Efficient Entry, Monopoly, and the Universal Service Obligation in Postal Service

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Abstract
This paper analyzes the nature of and justification for the Universal Service Obligation (USO) and its relationship to the Reserved Area for Postal Service. This is motivated by problems of funding the USO in the face of increasing competition in the postal sector. After reviewing various approaches to defining and funding the USO, we develop a model to consider the optimal scope of both the Reserved Area and the USO. The model assumes an incumbent postal provider and potential entrants. The incumbent is guaranteed a monopoly franchise for services in its Reserved Area \( R \) and offers services in a possibly larger set of services \( U \) at uniform prices. All services not in \( R \) face competition from entrants. We characterize the welfare-optimal scope of \( R \) and \( U \) subject to a breakeven constraint for the incumbent. Implications for USO policy are discussed in light of the results of the analysis.

1. Background
Two primary attributes of traditional postal service are ubiquity of service and uniform pricing. It costs a mailer the same to post a letter for delivery in his home town as it does for delivery in some town at the other end of the country. Similarly, the mailer pays the same whether his letter is addressed to an electric utility that receives thousands of letters a day or whether it is addressed to his aunt living on some outlying farm. Although the costs of a Post Office (PO) are very different in each of these cases, the mailer still faces the same price. This requirement of ubiquity of delivery\(^2\) combined with the uniformity of price, regardless
of costs, are the basic ingredients constituting the universal service obligation (USO).

The traditional approach to the USO has been to provide the PO with a legal monopoly. Without such a prohibition on entry, the USO would result in entry making it impossible for a PO to meet its USO. On the low cost routes, where it is making large surpluses, rivals will enter depleting the surpluses it is using to cover the losses in its high cost areas. This notion of a USO and the resultant requirement to secure the PO from entry has been generally accepted for around a century and a half, following the success of the Penny Post after its founding in 1840. Recently, however, this notion has come to be questioned for a number of reasons, including the general trend toward promoting competition in all network industries. Thus, over the last ten years or so, partly as a result of technological change, the guaranteed monopolies of network industries everywhere have been questioned, for example, in gas, electricity, and telecommunications, and public policy has focused on enabling competition.

Similar forces are at work in postal service, and here too the issue is how to design policies to enable competition with all its resultant gains and yet retain almost all the benefits traditionally expected from postal service, including the continuing existence of a USO. One approach to this problem has been that adopted in Sweden, Finland, and New Zealand, namely the abolition of monopoly protection and the apparent opening of postal markets to all comers. This "liberalization" approach is, however, difficult to maintain alongside a meaningful USO, at least in most major economies. Without some monopoly protection, the USO may become increasingly untenable. In addition, without a clear monopoly limit it is difficult to define when conduct on the part of the incumbent PO is anti-competitive. For European POs, abolishing the monopoly is particularly problematical since if the statutory monopoly is lifted then EU competition rules (Articles 85-6 of the Treaty of Rome), aimed at reducing dominance, could have a serious impact on a PO’s ability to meet its USO, and might impair the Members States’s ability to determine its USO according to domestic circumstances. The recent case of Sweden Post and Citymail is compelling. Sweden Post cut its prices for bulk mail in Stockholm and only Stockholm when faced with competition in Stockholm. Its actions prompted a suit by Citymail. The problem is that Sweden Post was faced with a USO and no defined monopoly. In this case what was its recourse? Should it just let a rival take its profitable business and be left with an increasing amount of high cost business? Absent a monopoly limit, there is no bright-line rule for a PO to employ when faced with such entry.

Faced with these somewhat conflicting developments, the current concern in postal service is that entry and substitution for postal service will make the USO increasingly untenable. As it is unrealistic to assume that POs will be relieved of their USO, we are not arguing for a complete liberalization of entry into the postal business but for a much more carefully designed USO and monopoly. Our aim is to promote efficiency in the postal

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3 Finland has a licensing system. However, the first license to an entrant has yet to be granted since the advent of liberalization in 1995. For a description of the USO and competition in New Zealand, see Allen (1997).
4 Leskien and Palmgren (1997) provides an analysis of this and other postal cases.
5 Nor are we arguing for a universal service fund, which is frequently proposed as a means of funding the USO (for example, Stumpf (1997)). Industry subsidies are not exactly renowned for their ability to promote efficiency, passenger railroads being an obvious example. Moreover, we think that current
sector. Thus, we are concerned not about competitive entry per se, but with inefficient entry that will damage the ability of the POs to provide a foundation for a more competitive postal sector, while assuring the continuing existence of a USO. This paper develops a framework for evaluating the optimal USO and the implied monopoly or “Reserved Area.” There is currently no solid economic foundation for determining the nature and extent of the Reserved Area beyond a sense that it should be reduced. Rather typical of the current approach is a bill before the U.S. House of Representative (H.R. 22 entitled The Postal Reform Act of 1997) proposing major reform of the U.S. Postal Service. The bill proposes to reduce the monopoly so that only items with postage of less than $2.00 are protected by the monopoly.

While the issue of efficient entry has been addressed in a number of papers over the years, there is a need to focus this general literature on the specific attributes of postal service. The central question addressed is thus: under what conditions should entry be permitted where an incumbent monopoly, faced with a USO, has an exclusive franchise? Entry has the potential to improve both static and dynamic efficiency in that service or cost innovations occur when entrants produce a given product or service, or some elements thereof, more economically or with better service quality attributes than the incumbent. By contrast, under a USO, entry may not provide any of these promised efficiency gains. Indeed, where the entrant has higher costs than the incumbent there are clear efficiency losses resulting from the increased costs. Even where an entrant has lower costs than the incumbent the revenue of the incumbent is eroded and the viability of the USO is threatened. This may be especially true if, as in postal services, there are significant cost differences across the service territory and uniform pricing is used. The necessary efficiency balance therefore involves a tradeoff between the efficiency benefits of competitive entry and the economic costs of cream-skimming which the USO, uniform pricing, and heterogeneous costs enable. Achieving the proper balance here requires a mixture of pricing approaches, entry restrictions, and possible re-design of the USO to decrease cost heterogeneity.

In this paper, we argue for a broader definition of the USO. Rather than begin, as in the traditional approach to the USO, with a notion that the USO applies only to end-to-end services and applies only to uniform pricing, we argue that quality attributes are also central to the definition of the USO and that both wholesale and retail services should be considered in determining the scope of the USO and the associated Reserved Area. For efficiency, both USO and Reserved Area should be determined simultaneously to balance the benefits of increased uniformity and ubiquity against the costs of a larger Reserved Area. In practice, however, this may take place in two stages. First, the USO is defined and then a Reserved Area to support this USO is determined. As we discuss below, the efficiency of the resulting USO and Reserved Area can be evaluated through various welfare and cost measures. These capture the fact that “universality” entails both costs and benefits. Universality of service decreases transactions costs for consumers and POs and increases (beneficial) network

attitudes on government spending make the introduction of such subsidies effectively infeasible at this time. In addition, it is not clear to us that such alternative institutional arrangements for ensuring the USO, for example, Rawnsley and Lazar (1997), are likely to be more efficient than the traditional approach. A comparative institutional analysis would be required to throw light on this issue. While we do not provide this here, our approach to the USO is grounded in transactions costs analysis and could provide the foundation for such a comparative institutional assessment.

In the case of Citymail, it could be argued that Citymail provided service innovation, such as “day-certain” delivery. However, Citymail delivered only on two days a week.
externalities (as in Economides (1996)). However, uniformity in price gives rise to significant cross subsidies benefitting largely rural areas. If the welfare gains are protected through a Reserved Area for a monopoly franchise, the benefits of universality can be captured by the same incumbent provider that bears the liabilities. Absent this protection, the usual difficulties of cream skimming arise through heterogeneity of cost and quality attributes across market segments. Just where to draw the line that balances the costs and benefits of universality against the foregone benefits of competitive entry is the key question associated with the definition of the Reserved Area and the USO.

The purpose of this paper is to provide a better understanding of the nature of and justification for the USO and its relationship to the Reserved Area. In the next section, we analyze in more detail the nature of the USO and the tradeoffs in determining its scope and that of the supporting Reserved Area which are implied by economic efficiency. In section 3, we develop a model to characterize jointly the optimal scope of both the Reserved Area and the USO. In section 4, we develop some of the policy implications of these results. Section 5 is by way of conclusion.

2. On Defining the USO under Competitive Entry

The question of the nature and extent of the USO is particularly important today given the increased impact of competition on postal and delivery services. Traditionally, the USO has been seen as the requirement to offer standard service at uniform and affordable rates, often coupled with various constraints on the quality of service. The emphasis in the traditional definition of the USO is on the level of cross-subsidy from low-cost routes to high-cost routes implied by uniform pricing if the incumbent postal service provider is to break even. With the advent of competition, both from other postal-type providers as well as from electronic substitutes, maintaining the USO becomes increasingly difficult as cross-subsidies and service quality standards are put under pressure by competitors who can potentially target specific customer segments with customized service offerings. These same trends suggest generalizing the traditional concept of USO to address better the implicit tradeoffs between the extent of the USO, the supporting Reserved Area, and economic efficiency.

For our purposes, we define the USO as a (legal or statutory) requirement on the incumbent PO to provide ubiquitous service at a uniform price, usually in return for certain guarantees or some protection of that provider’s franchise to operate, and satisfying restrictions on:

- The extent of USO-services offered by the PO;
- The quality of USO-services offered by the PO.

Concerning extent, the most common restriction is uniform pricing applied to all non-express letter mail. Given this restriction, the key policy question is how to fund this USO.

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7 Some countries require deliveries six days a week, e.g., United Kingdom, United States, France, and Germany, while others, e.g., Sweden and Finland are required to deliver only five days a week. In the United Kingdom, the P.O. is required to make two deliveries on week days in most urban areas.

8 Thus, the USO could be considered as prescriptions on services which take one of four forms: ubiquity alone; ubiquity with uniform price at no quality restrictions; ubiquity with uniform quality restrictions but no uniform price restrictions; and ubiquity with uniform price and some quality restrictions. We argue that only the last presents any significant problems for analysis, as the ability to provide a reduced quality in the higher cost areas is clearly important for POs. See Crew and Kleindorfer (1992) and Owen and Willig (1983).
In Cremer et al. (1997), for example, this question is analyzed by considering the welfare consequences resulting from the relative (in)efficiency of using the incumbent postal provider to cross-subsidize high-cost routes—with or without additional subsidies from general tax revenues (i.e., a USO Fund)—rather than allowing price differentiation between high-cost and low-cost routes. The basic idea underlying this kind of analysis has been understood from the early days of postal service, for example, Hill (1837) and Coase (1947).

Our approach differs from these contributions in that we adopt a “second-best” approach, which considers the relative efficiency resulting from alternative definitions of the USO. We regard the USO as fundamental to the very nature of postal service. It exists not just because the government has a naive belief in the importance of subsidizing outlying areas. The benefits arise from the provision of ubiquitous service at a uniform price. There are transactions cost economies, in both production and consumption, from uniform pricing. Government’s interest in the USO might be driven by efficiency in promoting these benefits rather than the traditional notion of cross subsidy. There are also arguably significant network externalities associated with the ubiquity of basic postal service and ubiquity is likely to be reduced in the absence of a USO. In addition, the USO has the advantage of providing some rough-and-ready protection against monopoly exploitation to consumers in high costs areas. The critical issue is what should be the nature and extent of the USO. This is the issue we address in this paper. We explore below the implications of modifications in the traditional broad scope of the uniform pricing restriction to allow greater benefits of competition by limiting the services to which uniform pricing applies. For example, the uniform pricing restriction of the USO might be redefined to apply only to single-piece First Class mail, excluding explicitly bulk mailings. In addition, we consider the possibilities of extending the well-established approach of providing a somewhat lower level of service to the outlying areas.

As noted, the incumbent PO accepts the responsibility of meeting its USO in return for certain guarantees and protections, usually embodied in a Reserved Area, the area of service in which the PO is guaranteed a monopoly. Thus, establishing a USO policy involves designing an appropriate relationship between the extent of the USO and the extent of the Reserved Area. The greater the USO, the greater the monopoly (i.e., Reserved Area) required

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9 We exclude parcels from this analysis, although in some countries there remains a USO for parcels as well. Note that, in many countries, including the United States, only the ubiquity aspect of the USO applies to parcel post. This means that prices for parcels can vary not just by weight but also by route, so that the problems of maintaining the USO are significantly less pronounced for parcels than for letter mail, except in the case of service to very high cost areas like Alaska, where the price is higher but may still be well below cost.

10 On the production side, significant economies result in mail processing and in counter operations when price depends only on weight rather than on weight and location. Similarly, the cost of production and distribution of postage stamps is significantly reduced through having (a small number of) prices vary by weight only. On the consumption side, for normal letters and advertising mail, uniform pricing saves considerable uncertainty and time in determining the appropriate postage required. Such transactions costs, while still significant, are likely to decrease as automation of metered mail increases. Of course, for high-value items, such as express mail, these arguments have less force and prices can and do vary by service attributes (time of delivery), weight, location, and size. It should also be noted that most express mail is individually priced and billed by the courier, so that the customer is not burdened with these transactions costs. For a related discussion of transactions costs in postal services arising from uniform pricing, see Cemadini (1995).
to finance it. Developing an economically efficient policy for the USO and Reserved Area involves striking the right balance between the efficiency losses associated with monopoly, the transactions cost reductions from uniformity, and potential scale and scope economies in certain parts of the postal value chain. Transactions cost reductions arising from uniform pricing may be a significant benefit in postal service. This contrasts with telecommunications and courier service. The major difference arises from the billing arrangements. The mailer is obliged to prepay the correct postage before the post office will deliver. The post office has a duty to monitor the postage affixed and provide a means of collecting any additional postage. Where there are errors, the cost to the post office is very high relative to the value of the stamp. From the consumer’s point of view, the costs of getting mail returned are also very high. Under the system of uniform pricing, he gets a low-price service which requires minimum hassle in terms of affixing the correct postage. Contrast this with courier service. Here it may make sense for the consumer to look up or inquire about the price because of the relatively high price of courier service. In addition, if the consumer obtains an incorrect estimate of the price, he and the courier would incur no additional transactions cost other than perhaps mild surprise for the consumer. Similarly with local telephone service, the consumer is billed by his telephone company every month, after the fact, and the prices are usually not even posted. Again, surprise on the part of the consumer would normally be the only transactions cost involved.

Our approach differs from other contributions in that we are concerned with the effects of entry on the USO. Our approach implies some monopoly being guaranteed to the PO. We are concerned with the tradeoffs between the extent of the monopoly and the extent of the USO. The problem is to frame USO in such a way that efficiency, competition and commercial operation on the part of the PO are encouraged. Recent contributions to the USO policy debate have been more restrictive in scope, concerned primarily with the efficiency losses associated with uniform pricing by the incumbent PO. These losses are usually referred to as the “Cost of the USO.” For example, Eisebast and Stumpf (1996) examine the nature and extent of the costs created for POs by the USO and propose a mechanism, a universal service fund, to finance the USO. Dobbs-Golay (1996), on the other hand, provide a conceptual basis for measuring the USO cost, including its profitability consequences for a PO, the costs of funding and the “welfare” or efficiency costs to the economy of the USO. Various other developments and estimates of the cost of the USO are analyzed in Crew and Kleindorfer (1997).

In addition to these efficiency losses from uniform pricing (and quality), other potential efficiency effects from the USO, and supporting Reserved Area, include the following:

- The extent to which entrants are able to supply services in the Reserved Area at lower cost than the incumbent.
- Improved cost and service innovations in the non-reserved sector through the dynamic effects of competition—the larger the Reserved Area, the lower these benefits.
- Reduced transactions costs and increased network externalities for customers and the PO associated with increased scope of uniform service—the broader the extent of the USO, the larger these benefits.

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11 With the possible exception of Stumpf (1997), who discusses some of the tradeoffs involved in determining the nature of the USO.
12 See, e.g., Gallet and Toledano (1997) and Stumpf (1997).
• The cost effects, especially in downstream delivery, of improved utilization of the incumbent PO's local delivery network implied by a larger Reserved Area. Analysis of these effects of USO policy need to be integrated with traditional concerns with the efficiency losses associated with uniform pricing (and quality). The objective of USO policy can be understood as striking the right balance between these effects and the breakeven requirement of the incumbent PO. Clearly, this implies significant tradeoffs in the costs and benefits implied by each of the above effects as the Reserved Area and the USO are modified. To analyze these tradeoffs, we develop a model below with the following key features:
  1. Break-even operations by the incumbent across all products offered.
  2. Uniform pricing and ubiquitous service by the incumbent for all services under the USO, which includes all products in the Reserved Area and possibly others.
  3. Quality may vary by service area, but is assumed fixed for each area, i.e., quality is exogenous to the model analysis.
  4. Non-uniform costs associated with providing the product (or products) to different customers, giving rise to incentives for cream-skimming.
  5. A competitive fringe which provides differentiated products in the non-reserved sector in competition with the incumbent.\textsuperscript{13}
  6. Transactions cost savings for customers resulting from uniform pricing.

3. Modeling the USO and Reserved Area

As described previously, we develop a model of the efficiency effects arising from the required scope of the USO and supporting Reserved Area. We focus here primarily on price and cost effects, with service quality issues exogenous to the model. We assume that the incumbent postal provider is guaranteed a protected monopoly for services within the scope of the Reserved Area. In return for this, the PO accepts a USO, which is assumed to contain the Reserved Area, such that all services under the USO are uniformly priced and offered ubiquitously. Outside the Reserved Area, the incumbent faces a competitive fringe which is assumed to price its services at cost. The fundamental tradeoff which we wish to capture in this model is between pricing to achieve the required breakeven constraint, transactions cost savings resulting from uniform pricing, and the extent of the Reserved Area. The greater the scope, the larger the allocative inefficiencies due to uniform pricing if we ignore transactions costs. In addition, to the extent that competitors could provide reserved services at lower cost than the incumbent, there could be additional inefficiencies from extending the scope of the Reserved Area and thereby not enabling cost-reducing competition. We begin with some notation. Let “A” be the set of all services, both reserved and competitive, which may be offered. Let \( R \) be the set of reserved services and let \( U \) be the set of services under the USO. We assume that \( R \) and \( U \) are of the form \( R = [0, r] \) and \( U = [0, u] \) with

\textsuperscript{13} The reader will note that the model captures only implicitly the benefits of network externalities associated with universal service through the assumption (made explicit below) that the incumbent PO retains a welfare advantage for basic letter mail sufficient to keep this in the Reserved Area. The magnitude of such externalities for various classes of mail has not yet, to our knowledge, been studied. See Economides (1996) for a general discussion of network externalities, of which those associated with universality are a special case.
\(0 < r \leq u < 1\), so that \(R \subseteq U \subseteq A\). We are interested in determining the optimal scope of both the Reserved Area \(R\) and the USO Area \(U\). Let \(T\) be the set of all delivery areas to be served. For analytical convenience, we will assume that both \(A\) and \(T\) are subsets of real numbers, indeed scaled so that \(A = [0,1]\) and \(T = [0,1]\). In the case of \(A\), this might be thought of as delineating services by their "weight." In the case of \(T\), the ordering can be thought of as indexing delivery areas from lowest (unit delivery) cost to highest (unit delivery) cost. We define the following unit costs and prices:
\[
\begin{align*}
c_m(a, t) &= \text{unit cost for incumbent of delivery of service } a \text{ in delivery area } t \in T; \\
c_f(a, t) &= \text{unit cost for competitive fringe of delivery of service } a \text{ in delivery area } t \in T; \\
c_n(a) &= \text{unit transactions cost for customers resulting from nonuniform pricing, } a \in (u, 1]; \\
p(a) &= \text{unit price (assumed to be uniform) for USO-service } a \in U \text{ anywhere at } t \in T; \text{ and} \\
p(a, t) &= \text{unit price (possibly nonuniform) for non-USO-service } a \in (u, 1] \text{ at } t \in T. 
\end{align*}
\]
Thus, the "full price" a consumer of the PO at \(t \in T\) faces in areas where nonuniform pricing prevails is \(p(a, t) + c_n(a)\). We assume that the transactions cost of nonuniform pricing is borne fully by the consumers. There would, of course, be cost savings (e.g., in mail processing and counter operations) by the PO resulting from uniform pricing as well but we do not address these here.

Define willingness to pay WTP for consumers of service \(a \in A\) in area \(t \in T\) as \(V(x, y, a, t)\), where \(x\) is the amount of service provided by the incumbent and \(y\) the amount provided by the competitive fringe (we assume some product differentiation between \(x\) and \(y\)). We represent consumer preferences in the usual quasi-linear form:
\[
V(x, y, a, t, m) = V(x, y, a, t) + m,
\]
where \(m\) is the numeraire good. Consumer demand in response to prices \(p_m\) and \(p_f\) for services \(x(a, t)\) and \(y(a, t)\) will then be the solution to \(\text{Max} [V(x, y, a, t) - p_m x - p_f y]\). In the reserved area \(R = [0, r]\), the PO charges uniform prices \(p(a)\) and the competitive fringe is forbidden from competing (which we represent by assuming that their prices are prohibitive as given by \(\bar{c}_f\)). For services under the USO which are not in \(R\) (i.e., for services satisfying \(r < a \leq u\)), the PO still charges a uniform price \(p(a)\), while the competitive fringe can compete in these services, but we assume they do so while ignoring consumer transactions costs, i.e., at prices equal to \(c_f(a, t)\). Given these constraints and assumptions, we can use the following notation to represent demands for the various services of interest:

**Demand for Incumbent's Services**
\[
\begin{align*}
x(a, t; R) &= x(p(a), \bar{c}_f, a, t) \quad &\text{for } a \in R = [0, r] \\
x(a, t; U) &= x(p(a), c_f(a, t) + c_p(a), a, t) \quad &\text{for } a \in U \setminus R = (r, u] \\
x(a, t; A) &= x(p(a), c_n(a) + c_p(a), a, t) \quad &\text{for } a \in A \setminus U = (u, 1] 
\end{align*}
\]

**Demand for Competitive Services**
\[
\begin{align*}
y(a, t; R) &= 0 \quad &\text{for } a \in R = [0, r] \\
y(a, t; U) &= y(p(a), c_f(a, t) + c_p(a), a, t) \quad &\text{for } a \in U \setminus R = (r, u] \\
y(a, t; A) &= y(p(a) + c_n(a), a, t) + c_n(a), a, t) \quad &\text{for } a \in A \setminus U = (u, 1]
\end{align*}
\]
Assuming separability of WTP across services, we represent welfare as the sum of consumer and producer surpluses, i.e.:

\[
W(P, r, u) = \int_0^1 \int_0^1 \left[ V(x(a, t; R), 0, a, t) - c_m(a, t) x(a, t; R) \right] dt \, da - F(A, T) \\
+ \int_r^1 \int_0^1 V(x(a, t; U), y(a, t; U), a, t) \, dt \, da \\
+ \int_0^1 \int_0^1 V(x(a, t; N), y(a, t; N), a, t) \, dt \, da \\
- \int_r^1 \int_0^1 \left[ c_m(a, t) x(a, t; U) + \left( c_j(a, t) + c_n(a) \right) y(a, t; U) \right] dt \, da \\
- \int_0^1 \int_0^1 \left[ \left( c_n(a, t) + c_n(a) \right) x(a, t; N) + \left( c_j(a, t) + c_n(a) \right) y(a, t; N) \right] dt \, da,
\]

(1)

where the fixed costs of the incumbents \( F(A, T) \) may depend on the services offered and the extent of the postal network \( T \). We use the notation \( P \) to represent the entire vector of the incumbent’s prices, with the understanding that these prices are constant across \( T \) for \( a \in U \) and may vary for \( a \in AU \). Note that the second and third terms in the definition of \( W(R, P) \) represent the total consumer benefits in the non-reserved sector and the final two terms represent the total cost in the non-reserved sector, including the transactions costs of nonuniform pricing. The profits of the competitive fringe are zero. The profit \( \Pi_m \) of the incumbent is given by

\[
\Pi_m(P, r, u) = \int_0^1 \int_0^1 (p(a) - c_m(a, t)) x(a, t; R) \, dt \, da - F(A, T) \\
+ \int_r^1 \int_0^1 (p(a) - c_m(a, t)) x(a, t; U) \, dt \, da \\
+ \int_0^1 \int_0^1 (p(a) - c_m(a, t)) x(a, t; N) \, dt \, da.
\]

(2)

We wish to solve the following Ramsey problem as a benchmark solution:

\[
\text{Maximize} \quad \{ W(P, r, u) \mid \Pi_m(P, r, u) \geq \Pi_0 \}.
\]

(3)

where \( \Pi_0 \) is the required profit level of the incumbent. We first characterize the optimal prices for fixed \( R \) and \( U \). Forming the Lagrangean \( L(\lambda) = W + \lambda \Pi_m \), we have the following first-order condition for \( a \in U \):

\[
\frac{\partial L(P, r, u, \lambda)}{\partial p(a)} = \int_0^1 \left[ (1 + \lambda) (p(a) - c_m(a, t)) \frac{\partial x(a, t)}{\partial p(a)} + \lambda \cdot x(a, t) \right] \, dt = 0, \quad a \in U = [0, u].
\]

(4)

Note from utility maximization and our assumption that consumers bear the transactions
costs of nonuniform pricing that, for any non-USO service \( a > u \), \( V_s(t) = p(a, t) + c_n(a) \) and, for any non-reserved service \( a > r \), \( V_s(t) = c_f(a) + c_n(a) \). Thus, we have the following first-order condition for \( a > u \):

\[
\frac{\partial L(P, r, u, \lambda)}{\partial p(a, t)} = (1 + \lambda) \left( p(a, t) - c_m(a, t) \right) \frac{\partial x(a, t)}{\partial p(a, t)} + \lambda x(a, t) = 0, \quad a \in A \setminus U = \{u, 1\}, \quad t \in T
\]  

(5)

**Example:** Regarding the FOCs for \( p(a) \) for \( a \in U \) and \( p(a, t) \) for \( a \in A \setminus U \), suppose demand functions \( x(p, c_f, a, t) \) for a given service \( a \in A \) have the form \( x(p, c_f, a, t) = H(t)D(p, c_f, a) \), with \( H(t) > 0 \) and \( H'(t) \geq 0 \). Then, setting \( k = \lambda/(1 + \lambda) \), the above FOCs (4)-(5) can be written as:

\[
\int_0^1 H(t) \left[ \frac{p(a) - c_m(a, t)}{p(a)} + \frac{k}{\eta(p(a), a)} \right] dt = 0, \quad a \in U
\]  

(6)

\[
\frac{p(a, t) - c_m(a, t)}{p(a, t)} = -k \frac{1}{\eta(p(a, t), a, t)}, \quad a \in A \cup U, \quad t \in T,
\]  

(7)

where \( k \in [0,1] \) is the Ramsey number and where elasticity \( \eta(p, a) = (\partial x/\partial p) (p/x) = (\partial D(p, a)/\partial p) (p/D(p, a)) \). This is an inverse elasticity condition, which must be solved to determine the Ramsey number \( k \) so as to satisfy the overall profit constraint for the incumbent. Thus, suppose there is but one reserved service \( a = R = U \) and one non-reserved service \( N \) and that we have two delivery areas, \( h = \) high cost and \( t = \) low cost, with demand and cost parameters as given in table 1.

<table>
<thead>
<tr>
<th>Table 1. Cost and Demand Data Used in the Example</th>
</tr>
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<tbody>
<tr>
<td>Unit Cost ( c_m(R, h) )</td>
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<tr>
<td>Unit Cost ( c_m(N, h) )</td>
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<tr>
<td>Unit Cost ( c_m(N, h) )</td>
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<tr>
<td>Demand for the Reserved/USO Service ( x(p, \eta) = H(t)D_R(p) )</td>
</tr>
<tr>
<td>Demand for the Non-Reserved Service ( x(p, c_l, h) = H(t)D_N(p, c_l) )</td>
</tr>
</tbody>
</table>

Then the FOCs reduce to the following for this example\(^{14}\):

\[
\left( \frac{p_R - 2c_R}{p_R} \right) + 10 \left( \frac{p_R - c_R}{p_R} \right) + \frac{11k}{\eta_R} = 0
\]  

(8)

\(^{14}\) The reader will note that we have, for this example, assumed a finite or discrete set of delivery regions. The translation of the above (continuous) results to this case should be clear.
\[
\frac{p_{Nh} - 2c_N}{p_{Nh}} = -\frac{k}{\eta_{Nh}} \\
\frac{p_N - c_N}{p_N} = -\frac{k}{\eta_N},
\]

where \( \eta_R = pD_R'(p)/D_R(p) \) is the elasticity for the reserved/USO service.
\( \eta_{Nh} = p_ND_N'(p_N)/D_N(p_N), t \in h, t, \) and where \( k \in [0,1] \) must be sufficiently large to just ensure breakeven operations for the incumbent.

For this example, first-best prices are obtained from the above FOCs by setting \( k = 0 \). Doing so yields: \( p_R = 12c_R/11; p_{Nh} = 2c_N; \) and \( p_N = c_N \). Note that the \( p_N \) are just marginal cost prices, while \( p_R \) is the welfare-optimal uniform price, an average (with weights proportional to the slope of the demand function in each zone) of the marginal costs of the high and low-cost delivery zones. This example illustrates the basic tradeoffs or sources of inefficiency in determining the USO and associated prices: one is w.r.t. to the Ramsey effect and the need to depart from first-best conditions in order to meet the incumbent’s breakeven constraint; the other is the need to impose uniform pricing to avoid transactions costs for consumers (and perhaps also producers) arising from spatially differentiated pricing. These prices also illustrate the problem of funding the USO. These prices are clearly not subsidy free but are made sustainable by the Reserved Area, which is assumed in this example to be co-extensive with the USO. Note that the prices in the competitive area are subsidy free and therefore are sustainable, a consequence of the cost and demand structure assumed here. The reader will note that the unit transactions cost \( c_u(a) \) of nonuniform pricing does not appear anywhere explicitly in the example. It is nonetheless present in that the appropriate price to include in demand for non-reserved services \( x(p, c_f, a, t) = H(t)D(p, c_f, a) \) is the full price faced by the consumer, i.e., \( p = p(a, t) + c_u(a) \). As \( c_u(a) \) increases, clearly demand for the non-reserved service decreases, placing an increased burden on the reserved sector for a fixed breakeven constraint. To examine the impact of this tradeoff further, let us now consider conditions determining the welfare-optimal size of the Reserved Area and USO.

**Conditions for the Optimal Scope of the Reserved Area \( R \)**

To solve the problem (3) for the optimal size of the Reserved Area \( r^* \) for a given \( u, \) we differentiate the Lagrangean \( L(\lambda) = W + \lambda \Pi_m, \) obtaining:

\[
\frac{\partial L(P, r, u, \lambda)}{\partial r} = \int_0^1 [V(x(r, t; R), 0, r, t) - c_m(r, t, x(r, t; R))] \, dt
\]

15 Brakigam (1979) recognized such departures from Ramsey pricing where competitive and regulated markets coexist. Like his "partially regulated second best" prices our prices yield lower welfare than "true" or unconstrained Ramsey prices.

16 Note that this is not strictly the case dealt with by Baumol, Bailey, and Willig (1977), where the Reserved Area is all or nothing. Nonetheless, the requirements of their Weak Invisible Hand Theorem for weak gross substitutes in demand and trans-ray convexity in the cost function are satisfied here.
\[
- \int_0^1 [V(x(r, t; U), y(r, t; U), r, t) - c_m(r, t) x(r, t; U) - (c_j(r, t) + c_n(r)) y(r, t; U)] \, dt \\
+ \lambda \left[ \int_0^1 (p(r) - c_m(r, t)) (x(r, t; R) - x(r, t; U)) \, dt \right].
\] (11)

To provide some insight on the implications of these expressions, let us define the following quantities:

\[
W(r; P, R) = \int_0^1 [V(x(r, t; U), y(r, t; U), r, t) - c_m(r, t) x(r, t; R)] \, dt
\] (12)

\[
W(r; P, NR) = \int_0^1 [V(x(r, t; U), y(r, t; U), r, t) - (c_m(r, t) x(r, t; U) + c_j(r, t) y(r, t; U))] \, dt
\] (13)

\[
TC(r; P, NR) = \int_0^1 c_j(r) y(r, t; U) \, dt
\] (14)

\[
\Delta \Pi_m(r, P, R) = \int_0^1 (p(r) - c_m(r, t)) (x(r, t; R) - x(r, t; U)) \, dt.
\] (15)

We note the following interpretation for each of the above expressions:

- \( W(r; P, R) \) = Welfare obtained from service \( r \) if \( r \) is in the reserved area \( r \in R \);
- \( W(r; P, NR) \) = Welfare obtained from service \( r \) if \( r \) is not in the reserved area \( r \in A \setminus R \);
- \( TC(r; P, NR) \) = Transactions Costs of service \( r \) if \( r \) is not in the reserved area \( r \in A \setminus R \);
- \( \Delta \Pi_m(r; P, R) \) = Change in incumbent Profit if service \( r \) is moved from the non-reserved area \( A \setminus R \) to the Reserved Area \( R \).

Using the definitions (12)-(15) with (11), and assuming an interior solution \( r^* \) such that \( 0 < r^* < u \), we obtain the FOC for the optimal scope of the Reserved Area as follows:

\[
W(r; P, R) - (W(r; P, NR) - TC(r; P, NR)) + \lambda \Delta \Pi_m(r; P, R) = 0.
\] (16)

This equation consists of three terms: The first two terms represent the change in welfare if service \( r \) is transferred from the reserved sector to the unreserved sector. The third term represents the product of \( \lambda \) times the change in incumbent profit if service \( r \) is transferred from the reserved sector to the unreserved sector. The sum of these three terms is to be set equal to zero as a requirement for the final service added to the reserved sector. The following assumptions concerning the variables above seem reasonable:

1. \( W(r; P, R) - W(r; P, NR) \) is positive for small \( r \) and decreasing in \( r \). This assumption relies on the notion that there are significant scale and scope economies for traditional letter mail (i.e., for small \( r \)). There may also be significant network externalities in assuring universality of service from the incumbent PO. However, for other classes of mail, two additional effects tend to erode this initial advantage of the incumbent: the benefits of consumer choice which would be foreclosed if \( r \) is reserved and the possible efficiency advantages of the competitive fringe foregone if \( r \) is reserved.

2. \( TC(r; P, NR) \) is positive and decreasing in \( r \). This assumption relies on the notion that unit transactions costs are likely to be nonincreasing as weight or price increase (i.e., as
$r$ increases) and that unit volumes decrease as $r$ increases.

3. $\Delta \Pi_m(r; P, R)$ is positive and decreasing in $r$. Incumbent profits for any service when offered as a monopoly service presumably are greater than when the same service is offered in the non-reserved, competitive sector. The consequences of opening traditional letter mail (i.e., when $r$ is small) to unreserved competition would presumably lead to greater losses in profits through cream-skimming than the lower profit margin and lower volume sectors associated with larger $r$.

Under assumptions 1-3 above, we can graph the likely behavior of the FOC (16) determining the optimal size of the reserved sector as shown in figure 1. There we show three curves, building successively on each other. The lowest curve, $\Delta W$, is the difference $W(r; P, R) - W(r; F, N)$, which is assumed to decrease as $r$ increases. The next is the sum of the first curve and $TC(r; P, N)$, the latter of which is expected to decline as $r$ increases. The highest is the sum of all terms in (16), which given our assumptions must also decline. The optimal scope of the reserved area is where the FOC is stationary, the point $r^*$ in figure 1. As transactions costs increase, $r^*$ will move to the right, i.e. the reserved area will increase, since increases in $TC$ will move the sum of all terms in (16) up and to the right. For analogous reasons, as the profit constraint becomes more binding, i.e., as $\lambda$ increases because $\Pi_0$ in (3) increases or because $F$ increases, the scope of the reserved area will increase. On the other hand, if the welfare gains from expanding competition increase, then $r^*$ will decrease because $W(r; P, R) - W(r; P, N)$ would then decrease.

Figure 1. Determining the Scope of the Reserved Area
Conditions for the Optimal Scope of the USO Area \( U \)

Now we consider similar conditions for the USO. Recall that we are constraining the USO area to be at least as large as the Reserved Area, i.e. \( u \geq r \). We first derive the FOC using the Lagrangian \( L(\lambda) = W + \lambda \Pi_m \), obtaining:

\[
\frac{\partial L(P, r, u, \lambda)}{\partial u} = \int_0^1 [V(x(u, t; U), y(u, t; U), u, t) - c_m(u, t)x(u, t; U)] \, dt
\]
\[- \int_0^1 [V(x(u, t; N), y(u, t; N), u, t) - (c_m(u, t) + c_n(u))]x(u, t; N)] \, dt
\]
\[- \int_0^1 (c_f(u, t) + c_n(u))y(u, t; U) - y(u, t; N)) \, dt
\]
\[+ \lambda \int_0^1 [(p(u) - c_m(u, t))x(u, t; U) - (p(u) - c_m(u, t))x(u, t; N)] \, dt.
\]  

(17)

Similar to the FOC for \( R \), define the expressions:

\[W(u; P, U) = \int_0^1 [V(x(u, t; U), y(u, t; U), u, t) - c_m(u, t)x(u, t; U)] \, dt
\]
\[- (c_f(u, t) + c_n(u))y(u, t; U) \]  

(18)

\[W(u; P, N U) = \int_0^1 [V(x(u, t; N), y(u, t; N), u, t)] \, dt
\]
\[- \int_0^1 [(c_m(u, t) + c_n(u))x(u, t; N) - (c_f(u, t) + c_n(u))]y(u, t; N)] \, dt
\]  

(19)

\[\Delta \Pi_m(u; P, U) = \int_0^1 [(p(u) - c_m(u, t))x(u, t; U) - (p(u) - c_m(u, t))x(u, t; N)] \, dt.
\]

(20)

The above quantities can be interpreted as follows:

- \( W(u; P, U) \) = Welfare associated with service \( u \in A \) if \( u \) is assigned to the USO Area;
- \( W(u; P, NU) \) = Welfare associated with service \( u \in A \) if \( u \) is not assigned to the USO Area;
- \( \Delta \Pi_m(u; P, U) \) = Change in incumbent PO’s profit if \( u \) is moved from the non-USO Area to the USO Area.

If we assume an interior solution \( 0 < r^* < u^* < 1 \), we can use the above expressions to represent the FOC for \( u^* \) as follows:

\[ [W(u; P, U) - W(u; P, NU)] + \lambda \Delta \Pi_m(u; P, U) = 0.
\]  

(21)

Following logic similar to that presented for \( R \), it seems reasonable to assume that both

\[\text{Note in contrast to the corresponding expressions for } R \text{ that now both welfare expressions (for } U \text{ and } NU \text{)}
\]

contain transactions costs, since the competitive fringe provides services at non-uniform prices for \( a > u \) as well as for \( r < a < u \).
\[ \Delta W = W(u; P, U) - W(u, P, NU) \] and \( \Delta II \) decrease with increasing \( u \), leading to a similar figure for \( u^* \) to figure 1.\(^{18}\)

It remains to note that the FOC for the case \( 0 < r^* = u^* < 1 \). In this case, the FOC characterizing \( u^* = r^* \) is

\[
\left[ \frac{\partial L(P, r, u, \lambda)}{\partial r} \right]_{u=r} + \left[ \frac{\partial L(P, r, u, \lambda)}{\partial u} \right]_{u=r} = 0, \tag{22}
\]

where \( \partial L/\partial r \) and \( \partial L/\partial u \) are given in (11) and (17). This yields

\[
\frac{\partial L(P, r, u, \lambda)}{\partial r} + \frac{\partial L(P, r, u, \lambda)}{\partial u} \bigg|_{u=r} = \int_0^1 \left[ V(x(r, t; R)) - c_m(r, t)x(r, t; R) \right] dt \\
- \int_0^1 \left[ V(x(r, t; N)) - (c_m(r, t) + c_n(r))x(r, t; N) \right] dt \\
+ \lambda \left[ \int_0^1 (p(r, t) - c_m(r, t)) x(r, t; R) dt - \int_0^1 (p(r, t) - c_m(r, t)) x(r, t; N) dt \right]. \tag{23}
\]

The FOC (23) leads to expressions similar to (16) and (21), i.e., the service \( r^* = u^* \) defining the scope of \( U = R \) must just balance increases in net welfare from adding the service to the Reserved/USO Area against losses in incumbent profits, now under the assumption that both \( R \) and \( U \) move together. In view of the analytical complexity of the FOCs for the different cases \( (r^* < u^* \text{ and } r^* = u^*) \), we consider an example to provide some insight on the structure of the optimal solution.

**Example:** Consider the following WTP function for consumer preferences:

\[ V(x, y, a, t) = H(a, t) \log \left( x^{\alpha} + \beta(a) y^{\alpha} \right). \tag{24} \]

where \( H(a, t) \) is some positive function representing the strength of demand for service \( a \) in zone \( t \). These preferences indicate some product differentiation between \( x \) and \( y \), with \( \beta(a) \) representing the relative advantage of \( y \) over \( x \) for service \( a \). For the examples below, we assume \( \alpha = 0.25, \beta(a) = a, H(a, t) = 100(1 - t)(1 - a) \), for two services, \( a = 0.25 \) ("letter mail") and \( a = 0.75 \) ("express mail") and two zones, \( t = 0.75 \) ("urban") and \( t = 0.75 \) ("rural"). The fact that \( \beta(a) = a < 1 \) reflects the fact that the incumbent enjoys a relative advantage in head-to-head competition with service \( y \), although \( x \) and \( y \) are clearly (imperfect) substitutes for all services and delivery areas. Solving \( \text{Max } [V(x, y, a, t) - p_x x - p_y y] \) leads to demand functions of the form:

\[ \text{In comparing (21) with (16), the reader will note that } W(u; P, U) \text{ and } W(u; P, NU) \text{ both contain transactions costs which are represented separately in (16). Otherwise, the logic leading to } u^* \text{ solving (21) is identical to that leading to } r^* \text{ solving (16).} \]
\[
x(p_m, p_f, a, i) = \frac{\alpha H(a, i)}{p_m + \beta(a) p_m \left( \frac{\beta(a)}{p_f} \right)^{\left[\frac{\alpha}{1-\alpha}\right]}} \tag{25}
\]
\[
y(p_m, p_f, a, i) = \frac{\alpha H(a, i)}{p_f + \left( \frac{p_f}{\beta(a)} \right) \left( \frac{p_f}{\beta(a) p_m} \right)^{\left[\frac{\alpha}{1-\alpha}\right]}} \tag{26}
\]

Given the assumptions above on \(H\) and \(\beta\), table 2 summarizes the parameters for the examples which follow.

<table>
<thead>
<tr>
<th>Table 2. Parameters for the Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha = .25, \quad \beta = .25)</td>
</tr>
<tr>
<td>(\alpha = .75, \quad \beta = .75)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incumbent's Cost (C_r(a, \beta))</th>
<th>.078</th>
<th>.234</th>
<th>.703</th>
<th>2.109</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Fringe Costs (C_f(a, \beta))</td>
<td>.231</td>
<td>.284</td>
<td>.481</td>
<td>1.044</td>
</tr>
<tr>
<td>(H(a, \beta))</td>
<td>56.25</td>
<td>18.75</td>
<td>18.75</td>
<td>6.25</td>
</tr>
<tr>
<td>(\beta(a))</td>
<td>.25</td>
<td>.25</td>
<td>.75</td>
<td>.75</td>
</tr>
</tbody>
</table>

The above costs reflect a cost advantage for the incumbent in providing letter mail service \((\alpha = .25)\) and a cost advantage for the competitive fringe in providing express mail service \((\alpha = .75)\).

Using the above functions and parameters, we simulated a number of solutions. There are six possible combinations of solutions for the optimal Reserved Area and USO Area, as listed below. The first case \((r = 0, \ u = 0)\) means that there is no reserved area and the postal administration does not face a USO. The second case \((r = 0, \ u = 1)\) is where the postal administration is subject to the USO for letter mail but has no reserved area. The third case \((r = 0, \ u = 2)\) is where there is no reserved area but that the USO applies to both services (when supplied by the PO). The fourth case \((r = 1, \ u = 1)\) is where letter mail is in the reserved area and also subject to a USO. The fifth case \((r = 1, \ u = 2)\) is where the USO applied to both services but the reserved area is confined to letter mail. The last case is where the PO has a Reserved Area across both products and a USO across both products. For each case, the "full prices" (viz. price charged plus transactions costs incurred by the consumer) faced in each case by consumers for services \(x\) and \(y\) are as shown in table 3, where the full price consists of the actual price paid plus transactions costs \(c_r(a)\) where applicable. Take \((r = 1, \ u = 1)\). The consumer faces the PO's uniform price of \(p_m(a)\) and no letter mail service is offered by the competitive fringe.\(^{19}\)

Coming to the results now, we solved for optimal prices for each of the above six regimes. We employed a number of values of "fixed cost" \(F\) and unit transactions cost \(c_n\). Fixed costs might be considered as arising from not only overhead costs but also form any financial

\(^{19}\) A price of \(\bar{c}_r\) is shown. Recall, however, that this is an analytical convenience. \(\bar{c}_r\) is the price that would suppress all demand for letter mail supplied by the competitive fringe.
Table 3. Full Prices under Various Regimes

| r = 0, u = 0: | $p_R(a, h + c_{i1}(a); c(a, h + c_{i1}(a))$ for all $a, t$ |
| r = 0, u = 1: | $p_R(a, h + c_{i1}(a); c(a, h + c_{i1}(a))$ for $a = .25$, all $t$; $p_R(a, h + c_{i1}(a); c(a, h + c_{i1}(a))$ for $a = .75$, all $t$ |
| r = 0, u = 2: | $p_R(a, h + c_{i1}(a); c(a, h + c_{i1}(a))$ for all $a, t$ |
| r = 1, u = 1: | $p_R(a, h + c_{i1}(a); c(a, h + c_{i1})(a))$ for $a = .25$, all $t$; $p_R(a, h + c_{i1}(a); c(a, h + c_{i1}(a))$ for $a = .75$, all $t$ |
| r = 1, u = 2: | $p_R(a, h; c_{i1})$ for $a = .25$, all $t$; $p_R(a, h; c_{i1})$ for $a = .75$, all $t$ |
| r = 2, u = 2: | $p_R(a, h; c_{i2})$ for all $a, t$ |

Targets imposed by the government (see equations (2), (3), (16), and (21)). Transactions costs, $c_{i1}$ is assumed constant across services $a$. Depending on the values of $r$ and $u$ assumed, any of the six regimes noted above can be optimal. This is shown by the examples in table 4, which shows the welfare at the optimal prices given by (3)-(4) under each of the above six possible delineations of $r$ and $u$. It can be noted that each example exhibits a different optimal $(r, u)$ combination; indeed the examples are arranged so that the highest welfare always occurs on the diagonal in table 4.

Table 5 presents the case $c_{i1} = 0.1$ and $F = 25$ (the 4th row in table 4) in detail by providing the prices and quantities for the incumbent and for the competitive fringe. The reader will note in this case that uniform pricing is desirable because transactions costs are fairly high relative to unit costs and some Restricted Area is desirable because of the relatively high fixed costs. The reader should note that the full price paid by the customers of the competitive fringe in all areas (for service $c_2$—note that the competitive fringe does not compete for $c_1$ which is in the Restricted Area) is $p_F(a_2, t) = c_2(a_2, t) + c_{i1}$. The profit for the incumbent (net of fixed costs $F$) at the prices given is, of course, zero. Maximum welfare is achieved where the postal operator has the USO and the Restricted Area confined to letter mail. Extending the USO to both products reduces efficiency because it places a cost on the incumbent of uniform pricing in express mail which has to be recovered in a slightly higher price for letter mail. Similarly, extending the USO and the Restricted Area to both products results in the loss of the cost advantages brought to express mail by the fringe. Moving in the other direction of liberalization—abolishing the Restricted Area and eliminating the USO—forces the postal operator to raise prices and in the case where there is no USO imposes transactions costs on consumers. Case $r = 0, u = 2$ is less efficient than $r = 0, u = 1$ because the benefits from uniform pricing of express mail are small and the postal operator does not have a cost advantage in this service.

These solutions are rather intuitive. Tables 1 and 2 illustrate the basic tradeoffs viz. the benefits in terms of transactions costs reductions against the loss in efficiency from the costs savings and other benefits from the competitive fringe. There is also the problem of the incumbent meeting a financial constraint. When transactions costs $c_{i1}$ are high, uniform pricing is important, and the USO tends to be the driving force. The third row of table 4 illustrates this case, where transactions costs are overwhelming and a USO across both products is required to achieve an efficient solution. The second row also makes a similar

20 We show a sample of the optimal prices in table 5 below.
Table 4. Efficiency Comparisons of Reserved Area and USO Combinations*

<table>
<thead>
<tr>
<th>CASE</th>
<th>( r = 0, u = 0 )</th>
<th>( r = 0, u = 1 )</th>
<th>( r = 0, u = 2 )</th>
<th>( r = 1, u = 1 )</th>
<th>( r = 1, u = 2 )</th>
<th>( r = 2, u = 2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( c_n = .01 )</td>
<td>179.75</td>
<td>178.54</td>
<td>177.34</td>
<td>177.53</td>
<td>176.33</td>
<td>168.08</td>
</tr>
<tr>
<td>( F = 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_n = .1 )</td>
<td>155.83</td>
<td>177.78</td>
<td>176.24</td>
<td>176.02</td>
<td>175.48</td>
<td>168.08</td>
</tr>
<tr>
<td>( F = 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_n = .5 )</td>
<td>110.82</td>
<td>171.39</td>
<td>174.61</td>
<td>171.03</td>
<td>173.20</td>
<td>168.08</td>
</tr>
<tr>
<td>( F = 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_n = .1 )</td>
<td>113.45</td>
<td>136.94</td>
<td>135.98</td>
<td>136.55</td>
<td>137.71</td>
<td>134.44</td>
</tr>
<tr>
<td>( F = 25 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_n = .4 )</td>
<td>74.11</td>
<td>134.03</td>
<td>135.95</td>
<td>134.77</td>
<td>136.48</td>
<td>134.44</td>
</tr>
<tr>
<td>( F = 25 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( c_n = .1 )</td>
<td>110.95</td>
<td>107.82</td>
<td>122.91</td>
<td>121.82</td>
<td>123.29</td>
<td></td>
</tr>
<tr>
<td>( F = 30 )</td>
<td>No Feasible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Table entries are the optimal welfare for each \((r, u)\) regime, where welfare is given by \(W = \Sigma_t W(t)\) with

\[
W(t) = \sum_{a \in A} W(a, t) = \sum_{a \in A} \sum_{o \in A} x(a, o, t) - \sum_{a \in A} c(a, o, t) x(a, o, t)
\]

where \(x(a, o, t), W(a, t), c(a, o, t)\) are given by (25)-(26) evaluated at optimal (full) prices for each respective regime, i.e., subject to the pricing restrictions noted in Table 3 above.

Although with less overwhelming transactions costs, in this case, the USO would apply only to letter mail. In both cases, it is clear that, absent the imposition of a USO, prices would not be uniform and losses in efficiency would occur. While transaction cost drive the USO,

Table 5. Optimal Prices and Quantities for the Case \( c_n = .1 \) and \( F = 25 \)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>( r = 0, u = 0 )</th>
<th>( r = 0, u = 1 )</th>
<th>( r = 0, u = 2 )</th>
<th>( r = 1, u = 1 )</th>
<th>( r = 1, u = 2 )</th>
<th>( r = 2, u = 2 )</th>
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<td>0.34</td>
<td>0.30</td>
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<tr>
<td>( x(a_1, h) )</td>
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<td>78.4</td>
<td>53.06</td>
<td>91.95</td>
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<tr>
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<td>0.23</td>
<td>0.23</td>
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<tr>
<td>( y(a_1, h) )</td>
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<td>26.39</td>
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<td>1.21</td>
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<td>0.00</td>
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<tr>
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<td>1.32</td>
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<td>1.85</td>
<td>2.11</td>
</tr>
<tr>
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<td>2.79</td>
<td>1.61</td>
<td>3.11</td>
<td>1.81</td>
<td>4.44</td>
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<td>1.99</td>
<td>3.43</td>
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<td>1.77</td>
<td>1.35</td>
<td>1.73</td>
<td>1.34</td>
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Welfare: 113.45  136.94  135.95  136.55  137.71  134.44
fixed costs drive the Reserved Area. When fixed costs are high, a larger Reserved Area is required to support the recovery of the fixed costs. This can be seen by reference to the bottom row. Note, in particular, that when \( r = u = 0, c_r = .1 \), and \( F = 30 \), there is no feasible solution which achieves breakeven operations for the incumbent. At the other extreme, where transactions costs are low, and when the Reserved Area is not required for the recovery of fixed costs, the benefits of competition are best achieved by imposing no restrictions. Thus, as might be expected from intuition, an array of solutions is possible, none of which can be \textit{prima facie} ruled out.

Of course, it would be interesting to determine the optimal scope of the Reserved Area and the USO from an empirical investigation, motivated by the above theoretical foundations. What can be noted on the basis of the above type of modeling is that the USO implies a number of conflicting tradeoffs for efficiency. These include foremost the following:

- The benefits of uniform pricing and universal service in decreased transactions costs and increased network externalities and the welfare losses of uniform pricing through distortions between prices and marginal costs.
- The benefits provided by the rough-and-ready consumer protection, particularly to high cost routes, implied by the uniform pricing versus the efficiency losses resulting from cross subsidy.
- The pricing and ubiquity constraints under the USO.
- The benefits of a larger Reserved Area on increased scope of Ramsey pricing versus the cost of competitive benefits foregone.
- As required “surplus” for the incumbent increases, all of the above tradeoffs are exacerbated, and the required Reserved Area must be increased.

4. Some Research and Policy Implications

The USO is currently the subject of considerable concern. At a time when postal service is facing increased competition from electronic communication it is also facing increased competition from other delivery service providers.\textsuperscript{21} This has taken the form of innovative courier service which employs advances in telecommunications and computers to provide a price system of tracking and tracing, as well as guaranteed on time delivery. Similar innovations have been applied to package service. Such innovations represent serious competition to the express and parcel services provided by incumbent postal services. With the growing strength of competitors has come demands for abolition or, at least, a drastic reduction in the postal monopoly. The USO could quite easily become a casualty of the process of liberalization unless it is placed on a much firmer footing. The firmer footing we propose is to develop a mechanism for defining an “efficient” USO, and we begun this process by developing the stylized model of Section 3. However, we see our efforts as a start in the process of defining the USO and developing an environment where competition

\textsuperscript{21} For several empirical analyses of the effects of competition with electronic media, see Crew and Kleindorfer (1995; 1997). It should be noted that, while letter demand has continued to grow over the past decade, these studies nonetheless show that electronic media are substitutes for traditional letter mail. Direct competition with POs has also been on the increase as national POs compete with other national POs in the area of remail as well as, where allowed, with consolidators and worsening activities in upstream operations.
can flourish according to a set of clear and well accepted rules.

In this section, we examine some of the directions this approach to the USO might take and some of the implications it might have for the structure of postal service. Throughout we maintain our position that the USO is to be funded through a postal monopoly and that this monopoly will be no larger than required to fund the USO. We leave it to others to consider alternative approaches that require explicit subsidies and taxes. For example, the USO might be funded by a tax on all postal and delivery service. We do not expect that such an idea is politically feasible in the current environment or likely to be very efficient. All kinds of small operators of cream-skimming local services would probably find it relatively easy to evade the tax. Collecting the tax might also be costly. However, supporters of such an explicit tax-subsidy approach might find our transactions cost approach a reasonable means of analyzing the problem. We will not consider this approach further but will now proceed to examine some of the implications of our approach.

Our approach might be considered an early attempt to provide a more analytical basis than heretofore for determining the nature and extent of the USO and its implied monopoly protection or reserved area. While our approach to modeling the USO does not take into account all of the tradeoffs between benefits and costs it does provide a means of determining the extent of the USO, which has previously not been examined. At a time when the future of the USO is uncertain because of changes in the postal monopoly in several countries, it is important to have a basis for determining the USO and the resultant monopoly protection. Current developments in the United States provide a case in point. Under H.R. 22, there is a proposal to reduce the monopoly limit in the United States from the current limit, which is the greater of $3.00 or twice the first-class postage, to $2.00. The drafters of H.R. 22 argue that, since it represents 80% of the Postal Service's revenue the proposed $2.00 limit will "ensure that the Postal Service is provided sufficient revenue to carry out its statutory mandate to the American public." The approach of H.R. 22 is certainly correct to be concerned with the effect on revenue of changing the monopoly limits, but this is only part of the problem. By considering not only the revenue consequences of a change in the monopoly limit but by attempting to determine the efficient size of the USO our approach breaks new ground and attempts to put changes in the monopoly limit on a much sounder footing. It is very important that changes in the monopoly be considered along with the USO if economic efficiency is to be attained and if a framework is to be developed in which both the incumbent postal services and competitors potentially can benefit. In the US our approach would likely result in a reduction of that monopoly limit if at the same time there is an attempt to define an efficient USO, as the USO would likely be reduced as well. However, our approach provides no basis, absent further analysis of the actual benefits and costs, for the figure of $2.00. There may be additional reasons for choosing $2.00 including the preference for a round number. Our approach, by focusing on some of the tradeoffs involved would highlight the importance of the various residual issues involved in determining the nature and extent of USO.

The USO is a very timely issue given the competitive changes facing postal services worldwide. If there is to be a USO there has to be some guaranteed monopoly or some

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22. The Bill also offers some increased commercial freedoms to the Postal Service, which presumably are taken into account in proposing the $2.00 limit.
23. HR22 recognizes the importance of the USO by requiring the Postal Rate Commission (PRC), to be
form of explicit subsidy. While our approach supports the continuation of a USO supported by monopoly protection its likely practical impact is a modified and probably reduced USO and correspondingly reduced reserved area, at least in some countries. Our approach is part of a debate and re-thinking of universal service which is currently taking place. It is certainly not the last word. A number of other issues should be considered in the context of the optimal design of the USO, some of which we outline below.

Traditionally, incumbent postal operators have provided a somewhat reduced level of service to outlying areas. Our approach would call for a further re-examination of the role of service standards in defining the optimal USO. For example, outlying areas might receive service three days a week instead of the typical five or six currently. In other areas Saturday service might be eliminated. In the United Kingdom, twice daily deliveries might be eliminated in most areas. Another variable to consider might be slower delivery. For example, in the case of First Class post in the United Kingdom, instead of providing service on the next business day, First-Class service would be redefined for outlying areas to mean service on the second business day. Currently, reliability tends to be lower to outlying areas. This would also be part of the service dimension. Reducing the standard of service might be considered an alternative to further reduction in reliability.

Enabling competition to foster while preserving a USO requires that the monopoly limit be defined very carefully, as we have argued above. Indeed, the definition of the monopoly is likely to be more complicated than the approach we and others have employed, which is one-dimensional. The monopoly is defined in terms of one dimension, usually a monetary limit. Under competition, it is likely that at least a two-dimensional approach would be required. The monopoly, for example, might be defined not simply as a monetary or weight limit but as a monopoly in local delivery and a monetary limit for traditional end-to-end service. This kind of approach would have a number of advantages from the point of view of encouraging effective competition and providing opportunities for incumbent POs not only to compete vigorously but also to share in the growth of their competitors. It would also potentially provide a way of lowering the cost of the USO. Under a scheme which guaranteed a postal service a monopoly on local delivery in addition to the traditional monopoly in end-to-end service, different monetary values of the monopoly would apply for the two types of service, since local delivery would be cheaper than end-to-end service. Under a monetary-limit approach the end-to-end weight would have to be less than the local delivery weight if the same monetary limit were set. Defining the monopoly is slightly more complicated as it has two dimensions to it, end-to-end service and access to the local delivery network (access), but this is not a significant problem.

One advantage of defining the monopoly in two dimensions is that it recognizes the inherent natural monopoly in local delivery and it allows competition in all the other functions of postal service. In addition, it provides a clear statement of the limits of the

\[24\] It could also be defined in terms of weight. However, defining the limit in terms of both weight and price would not add a dimension, since one is price and the other is quantity!

\[25\] Local delivery would be a bulk or wholesale service, e.g., downstream access on the part of other carriers and bulk mailers.

revised Postal Regulatory Commission, to undertake a one-year proceeding on universal service. In addition, the PRC would be required to provide an annual report which would address the “public service” costs borne by the U.S. Postal Service.
monopoly and virtually eliminates the possibility of inefficient entry or cream-skimming from higher-cost entrants. For example, entrants who provide delivery within a restricted low-cost area are able to undercut the incumbent’s end-to-end price but are unlikely to be able to undercut the incumbent’s access price to the local delivery network. Of course, even if the entrant were able to provide end-to-end restricted local service at a lower price than the incumbent he would not be allowed to as this would be in breach of the monopoly.\textsuperscript{26}

Emphasizing the local delivery monopoly makes for a smaller reserved area in end-to-end service more feasible, thus opening up the benefits of competition. The monopoly in local delivery combined with increased competition elsewhere is likely to foster increased demand for local delivery service,\textsuperscript{27} providing the incumbent with an increased contribution from local delivery that can help finance the cost of the USO.

Focusing on local delivery is likely to sharpen up the kind of costs analysis that will make for a better understanding of how the costs of the USO arise and, ultimately, how to calculate them more accurately. This, in turn, may lead to more efficient prices, thereby reducing the extent of the reserved area. One example of how more efficient prices may result from the unbundling of the local delivery monopoly arises from the opportunity that unbundling would provide to offer different prices for local delivery in different areas. For example, delivery networks might be classified according to cost categories—High, Medium, Low—and access prices would be set accordingly.\textsuperscript{28} While this would increase transactions costs, the impact would likely be small because local delivery would be a wholesale service not available to single-piece mailers. A further advantage of this approach would be that the prices charged for local delivery did not cross subsidize one another to any great extent. They could still include some contribution to the total USO. For example, local delivery prices could be marked up using the Ramsey rule to contribute to cover fixed costs including the cost of the USO.

Explicitly incorporating the local delivery monopoly into our model for determining the optimal USO and its funding goes well beyond the scope of this paper. For the moment, it will remain a topic for future consideration. Explicitly defining the local delivery monopoly has several advantages. It adds greatly to a better understanding of how costs arise in postal service and therefore to how optimal prices and the USO should be set. In addition, it makes (cream-skimming) entry by higher-cost firms much more difficult which, in turn, makes the funding of the USO more secure.

5. Concluding Comments

With the desire on the part of governments and with advances in other communications technologies, postal service will be forced to become more efficient. This implies that universal service obligations will have to be reconsidered and in many cases the USOs will

\textsuperscript{26} It may be unnecessary to define the monopoly in terms of local delivery if, indeed, the incumbent has a true (or sustainable) natural monopoly. However, in the absence of information on this we err on the side of caution by defining the monopoly to include access.

\textsuperscript{27} While there are some obvious differences, while technological change is very rapid in telecommunications, a large increase in the demand for access followed the opening up of long-distance service to competition.

\textsuperscript{28} It is beyond the scope of this paper to go into the details of how prices would be set.
have to be reduced or modified. In this paper, we have attempted to show how an efficient USO might be determined. The government would implicitly be required to determine the value of transactions costs and network externalities for various postal services in arriving at the optimal USO. This approach differs from existing approaches in that it explicitly focuses on the relevant quantities for decision making. It would also be attractive in terms of its ability to offer legitimation of the monopoly. The monopoly would be driven explicitly by the USO and would be no larger than needed to cover the costs of the USO. To make this approach to the USO effective other changes would be required—for example, explicit monopoly in local delivery and regulatory changes to encourage efficiency. These will no doubt continue to be the subject of further research and policy papers.

References

Hill, Sir Rowland. 1837. Post Office Reform.