regulator sets a price schedule that maximizes welfare subject to a non-negative profit restriction. Baumol and Bradford (1970), Boiteux (1971) and Ramsey (1927) follow this approach. However, the optimal price schemes may or may not be voluntarily sustainable.¹¹ If the optimal prices are not voluntarily sustainable, then the public service may split. With scale economies, this leads larger social costs. To defend this approach while avoiding service splitting, regulators should restrict entry. By doing so, the optimal price schedule may be sustainable, but not voluntarily sustainable. However, it may be difficult to control entry

¹¹ The Weak Invisible Theorem states the conditions under which optimal prices are voluntarily sustainable. See Baumol, Baily and Willig, 1977.

effectively since regulators may easily prevent entry into new markets, but may not stop consumers from providing their own service. Nevertheless, whatever the reason for splitting, the scale economy advantages are lost. The case in which optimal prices are not voluntarily sustainable should be quite common. The reasons are, as discussed in section 4, that optimal prices depend upon demand elasticities and the cost schedule of joint community provision, whereas voluntarily sustainable prices depend upon the cost alternatives of each group of consumers.

In the example, hotels have a lower price elasticity of demand, therefore, the optimal price schedules from a welfare perspective should set hotel prices higher than prices for other consumers. Nevertheless, these price schemes are not sustainable because hotels have an alternative source of water supply: wells. In other words, hotels can block optimal price policy. The Annex shows a numerical example with no sustainable optimal prices.¹²

¹² Although complete information is not available, figures suggest that optimal prices are not sustainable in the Bahamas because hotels can obtain water from wells at a total cost close to their payments when price is set to the average total cost of providing jointly the whole island. The actual price schedule, which charges the hotels over average cost, induces hotels to separate. Most hotels actually do separate.

Another approach is for the regulators to choose the price scheme that maximizes welfare within the set of voluntarily sustainable prices. In this approach, entry may be free because price conditions prevent competitive entry. If revenues from all groups cover total costs, then entry would not improve the current position of any consumer group. In this approach regulators take into account consumer incentives and the communities benefit from the advantages of economies of scale through incentives. In the previous approach the economy of scale benefits the community through regulator prohibitions. This approach requires that the regulators have information on coalitions, and technologies available to each coalition. Such information is difficult to gather. As managers often have more information than regulators on coalitions and technologies, discriminatory price schedules proposed by managers and supervised by regulators may be appropriate for actually carrying out this approach. The regulators check the

optimality properties of the manager's proposal that likely will be sustainable since managers usually wish to avoid separation.

A comparing of the two approaches yields the following conclusions. One, the first approach tops efficiency over voluntary sustainability. Second, the first approach relies on regulator intervention for avoiding service splitting, while the latter relies on consumer incentives. Third, for choosing an approach, regulators should balance efficiency gains against the losses of splitting the service that the first approach entails. Fourth, the service would be easier to split when the coalitions among consumers of a community are feasible because the coalitions make it easy to share common costs. For example, larger consumers (hotels and big industrial consumers) are easy to split because they do not need to join with other consumers to share the costs of a provider different from the regulated monopoly.

7. CONCLUSIONS

This article reaches the following conclusions:

- Schemes with price discrimination and cross subsidies may be suitable from an efficiency standpoint. Even more, price schemes with some prices below average cost and others above (that is, with cross subsidies according to one of the many definitions of cross subsidy prices) are a necessary condition for welfare maximization in public services with increasing returns and no loss constraints.
- Schemes with price discrimination and cross subsidies may not be voluntarily sustainable because a group of consumers may be better off by separating from the public service. The overpriced consumers may force the community service to split and therefore, the overall community would lose the benefits from the increasing return technologies.
- If optimal prices are not compatible with voluntary sustainability, then a choice between sustainable prices and efficient prices has to be made. The appropriate choice will depend upon the likelihood that entry will actually

be prevented, the efficiency losses from service splitting, and the alternatives for service provision.

These conclusions lead to a final observation: centralized price policy, through regulators, is a complex matter because the information required to set the appropriate prices is often not available to regulators. Therefore, even with increasing returns and the no loss restriction, the price policy should rely, to some extent, on the information provided by markets. Market agents, consumers and producers, are better than regulators in gathering the information¹³ required to set price discrimination schedules for profit maximization without losing customers. Regulators may set limits to these prices, but not forbid them. Finally, if entry is free, the markets will signal unsustainable pricing policies to regulators. However, restrictions are sometimes required from private operators. In particular, the concessions of traditional monopolies with large investment requirements demand exclusivity of market entry to make a trade-off. As Friedman, 1962, laments **A**there is unfortunately no good solution for technical monopoly.@

¹³ A necessary condition for gathering the appropriate information is consumption measurement. However, a large meter program may be difficult to implement due not to technical or economic reasons but to the reluctance of large consumers to accept to meter consumption.

ANNEX

OPTIMAL AND VOLUNTARILY SUSTAINABLE PRICE SCHEMES

The following example shows a case in which optimal prices are not voluntarily sustainable. Thus, the Ramsey rule that prices should be lower for high elasticity consumers contradicts the sustainability rule that, in this example, would require prices to be lower for low elasticity consumers.

Lets consider two neighborhood 1 and 2. The cost schedules of providing water are the following:

- Neighborhood 1. $C(X_1) = X_1 + 5$
- Neighborhood 2. $C(X_2) = X_2 + 4$
- Neighborhood 1 and 2. $C(X_1 + X_2) = X_1 + X_2 + 9$

Where X_1 and X_2 stand for the quantity of water used in each neighborhood.

The demand shedules and consumer surplus for neighborhoods 1 and 2 are the following:

- Indirect Demands: $P_1 = 2 - 1/5 X_1$ and $P_2 = 10 - X_2$
- Consumer Surplus: $S(X_1) = 2X_1 - 1/10 X_1^2$ and $S(X_2) = 10X_2 - 1/2 X_2^2$

Where P_1 and P_2 stand for prices in each neighborhood.

Optimal prices are obtaining by solving the following optimization problem:

$$\text{Maximize: } l_1 S(X_1) + l_2 S(X_2) - X_1 - X_2 - 6$$

$$\text{Subject to: } P_1 X_1 + P_2 X_2 - X_1 - X_2 - 6 = 0$$

Where l_1, l_2 are consumer surplus=weights.

First, lets consider the solution for l_1 and l_2 equal to 1. That is, the case in which the welfare of both neighborhoods are equally weighted. A pair (X_1, X_2) solves the above problem if and only if $9 X_1 = 5 X_2$. This equation implies the following relationships between prices:

$$P_1 = 2 - 1/9 X_2 \text{ and } P_2 = 10 - X_2 \text{ which in turn implies that } P_1 = 1/9 P_2 + 8/9.$$

The figures corresponding to the solution of this problem are summarized in table 1:

Table 1

	Optimal prices	Quantities Under optimal prices	Elasticity	Payments under optimal prices	Current costs	Alternative cost
Neighb. 1	1.0755	4.6225	1.1633	4.9715	-	9.6227
Neighb. 2	1.6791	8.3206	0.2018	13.9716	-	12.3209
Total	-	12.9431	-	18.9431	18.9431	21.9256

Notice that the payments of consumers of neighborhood 1 are 4.9715 units and the payments of consumers of neighborhood 2 are 13.9716 units. Payments of neighborhood 1 cover the marginal and variable costs for this neighborhood (i.e., 4.6225 units) and a small part of the common costs. Payments of neighborhood 2 also cover the marginal and variable costs (i.e., 8.3206 units) and a large part of the common costs.

It should be noticed that this solution is in accordance with the elasticity rule of Ramsey prices because the price for neighborhood 1 is lower than the price for neighborhood 2 and the price elasticity of neighborhood 1 is larger than the price elasticity of neighborhood 2. This solution, which that is optimal from a welfare standpoint, is not sustainable because neighborhood 2 would be better off separating and providing service with its own company. The cost of water consumption for neighborhood 2 would be 12.30 units (the new company cost schedule is $C(X_2) = X_2 + 4$). Thus, if the new producer reduces the price for neighborhood 2 to 1.5, the revenues will be enough to cover total cost and produce some profits.

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