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Market-Based Cost Allocation Principles for Postal Services

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The question of how to price postal services poses problems of economic theory and public policy, and it has been the subject of no small amount of controversy. The factors that make this problem difficult are well known. Postal authorities are often required for public policy reasons to charge uniform prices for core letter-mail services that entail some degree of cross-subsidization across classes of core service customers. For example, urban and rural users might pay identical rates despite the higher cost of serving low-density locations. For this reason, postal authorities typically enjoy a statutory monopoly in the provision of core postal services. Usually they are organized either as government departments or as government-sponsored enterprises. In addition, many postal authorities use their common network of offices, processing plants, and transportation assets to provide a wide range of different services, including some that might compete with services offered by private firms.

It is this provision of competitive services by an entity that does not necessarily need to answer to shareholders and that enjoys a statutory monopoly that has created most of the controversy in discussions of appropriate means of postal costing and rate setting. If the provision of core postal services and competitive services within a single entity is characterized by economies of scope (that is, if at least at some levels of output the bundle of services can be produced at a lower cost in a single firm than in separate firms), then the postal authority can potentially provide competitive services in a way that enhances economic efficiency and earns revenues that can be used to lower the rates that it charges to its core services customers. Against this potential

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outcome, however, must be weighed the possibility that an entity organized either as a government department or as a government-sponsored enterprise, and insulated to a degree from competitive pressures for profit maximization and productive efficiency, might squander the potential for efficiency gains and benefits to consumers of core services through the pursuit of other objectives, such as revenue or employment maximization. In particular, policy makers might be concerned that, in pursuit of such objectives, postal authorities could choose to use revenues from monopoly services to subsidize services offered in competition with private entities.

To minimize the potentiality for uneconomic behavior or exploitation of their monopoly authority, many postal authorities operate under some degree of regulatory scrutiny. Postal regulators charged with oversight responsibility might monitor costs, review pricing and service decisions, and establish a framework ensuring efficient production and pricing behavior. To accomplish these tasks, postal regulators need accurate information about the costs associated with individual postal services and a framework by which to detect the presence of cross-subsidy.

In this article, we propose a market-based procedure for assigning costs to groups of postal services. Our proposed procedure is based upon the conceptual experiment of splitting the postal authority into parallel organizations—one charged with the provision of "core" postal services, and the other charged with the provision of "diversification" services. This split recognizes the traditional rationale for the public provision of basic postal services—that is, to provide a system of communication that is universally available at uniform rates to all citizens. Our procedure for assigning costs is then based on the outcome of a hypothetical auction in which the provider of core services accepts bids from other organizations for the right to use its network of facilities to provide additional services. We argue that the amount bidders would be willing to pay in such a hypothetical auction should be included as a cost that should be recovered in the rates charged for these additional services. Following such a procedure would require the postal authority to reflect in its rates for competitive services the full opportunity costs of the assets used to provide these services.

This approach recognizes the potential efficiencies that might be realized by using the postal network to provide a wide array of services. However, we argue that the efficiencies realizable from the postal network properly belong to the core organization it was created to serve. The implication of this stance is that the gains that can be realized from the provision of a wide array of services should properly be used to defray the cost of the core services.

In Part I, we review some of the approaches used to assign costs to various postal services and some of the monopoly and competitive services. In Part II, we develop in detail the conceptual framework underpinning

our auction-based approach to assigning the costs of the postal network to individual services, relating the pricing principles that flow from it to the concepts and principles that have traditionally been used to determine prices for postal services. In Part III, we explore the market outcomes that this approach implies, showing that the opportunity-cost approach leads to an efficient production outcome in a situation in which other break-even pricing rules can lead to excessive and inefficient production of competitive service by the monopoly provider of core services.

I. The Regulatory Problem

The rationale for regulatory oversight of postal authorities emerges directly from the structural features described above. In particular, many postal authorities enjoy some degree of monopoly authority. The possibility of abuse of the market power that flows from that monopoly status provides a rationale for regulation or public oversight, even where the monopoly is nominally in public hands.

In addition to possessing monopoly status, postal authorities confront unique issues relating to cross-subsidies—using revenues raised from one class of users to defray the costs of serving other classes of users. Postal authorities are often required for public policy reasons to build a certain degree of cross-subsidy into their rate structures. To facilitate communication and the conduct of public and private business, postal authorities will often charge geographically uniform rates, despite the existence of substantial differences in the costs of serving different regions or classes of users.[1] Postal authorities might also be encouraged (or required) to carry classes of mail judged to be of special social value at rates that fail to fully cover costs. In addition to these forms of cross-subsidy, which are due to explicit or implicit political mandates, the simultaneous presence of many postal authorities in both monopoly and competitive markets can create possibilities for other forms of subsidy. In particular, there is considerable concern from policy makers that postal authorities might choose to divert excess revenues raised in monopoly markets to support uneconomic forays into competitive markets. For this reason, one of the key goals of postal regulators should be to guard against such behavior.

The fact that postal authorities often operate either as government departments or government-sponsored enterprises has a major effect on the nature of the regulatory problem. Postal management is often appointed

[1] The coexistence of geographically uniform rates and geographically differentiated costs provides one of the key rationales for the statutory monopolies that many postal authorities enjoy. Absent prohibitions against entry, the existence of these geographic cross-subsidies could encourage private entities to "cream skim," selectively offering services to low-cost regions, undercutting the postal authority, and eliminating the ability of the postal service to maintain low rates in high-cost regions.

by public authorities, answerable to public authorities, and charged explicitly with the pursuit of public goals. Lacking private shareholders, they face muted incentives for the more naked forms of exploitation of the market power they possess. For the same reason, however, they might possess similarly muted incentives for pursuit of efficiency and enjoy greater freedom to pursue uneconomic goals such as maximization of revenue or employment. Postal regulators must therefore remain on guard against a different and potentially broader range of economic behaviors.

Postal regulators thus face a variety of complex theoretical and practical issues as they seek to establish a workable regulatory framework for postal decision making. In this complex environment, what should the goals of regulation be? What types of rules and guidelines direct postal authorities toward desired outcomes? How robust are those rules and guidelines in the presence of potentially uneconomic behavior on the part of postal authorities? Can the rule be implemented effectively given the limited information that is often available regarding the nature of the market for postal services, or the structure of the costs of postal service delivery?

II. Review of Proposed Solutions

Economists have wrestled with many of these questions and have proposed a variety of answers.

A. Cross-Subsidy Tests

Commonly used tests for the presence of cross-subsidy rely upon two key economic concepts. The incremental cost of a service or group of services is the additional cost that the postal authority incurs as a result of providing the service or services in question. It is calculated through the conceptual experiment of determining what the postal authority's costs would be if it offered all of its current services except for the service or services in question. The standalone cost of a service or group of services is what it would cost to provide those services, and no others. These costs are calculated through the conceptual experiment of setting up a new organization specializing in the provision of the services in question, and optimized for that purpose. If the revenues generated by a service or group of services fail to cover their incremental costs, this failure is generally regarded as proof that the services in question are being subsidized. Alternatively, if the revenues for these services exceed their standalone costs, this is generally regarded as

proof that revenues from these services are subsidizing other services that are being offered.[2]

These tests provide useful, although limited, guidance to the potential rate setter or postal regulator. Because it seems unreasonable to ask captive consumers of core services to subsidize the provision of competitive services, postal regulators generally seek to ensure that competitive services are priced at least to cover their incremental costs. If the postal authority is to avoid losing competitive services business to existing or potential rivals with similar (or perhaps more favorable) cost structures, it must also price these services at the market price, which, as we will see, is likely to be at or below its standalone costs.[3] But the bounds established by those two guideposts will often be very wide. A large gap between incremental and standalone costs arises whenever the fraction of the postal authority's costs that is accounted for by joint fixed costs that are not easily attributable to any particular service is relatively large, as is often the case in postal operations. The question of where rates should be set in the range between covering incremental costs and covering standalone costs is generally posed as one of how best to cover these common fixed costs.

B. Ramsey Pricing

The literature concerning cost recovery for multiproduct natural monopoly firms has been used to suggest certain approaches to this problem. In particular, Ramsey pricing is an approach from this literature that has attracted considerable attention and controversy.[4] Under Ramsey pricing, a natural monopoly firm meets its break-even profit constraint by marking up its marginal costs for its product lines by amounts such that demand for each product is reduced by an equivalent percentage from the level that would prevail if all of its products had been priced at marginal cost. In the case where cross-price elasticities of demand among products are all zero, this approach implies the familiar rule in which the markup over marginal cost for each product is inversely proportional to the price elasticity of demand for that product. Unless cross-price elasticities are significant, this approach implies that relatively price-inelastically demanded core services should have

[2] Gerald Faulhaber provides the first discussion of the potential importance of both of these tests. *See* Gerald R. Faulhaber, *Cross-Subsidization: Pricing in Public Enterprises*, 65 Am. Econ. Rev. 966 (1975).

[3] In the model we present below, the non-core services produced by the postal authority and private providers are perfect substitutes. In such a model failure, charging above the competitive price will result in the loss of all non-core business. A more realistic model might involve some degree of quality differentiation between public and private providers, with the result that failure to charge a market price could result in the loss of much but not all of the non-core business. We hope to address this case in future work.

[4] William Baumol and David Bradford discuss the optimality properties of Ramsey pricing and provide an intellectual history of Ramsey pricing and related concepts in the economics literature. *See* William J. Baumol & David F. Bradford, *Optimal Departures from Marginal Cost Pricing*, 60 Am. Econ. Rev. 265 (1970).

higher markups over marginal costs, and that competitive services, with their more price-elastic demands, should have relatively lower markups and be priced closer to marginal cost.

Although developed originally for the case of the multiproduct monopoly firm, the Ramsey pricing rule has been applied in other contexts in which it has often become a shorthand for charging "what the market will bear." These cases include multiproduct firms selling differentiated products into competitive markets, as well as multiproduct firms facing a monopoly or near monopoly in some markets, and competition in others. Although Ramsey pricing has been shown, on efficiency grounds, to represent the optimal departure from marginal-cost pricing for multiproduct natural monopolies subject to a break-even constraint, its relevance to postal rate setting has been a matter of some controversy. One problem arises from the fact that the Ramsey rule applies to markups over marginal costs rather than incremental costs. The two concepts can differ to the extent that there are product-specific fixed costs. The Ramsey rule can then lead to prices that fail to cover incremental costs, resulting in cross subsidies.[5] Yet another objection is that although Ramsey pricing might, in the natural monopoly case, produce prices that are economically efficient, those prices might have undesirable distributional consequences. In the United States, the importance of factoring considerations other than pure economic efficiency into rate setting was historically invoked by the U.S. postal regulator as a reason to reject the U.S. Postal Service's advocacy of Ramsey pricing principles as a guide for rate setting.[6]

Additional problems arise because regulators are unlikely to have enough information to implement Ramsey pricing in a way that actually promotes efficiency rather than furthering other objectives on the part of the regulated entity. One such problem arises from the difficulty of measuring the relevant price elasticities, which are those that would apply if marginal cost pricing were in place for all product lines. Such prices (and resulting quantities) are likely to be well outside the range of observed prices and quantities, which result from the use of prices in excess of marginal cost. The simple Ramsey pricing formula—the so-called inverse-elasticity rule—has the mathematical effect of dramatically amplifying the effects of any uncertainties in the estimated elasticity value when that value is small (in absolute value); it is precisely such situations in which Ramsey pricing yields the largest markups

[5] The U.S. Postal Rate Commission has noted this point in Postal Rate and Fee Changes, Opinion and Recommended Decision, vol. 1, Dkt. No. R97-1, at 234 ¶ 4020 (Postal Rate Commission 1998) [hereinafter 1998 PRC Opinion and Recommended Decision].

[6] The PRC reiterated this position in its 2001 decision in rate case R2000-1: "Economic efficiency is neither the exclusive nor even the paramount ratemaking objective under the [Postal Reorganization] Act. Hence, the premise for using Ramsey pricing is dubious at best." Postal Rate and Fee Changes, Opinion and Recommended Decision, vol. 1, Dkt. No. R2000-1, at 210 ¶ 4042 (Postal Rate Commission 2001).

over marginal costs. In addition, the efficiency characteristics of Ramsey pricing hold only when the regulated firm is producing at efficient marginal costs. Regulators, however, are likely to encounter difficulty in assessing whether the firm is producing efficiently. Bruce Allen has argued that in the absence of any incentives or guarantees that they are minimizing costs, firms that are "allowed" to practice Ramsey pricing will instead pursue strategies that maximize net revenues, output, or some other corporate objective.[7] In the United States, the Postal Rate Commission has noted that this is a particularly serious issue in the case of a firm that faces competition in some of its product lines while maintaining a legal monopoly over others. Such a firm may choose to adopt an operating plan that entails higher than efficient marginal costs for products where it faces no competition; such costs can be used to justify markups to fund entry into the market for a new product where the firm may not be the most efficient producer.[8]

Finally, it is important to note that Ramsey pricing was originally developed in the context of a multiproduct producer that enjoyed a monopoly in all of its individual product markets and in all cases faced the market demand curve. While Ramsey pricing, even apart from all the difficulties discussed above, might be an appropriate pricing approach in theory for pure multiproduct natural monopolies, it is not clear that the approach is appropriate to the case of postal services. At observed market prices, a postal authority might face a highly price-elastic demand for competitive services, not because overall market demand is price sensitive, but rather because of the presence of alternative private providers to whom customers can readily switch with little or no loss in consumer welfare. These non-core services can and are being efficiently provided by competitive providers. Ronald Braeutigam has argued, and we agree, that it is far from obvious that in such circumstances regulators should reward a postal authority for consumer surplus associated with competitive product sales that would have been made at the same prices even if the postal authority had never entered competitive markets in the first place.[9]

C. Maximum Competitive Contribution

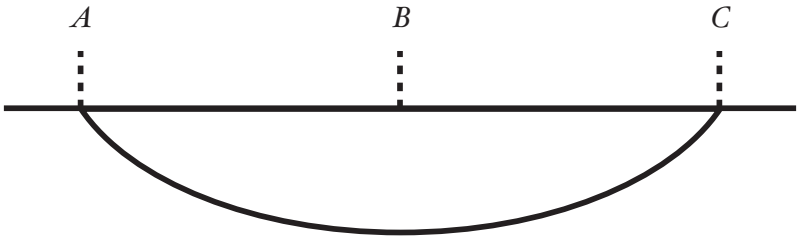
This argument leads to a regulatory approach in which the monopoly provider of core services should price any competitive services it offers so as to maximize the consumer surplus that can be provided to its captive core customers. This approach is also established in the literature and has been termed the maximum competitive contribution methodology (MCCM). The idea is

[7] W. Bruce Allen, *Ramsey Pricing in the Transportation Industries*, 3 Int'l J. Transp. Econ. 293 (1986).
[8] 1998 PRC Opinion and Recommended Decision, *supra* note 5, at 244–45 ¶¶ 4045–49.
[9] Ronald R. Braeutigam, *A Regulatory Bargain for Diversified Enterprises*, 11 Int'l J. Indus. Org. 1 (1993).

also well established in the economics literature, as it provides an answer to one of the oldest problems in regulatory economics—that of pricing competitive and monopoly railroad service.

Consider the following example, drawn from Alfred Kahn,[10] of a railroad that operates between points *A* and *C* via point *B*. Because marginal costs are constant over the relevant range of output and fixed costs are large, the railroad has characteristics of a natural monopoly. Points *A* and *C* are connected by a navigable river that supports barge traffic, while *B* is an inland point that shippers can reach only by rail. The railroad thus has an effective monopoly on freight carriage for the short hauls between *A* and *B* and between *C* and *B*, but faces competition from water carriers for the longer haul between points *A* and *C*.

Figure 1



Suppose that the railroad is regulated and subject to a break-even constraint. In this situation, what price should the regulator direct the railroad to charge for its competitive service? The answer is that, provided the resulting price at least covers incremental costs of the service, the railroad should charge those wishing to ship goods between *A* and *C* the highest possible price that will keep the traffic moving—a price equal to or just below the cost of the competitive water carriers.[11] Such a price maximizes the contribution made by the competitive service toward offsetting the fixed costs of operating service along the line, thereby reducing to the greatest possible extent the contribution required of captive shippers to and from *B* toward meeting these costs if the railroad is to meet a break-even constraint.

Traditionally, the MCCM approach has been developed within a contribution analysis framework analogous to that in which the Ramsey pricing result is derived.[12] From this point of view, the calculation of an MCCM price

[10] 1 Alfred E. Kahn, The Economics of Regulation: Principles and Institutions (John Wiley & Sons 1970).

[11] To induce shippers to switch, the railroad must charge a price below that charged by the barge operator. To achieve a market equilibrium, however, the railroad must charge a price below the barge operator's cost. Otherwise, the effort by the railroad to undercut the price of the barge operator might simply trigger a matching price cut by the barge operator.

[12] *See, e.g.*, Allen, *supra* note 7.

requires information about marginal costs and price elasticities of demand for non-core services. Meeting these information requirements can prove to be a daunting task, especially when the number of goods that must be considered increases and the complexity of the production processes grows. Thus, despite the MCCM's conceptual appeal, its practical utility in the postal context remains largely untested.

III. The Auction Alternative

As an alternative to the traditional arguments for the MCCM, we propose an auction-based approach that produces essentially the same results. Our approach is grounded in the notion that the assets used by a postal authority to provide core services have an opportunity cost that should be covered by rates charged for competitive services. Conceptually, the way to recognize these opportunity costs is to mimic the outcome of a hypothetical auction in which outside organizations are allowed to bid for the right to use the postal authority's facilities to provide a bundle of competitive, non-core services.

The revenues that the postal authority could have realized from the winning bid or bids in this hypothetical auction represent the opportunity cost of the postal authority's decision to utilize these assets to provide these additional services itself. That cost is properly considered as part of the incremental cost of the postal authority's providing those services. Like any other component of incremental cost, that opportunity cost should be recovered from the revenues generated by sales of the additional service. Hence, such opportunity cost should be reflected in the rates charged for non-core competitive services. Rates for competitive services that fail to cover opportunity costs represent a cross-subsidy from core customers to competitive services.

We recognize that the design of such an auction would itself be a complex task, and we freely admit that we will not explore such complexities in this article. For present purposes we assume that private firms submit two-part bids separately covering their fixed and variable costs. In effect, then, we are assuming that the marginal-cost schedule of private bidders is known to the regulatory authority. This assumption allows us to impose coverage of opportunity costs as a constraint that continues to hold even if coverage of that constraint forces the postal authority to a different level of output.

In such a hypothetical auction, each bidder should be willing to bid an amount up to the total costs, fixed and variable, that it would expect to avoid by not providing the services itself. In the railroad example discussed above, for example, a hypothetical winning bidder for the right to serve traffic between *A* and *C* would be willing to bid an amount just less than the cost of providing the same level of service by barge. This observation leads to the

conclusion that a postal authority's competitive services should cover the full costs that an efficient private entity or entities would incur in providing the services on a standalone basis.

IV. Comparison of the Auction-Based Outcome to the Outcomes Under Other Rules

In the railroad example discussed above, the MCCM and auction approaches yield equivalent, and economically efficient, outcomes. In this part, we present a highly simplified model of postal service provision that generates a similar conclusion about the efficiency of the auction approach. In addition, the model allows us to compare economically efficient outcomes to those produced by certain other regulatory regimes when the postal authority is pursuing a goal of revenue maximization.

A. Structure of the Model

In our model, the postal authority provides two services: monopoly or core services (designated by the subscript *c*) and competitive, non-core services (designated by the subscript *n*). For simplicity, we assume that each of the services can be represented as a single, homogeneous good. These services are produced using productive technology that entails both fixed and variable costs. We initially assume that public and private providers use the same technology with the same efficiency, such that at any given level of output public and private entities have the same costs. There are economies of scope associated with the provision of both services by the same entity. The postal authority enjoys a statutory monopoly over the provision of core services, but entry into the non-core market is open to all. We assume that there is vigorous competition in the non-core market, with the result that there are multiple providers of non-core services who charge prices that just cover their costs. The postal authority is a price taker in the non-core market. Let:

X_c equal the postal authority's output of core services,

X_n equal the postal authority's output of non-core services, and

P_n equal the competitively determined price for non-core services.

The cost function for the postal authority is given by:

$$c = F + f_c + g_c(X_c) + f_n + g_n(X_n), \tag{1}$$

where:

f_c is the fixed cost associated with the provision of core services, and

f_n is the fixed cost associated with the provision of non-core services.

F is the nonspecific fixed cost that must be incurred in every period in order to either type of service individually or both jointly. Economies of scope arise because of the fact that a firm producing both types of services incurs fixed cost F once per period rather than twice.

The functions g_c and g_n give the variable costs associated with the production of core and non-core services respectively. We assume that the provision of each service is characterized by diseconomies of scale,[13] such that:

$$g_c' = \frac{\partial C}{\partial X_c} > 0$$

$$g_c'' = \frac{\partial^2 C}{\partial X_c^2} > 0$$

$$g_n' = \frac{\partial C}{\partial X_n} > 0$$

$$g_n'' = \frac{\partial^2 C}{\partial X_n^2} > 0.$$

Our assumptions regarding competition in the non-core market imply that:

$$p_n X_n^* = F + f_n + g_n(X_n^*), \tag{2}$$

where X_n^* is the volume of non-core services produced by each private firm in equilibrium.

We assume that there is a simple linear demand curve for core services:

$$p_c = \gamma_0 - \gamma_1 X_c, \tag{3}$$

where p_c is the price of core services.

In all that follows we assume that the postal authority operates under a break-even constraint, generating enough revenue in each period to fully cover its costs, but is prohibited by the regulatory authority from raising any more than that amount.

[13] The assumption of increasing marginal costs is necessary for the existence of a competitive equilibrium in the market for non-core services. It is not strictly required for the core service, which could, in principle, be a natural monopoly with constant or falling marginal costs.

1. Scenario 1: Welfare Maximization

We first consider a regime in which the goal of the regulator is simply to maximize overall societal welfare. To flesh out this scenario, we must first consider how to define societal welfare in this context. The answer to this question flows from the discussion above.

Under our assumptions, the demand for non-core services would be fully met at the same price, regardless of the volume of such services provided by the postal authority or even if the postal authority provided no such services at all. In our model, the postal authority displaces one private provider, and, if it were to withdraw from the market, a new entrant would take its place. Thus, the postal authority should be given no credit for consumer surplus generated in the competitive market. There is, however, a cost saving associated with the provision of such services by the postal authority. In our model it is equal to *F*—the nonspecific fixed costs that must be incurred to produce any volume of either service. A welfare-maximizing regulator would thus be interested in ensuring the ability of the postal authority to participate in the non-core market in order to ensure realization of these savings. However, given the fact of participation, the magnitude of the cost savings is independent of the volume of non-core services sold.

The final contribution to overall welfare is the consumer surplus associated with the provision of core services. This quantity is equal to the area under the demand curve above the market-clearing price. For the demand curve given in equation (3), this consumer surplus is given by $\gamma_1 X_c^2 / 2$.

Maximization of welfare subject to the constraint that revenues fully cover costs then leads to the following constrained maximization problem:

$$\begin{aligned} Max\ L = {} & \frac{\gamma_1 X_c^2}{2} + F - \lambda(F + f_c + g_c(X_c) \\ & + f_n + g_n(X_n) - \gamma_0 X_c + \gamma_1 X_c^2 - p_n X_n), \end{aligned} \tag{4}$$

with respect to X_c, X_n, and λ.

The first-order conditions for this problem are given by:

$$\frac{\partial L}{\partial X_c} = \gamma_1 X_c - \lambda(g_c'(X_c) - \gamma_0 + 2\gamma_1 X_c) = 0 \tag{5}$$

$$\frac{\partial L}{\partial X_n} = g_n'(X_n) - p_n = 0 \tag{6}$$

$$\frac{\partial L}{\partial \lambda} = F + f_c + g_c(X_c) + f_n + g_n(X_n) - \gamma_0 X_c + \gamma_1 X_c^2 - p_n X_n = 0. \tag{7}$$

Equation (6) contains the familiar result that the level of output of non-core services should be set such that price is equal to marginal cost. This is precisely the behavior that we would expect from private producers. As equation (2) shows, such producers will operate at the point where marginal cost equals average total cost, which is where revenues will just cover their full costs.

Because we are assuming that private producers and the postal authority use the same technology with equal efficiency, $X_n = X_n^*$, the welfare-maximizing solution is for the postal authority to produce a volume of non-core services such that revenues from those services fully cover the incremental costs associated with the production of non-core services *and* all of the joint costs.

2. *Scenario 2: Revenue Maximization Subject to an Overall Break-Even Constraint*

The welfare-maximizing outcome stands in sharp contrast to that which results when the postal authority is freed from regulatory constraints and is allowed to pursue non-economic objectives. To illustrate this fact, we consider what happens when the postal authority pursues a goal of revenue maximization. We assume that no external funds are available to cover deficits, and hence that the constraint that revenues must equal costs is binding. This objective then yields the following maximization problem:

$$\begin{aligned} Max\ L = {} & p_n X_n + \gamma_0 X_c - \gamma_1 X_c^2 - \lambda(F + f_c + g_c(X_c) \\ & + f_n + g_n(X_n) - \gamma_0 X_c + \gamma_1 X_c^2 - p_n X_n), \end{aligned} \tag{8}$$

with respect to X_c, X_n, and λ.

The first-order conditions in this case are:

$$\frac{\partial L}{\partial X_c} = \gamma_0 - 2\gamma_1 X_c - \lambda(g_c'(X_n) - \gamma_0 + 2\gamma_1 X_c) = 0 \tag{9}$$

$$\frac{\partial L}{\partial X_n} = p_n - \lambda(g_n'(X_n) - p_n) = 0 \tag{10}$$

$$\frac{\partial L}{\partial \lambda} = F + f_c + g_c(X_c) + f_n + g_n(X_n) - \gamma_0 X_c + \gamma_1 X_c^2 - p_n X_n. \tag{11}$$

Under this regime, welfare declines, but the effect of moving from welfare maximization to revenue maximization on the output of core and non-core services is ambiguous. To demonstrate this result, we note that:

$$\lambda = \frac{\gamma_0 - 2\gamma_1 X_c}{g_c'(X_c) - \gamma_0 + 2\gamma_1 X_c} = \frac{p_n}{g_n'(X_n) - p_n}. \tag{12}$$

The revenue-maximizing postal authority that is subject to a break-even constraint will choose output levels such that the ratios of marginal revenue to incremental contribution margin are equal for the two outputs. Without knowing the shapes of the demand and marginal cost curves, one cannot determine what this outcome will look like. If, at the welfare-maximizing point, demand for core services is price inelastic and marginal cost for those services is steeply rising, it could be the case that the postal authority could expand revenue by reducing the output of core services and increasing output of non-core services. Conversely, if the marginal cost curve for core services is relatively flat while that for non-core services is steeply rising, the opposite result might hold.

One important implication of this model is that it is possible even under a non-cross-subsidy constraint for all of the potential efficiency gains made possible by the presence of economies of scope to be dissipated in inefficient production by the postal authority. The intuition behind this result is straightforward. A profit-maximizing monopolist will equate marginal revenue and marginal cost, earning a positive economic profit. A revenue-maximizing monopolist, like the one that we have posited here, will expand output beyond that point until profit disappears. In the process, such a monopolist will drive marginal cost above marginal revenue (although not necessarily above price), such that there will be a negative contribution margin on incremental sales. In our model, the postal authority, faced with a break-even constraint, will

equalize opportunities for trading off revenue against contribution margins in the two markets. The result can be a situation in which incremental contributions in both markets are negative. On the non-core side, this situation implies pricing below marginal cost. Because the price of non-core services is fixed by competition, this implies that the postal authority's output of such services will be inefficiently large.

3. Scenario 3: Coverage of Opportunity Costs

Finally, we present the outcome generated by our proposal that revenues from non-core services should be set at a level that is sufficient to cover what a private firm would be willing to pay to buy access to the postal authority's network. That amount would be equal to what the private firm could avoid in cost, which, under our assumptions, is equal exactly to the standalone cost for non-core services. The imposition of this constraint plus a break-even constraint on a problem with only two decision variables leaves only one feasible output solution for the postal authority. That solution requires the postal authority to equate price and marginal cost in the non-core market. As we saw above, doing so results in a situation in which non-core revenues exactly cover standalone costs. For core services, output is set such that core service revenues just cover core service incremental costs. Together, these two solutions yield the welfare-maximizing solution exactly.

Thus far, we have assumed that the postal authority and private providers operate with equal efficiency. However, it is possible that uneconomic behavior on the part of the postal authority takes the form of inefficient production. We next consider how the auction-based pricing rule might operate in this context.

We assume initially that the superior efficiency on the part of private providers takes the form of lower fixed costs, such that for private providers:

$$C = F^* + g_n(X_n^*), \tag{13}$$

where:

$$F^* < F + f_n. \tag{14}$$

Competition in the private sector will force producers there to a solution in which:

$$p_n = g_n'(X_n^*) = \frac{F^* + g_n(X_n^*)}{X_n^*}. \tag{15}$$

Imposition then of a regulatory constraint forcing the postal authority to cover opportunity costs from non-core revenues will once again force the authority to a solution in which non-core price is set equal to its marginal

cost, and welfare is once again maximized. The solution in this case harkens back to that depicted earlier in the railroad example. The postal authority charges just enough to remain in the market, and thereby realizes the cost savings made possible by the presence of economies of scope.[14]

Conclusion

In this article, we have advocated the use of a market-based measure as the proper conceptual framework to be used to allocate postal authority costs to services that it provides in competition with private providers. The measure we propose is to mimic the outcome of a hypothetical auction in which private providers bid on the right to use postal authority facilities to provide competitive services. In its pricing of competitive services, the postal authority should be required to meet an opportunity-cost test based on the outcome of this hypothetical auction: failure to earn enough on non-core services to recover the proceeds of this hypothetical auction should be viewed as providing subsidy to non-core services.

The auction mechanism represents an opportunity-cost framework for implementing an approach to pricing that is very similar to the MCCM approach previously advocated in the literature. Like advocates of the MCCM approach, we believe that the benefits that any scope economies the postal authority can earn by using its assets to provide services that compete with private providers belong to the captive, core service customers that the authority was put in place to serve.

We have shown, however, that the auction approach can also be advocated on efficiency grounds. One important implication of our model is that, under rather simple conditions, a requirement that the postal authority merely cover the incremental costs of non-core services can yield an outcome in which the marginal cost to the postal authority of providing these services exceeds their price. A requirement that the postal authority cover the full opportunity cost of providing such services thus can eliminate the ability of a revenue-maximizing postal authority to squander any benefits derived from realizing economies of scope on excessive and inefficient production of competitive services.

As a practical matter, we recognize that, for regulators, implementing the auction approach would not be entirely straightforward, and we have not addressed, for example, issues of auction design or other complexities in this article. Nor have we dealt seriously with the fact that regulators are likely as a practical matter to have access only to limited information about the

[14] The problem becomes more complicated if the superior efficiency on the part of the private sector takes the form of marginal costs that are lower than those of the postal authority. We hope to examine this case more closely in future work.

details of private-firm costs. Even at a conceptual level, however, the auction approach suggests some insights for postal regulators. Our principal insight is that regulators need to pay some attention to benchmarking postal authority prices for non-core services against the costs that an efficient, standalone competitive provider of such services would incur in providing those services. If the postal authority is pricing below the likely costs of such a provider, then its pricing ought to be viewed as suspiciously low, even if it nominally passes the usual cross-subsidy test of covering incremental costs.

This article represents our initial contribution to developing the market-based approach to postal rate setting. Potentially useful extensions of our work include more extensive consideration of the information requirements needed to implement the auction approach and extensions of our illustrative model to cases in which non-core products are differentiated rather than homogeneous.